Chapter 12
Biodiversity and habitat

12.1 Overview

This chapter describes the biodiversity within and surrounding the project site focusing on terrestrial vegetation, flora and fauna. The chapter assesses 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 is defined as the ecosystems, communities and flora and fauna populations these comprise within a defined area

This chapter is based on the findings of the flora and fauna impact assessment (provided in Appendix D) prepared by Nature Advisory Pty Ltd. An independent peer review of the Southern Bent-wing Bat assessment was completed by Biosis Pty Ltd (provided Appendix C2).

Characterisation and assessment of the Brolga has been presented separately in Chapter 11 – *Brolga*.

The project site has been used for sheep and cattle farming for more than 100 years and the majority of the site is comprised of introduced and planted vegetation, including grazing pasture, areas of cropping and wind breaks comprising of non-indigenous species. Habitats across the project site and surrounding areas were assessed to be of low to moderate ecological quality.

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

Nine native Ecological Vegetation Classes (EVCs) were mapped within or near the project site. Two threatened ecological communities listed under the EPBC Act were identified within the project site. Both are listed as 'critically endangered'. These are the Grassy Eucalypt Woodland of the Victorian Volcanic Plain and Seasonal Herbaceous Wetland of the Temperate Low Plain. Two threatened flora species were recorded in the project site. These were the Swamp Everlasting (*Xerochrysum palustre*) and the Trailing Hop-bush (*Dodonaea procumbens*). Targeted surveys did not record any other threatened flora.

A total of 103 fauna species were recorded during field surveys for the project. These consisted of 19 mammals (including 11 bats identified to species level), 76 birds, three reptiles and five frogs. Five of the mammal species and five bird species observed were introduced species.

Fauna listed as threatened or migratory on the EPBC Act and/or FFG Act with the potential to occur in the site include:

- migratory bird species including the Fork-tailed Swift (*Apus pacificus*), White-Throated Needletail (*Hirundapus caudacutus*), Sharp-tailed Sandpiper (*Calidris acuminata*), Common Greenshank (*Tringa nebularia*), Latham's Snipe (*Gallinago hardwickii*), Curlew Sandpiper (*Calidris ferruginea*), Red-necked Stint (*Calidris ruficollis*), Eastern Cattle Egret (*Ardea coromandus*), Eastern Great Egret (*Ardea modesta*) and Glossy Ibis (*Plegadis falcinellus*)
- other birds including Australasian Shoveler (*Anas rhynchotis*), Black Falcon (*Falco subniger*), Blue-billed Duck (*Oxyura australis*), Brolga (*Grus rubicunda*), Hardhead (*Aythya australis*), Little Eagle (*Hieraaetus morphnoides*), Musk Duck (*Biziura lobata*) and Plumed Egret (*Ardea intermedia plumifera*)
- bats including the Southern Bent-wing Bat (*Miniopterus orianae bassanii*), Yellow Sheath-tailed Bat (*Saccolaimus flaviventris*) and Grey-headed Flying-fox (*Pteropus poliocephalus*)

- frogs and reptiles including the Growling Grass Frog (*Litoria raniformis*), Striped Legless Lizard (*Delma impar*) and the Swamp Skink (*Lissolepis coventryi*) and Glossy Grass Skink (*Pseudemoia rawlinsoni*)
- aquatic fauna including the Little (Dwarf) Galaxias (*Galaxiella toourtkoourt*, listed as *Galaxiella pusilla*), Yarra Pygmy Perch (*Nannoperca obscura*) and Hairy Burrowing Crayfish (*Engaeus sericatus*).

The primary impact during construction resulting the direct loss and/or degradation of native vegetation and flora and fauna habitat is from vegetation clearance and physical disturbance. As the project has been developed in accordance with the 'avoid' and 'minimise' principles, the majority (more than 99.5%) of the native vegetation and ephemeral wetland habitat has been avoided during the design process. Construction of the project would result in the loss of up to 4.6 hectares of native vegetation and six large trees. Losses of native vegetation and large trees would be offset according to the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP, 2017b).

While this vegetation clearance has the potential to directly impact a range of flora and fauna species, these impacts were assessed to be either very low or low (depending on the species), given the relatively poor condition of the habitats present, and the small amount of proposed vegetation clearance in any one location.

Indirect impact pathways such as spreading weeds and pathogens and degradation of surrounding land would be managed through the incorporation of washdown stations at strategic locations, and the implementation of vehicle hygiene protocols and soil management and rehabilitation measures, which would be incorporated into the project Environmental Management Plan.

Physical disturbance to watercourses and associated aquatic habitats at crossing points over Back Creek and to a lesser extent Shaw River for access tracks and cables have the potential to impact the nationally threatened Growling Grass Frog, Little Galaxias (formally Dwarf Galaxias) and Yarra Pygmy Perch. These crossings would be expected to temporarily increase sedimentation from construction at the watercourse crossing locations. A range of design measures and management controls are proposed to limit the potential impacts of watercourse crossings to these species. These would include using fish and frog friendly culverts to ensure natural flows are maintained, micro-siting access tracks and cable crossings to avoid deeper pools of water, limiting the construction workspace for these watercourse crossings and rehabilitating crossings.

During the operation of wind farms, some birds and bats are known to collide with turbine blades. Some species are more susceptible to collision based on their flying behaviour, for example, high flying species and those that are less manoeuvrable.

The project has developed a range of measures to mitigate potential impacts to fauna populations including creating habitat buffers to minimise disturbance and committing to having a minimum turbine blade height of 40 metres to minimise potential collision risk with birds and bats.

Due to their presence at the project site, there is a risk that Southern Bent-wing Bats may collide with operating turbines. Given their critically endangered status, this would be of higher significance. Based on the low activity of the Southern Bent-wing Bat on the site, the behaviour of the species and design measures to minimise the risk of collision, the likelihood of collisions with project wind turbines was assessed as to be very low. As the species is critically endangered, any mortality is considered significant. As part of a bird and bat and adaptive management plan, a monitoring program to record bat collisions would be implemented. If mortality of the species is recorded, defined trigger responses would be executed. With these measures in place, the impact to the Southern Bent-wing Bat was assessed to be low.

12.2 EES objectives and key issues

The EES scoping requirements specify the draft evaluation objective and key issues, outlined in Table 12.1, relevant to terrestrial and aquatic biodiversity that have guided this assessment.

Table 12.1 EES draft evaluation objective and key issues

Draft evaluation objective	
Biodiversity and habitat: *To avoid or 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, the FFG Act and/or DELWP advisory lists. • Direct loss or degradation of habitat for flora and fauna listed as threatened under the EPBC Act, the FFG Act and/or DELWP advisory lists. • Disturbance and/or degradation of adjacent or nearby habitat that may support listed species or other protected flora, fauna or ecological communities. • Disturbance and/or individual to population level loss of flora and fauna species listed as threatened under the EPBC Act, FFG Act and/or DELWP advisory lists. • 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 or breeding sites for the Southern Bent-wing Bat. • The availability of suitable offsets for the loss of native vegetation and habitat for listed threatened species under the EPBC Act and FFG Act. • Potential collision risk for protected bird and bat species with project infrastructure, including with wind turbine blades. • Potential cumulative effects on relevant listed threatened species and communities of flora and/or fauna, in particular Brolga and Southern bent-wing bat, from the project in combination with the construction and operations of other energy facilities.

12.3 Legislation, policy and guidelines

Key legislation, policies and guidelines relevant to the biodiversity impact assessment are summarised in Table 12.2.

Table 12.2 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 • wetlands of international importance.	The project was referred to the Commonwealth Department of the Environment and Energy (now the Department of Agriculture, Water and the Environment, DAWE) under the EPBC Act in April 2019. The Commonwealth Minister for the Environment determined the project to be a 'controlled action' 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 DELWP.
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.
Wildlife Act 1975	The *Wildlife Act 1975* establishes procedures for the protection and conservation of wildlife in Victoria.	All field work for the project was conducted in accordance with the *Wildlife Act 1975*. Permission under the *Wildlife Act 1975* is required to remove, salvage, hold or relocate native fauna. Should wildlife be encountered during construction, a licence or authorisation would be obtained from DELWP.

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 the 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 assist the protection and conservation of 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.”
		• 21.06 Environment objectives include:
		  – reduce the impact of pest plants and animals on the Shire’s resources and production
		  – protect and enhance the region’s indigenous genetic biodiversity.
		• 22.02 Environment key clauses include:
		  – 22.02-2 Rare and threatened species (objective: “to maintain and enhance the habitat, particularly the critical habitat, of Victorian Rare and Threatened Flora and Fauna species”)
		  – 22.02-8 Flora and fauna local policy (objective: “*to protect and enhance flora and fauna communities*”).

Legislation, policy and guidelines	Description	Relevance to project
Guidelines for the removal, destruction or lopping of native vegetation (the Guidelines) (DELWP, 2017b)	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. An offset 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.
Other guidelines		
Planning and Policy Guidelines for Development of Wind Energy Facilities in Victoria (Policy and Planning Guidelines) (DELWP, 2021f)	The Policy and Planning Guidelines provide a set of consistent operational performance standards to inform the assessment and operation of a wind energy facility project; and guidance as to how planning permit application requirements might be met. In relation to biodiversity, the Policy and Planning Guidelines state that proposed wind farm developments must examine any risk to flora and fauna species and should apply project design and adaptive management measures where necessary.	The Policy and Planning Guidelines were considered in the development of the flora and fauna impact assessment for the project.
Significant Impact Guidelines 1.1 – MNES, EPBC Act (Significant Impact Guidelines) (Department of the Environment, 2013a)	The Significant Impact Guidelines help determine whether a referral to DAWE under the EPBC Act is required.	Potential impacts to MNES from the project were considered in accordance with the Significant Impact Guidelines. The project was referred to the Commonwealth Department of the Environment and Energy (now DAWE) under the EPBC Act in April 2019.

Legislation, policy and guidelines	Description	Relevance to project
Policy statements/ Nationally threatened species guidelines	Policy statements and species guidelines relevant to the project include: • EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (Department of the Environment and Energy, 2017) • EPBC Act Policy Statement 3.14: Significant Impact Guidelines for the vulnerable Growling Grass Frog (*Litoria raniformis*) (Department of the Environment, Water, Heritage and the Arts, 2009) • EPBC Act referral guidelines for the vulnerable Striped Legless Lizard (*Delma impar*) (Department of Sustainability, Environment, Water, Population and Communities, 2011a).	These provide guidance on specific nationally threatened species and were considered as part of the impact assessment process.
Survey Guidelines	Survey guidelines relevant to the project include: • *Survey Guidelines for Australia's Threatened Birds* (Department of Water, Heritage and the Arts, 2010a) • *Survey Guidelines for Australia's Threatened Frogs* (Department of Water, Heritage and the Arts, 2010b) • *Survey Guidelines for Australia's Threatened Bats* (Department of Water, Heritage and the Arts, 2010c) • *Survey guidelines for Australia's threatened reptiles* (Department of Sustainability, Environment, Water, Population and Communities, 2011b).	These provide advice on survey techniques for specific threatened species and give guidance on the DAWE's expectations on surveys.
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.
Wind Farms and Birds - Interim Standards for Risk Assessment (interim standards) (Australian Wind Energy Association, 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 in these standards.

12.4 Method

A combination of desktop information and field-based survey techniques were used to characterise native vegetation and flora within the project site and surrounding areas.

12.4.1 Desktop review

Resources used in the desktop review included:

- EVC benchmarks for the Victorian Volcanic Plain bioregion (Department of Sustainability and Environment, 2004)
- DELWP NatureKit to determine pre-1975 (pre-European settlement) vegetation distributions
- Victorian Biodiversity Atlas to identify previous flora and fauna species records within 10 kilometres of the project site
- Commonwealth Protected Matters Search Tool to identify MNES with the potential to occur within 15 kilometres of the project site based primarily on their distribution and habitat modelling
- DELWP Victorian Wetland Inventory ('current wetlands') database
- VicMap Hydro - Watercourse Rivers which provides a visual representation of drains, channels, creeks, rivers and water storages in Victoria at a capture scale of 1:25,000
- Birdata (administered by Birdlife Australia) for a list of bird species in the investigation area (see Section 12.5)
- previous ecological 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.

12.4.2 Terrestrial vegetation and flora assessment

Several vegetation and flora surveys have been carried out at the project site. The initial surveys were done by Ecology Partners Pty Ltd from 2009 to 2017, and then by Nature Advisory Pty Ltd from 2018 onwards. A summary of the vegetation and flora surveys is provided in Table 12.3.

Vegetation surveys were completed on foot, with all observed flora species recorded, any significant species mapped, the overall condition of vegetation and habitats noted, and habitat hectare assessment 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.

A list of threatened flora with the potential to occur in the project site was developed based on a review of desktop information. This enabled targeted flora surveys to be conducted during appropriate survey periods (see Table 12.3). Targeted flora surveys involved visual searching on foot by experienced botanists along transects spaced no more than 5 metres apart. Where any threatened flora species was observed, its location was recorded using a handheld GPS. Specimens requiring identification using laboratory techniques were collected.

Table 12.3 Summary of vegetation and flora surveys

Survey effort	Species targeted or objectives
25 November 2009 1–3 December 2009 8–9 December 2009	Threatened flora species considered likely to occur within the study area. Mapping of remnant vegetation.
25 February 3 March 2011	Vegetation surveys of additional infrastructure areas.
11 days in June and July 2017	All observed vascular plants recorded, any significant records mapped, and the overall condition of vegetation noted. Mapping of remnant vegetation.

Survey effort	Species targeted or objectives
25–27 July 2018	Flora survey of over dimensional vehicle transport route areas and areas within the project site geographically beyond the earlier survey area proposed to be impacted.
22–24 October 2018 31 October 2018	Targeted surveys for spring-flowering threatened ecological communities and listed flora species in areas of suitable habitat.
10–12 December 2018 6 February 2019	Targeted surveys for summer-flowering threatened species were carried out in areas of suitable habitat. Wetland and habitat assessment surveys were carried out on four occasions from December 2018 to February 2019.
19 March 2019 18 June 2019 1–3 March 2021	Vegetation survey of other areas within the project site geographically beyond the earlier survey area where impacts were proposed.
6–8 October 2021 7–8 December 2021	Targeted surveys for Seasonal Herbaceous Wetland of the Temperate Lowland Plain and Grassy Eucalypt Woodland of the Victorian Volcanic Plain ecological communities, and targeted surveys for spring-flowering threatened flora species.

12.4.3 Terrestrial fauna assessment

Many fauna assessments have been conducted within and around the project site. The initial surveys were performed by Ecology Partners Pty Ltd from 2009 to 2011, and then by Nature Advisory Pty Ltd from 2018 onwards.

A summary of the survey effort and methods used to characterise fauna within the project site is provided in Table 12.4. A range of further surveys and assessments were also completed to assess Brolga and potential Brolga breeding habitats, which are presented in Chapter 11 – *Brolga*.

Table 12.4 Summary of fauna surveys and methods

Survey effort	Species targeted or objectives	Survey method
30 October – 22 November 2009 20 October – 22 November 2010 9 February – 31 March 2011 25 October – 14 December 2018 27 February – 1 May 2019 2 May 2019 to 20 May 2020	Bats, including Southern Bent-wing Bat and Yellow-bellied Sheathtail-bat	Bat surveys were carried out using ultrasonic bat detectors deployed remotely and recording the calls of bats that passed by them. Surveys involved the deployment of bat detectors for several weeks at a time at 100 unique survey sites in both spring and late summer to early autumn; times when bat activity is maximal and migration of the EPBC Act listed critically endangered Southern Bentwing Bat *(Miniopterus orianae bassanii*) occurs. Recordings were done at ground level and at heights of 45 metres on wind monitoring masts to detect species flying at height, and thus provide data on which species may be at greater risk of collision with operating wind turbines. Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded from Victoria by Rob Gration (ECOAERIAL Ecological Services, Newport, Victoria) for identification. The call characteristic graphs and identification for the two threatened species were provided to Greg Ford – Director and Principal Consultant at Balance! Environmental, to peer review for confirmation of bat call identification.

Survey effort	Species targeted or objectives	Survey method
4–6 November 2009 16–20 November 2009 15–20 October 2018 24–28 February 2019	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 for 15 minutes. During this period, all birds (species and abundance) were recorded, and the height of birds were documented. Incidental observations of threatened bird species and raptors were also recorded while moving across the site. Extensive roaming field surveys were also completed to assess the presence of Brolga, which are presented in Chapter 11 – *Brolga*.
4–7 November 2018 11–13 December 2018 11–12 January 2019 23–24 January 2019 28 February 2019	Migratory water bird habitat assessment and targeted surveys	Wetlands were visited during spring and summer and assessed for the 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 migratory shorebird survey guidelines. Roaming wetland field surveys targeting Brolga and wetland habitat assessments were also completed (see Chapter 11 – *Brolga*).
4 November 2009 – 19 February 2010 13 September – 22 November 2018 July – November 2019	Striped Legless Lizard	Habitat surveys were carried out to identify native and non-native vegetation that could provide habitat for the Striped Legless Lizard. Targeted tile surveys were then conducted using the tile grid method in identified potential habitat to detect this species.
15–19 February 2010 4–7 November 2018	Swamp Skink	Active searching was done in potentially suitable microhabitats including looking underneath ground cover and debris, to locate and identify the species. In addition, binocular surveys were carried out at a distance to detect basking individuals. Cage traps set along a tributary of the Moyne River in the east and the along the Shaw River in the west where the Swamp Skink was considered most likely to be detected. Traps were placed about five metres apart underneath suitable vegetation and adjacent to potential shelter sites (e.g., logs). Traps were baited with dough made from sardines and flour. Further detailed Swamp Skink habitat assessments were completed to identify potential wetland/swamp areas including hydrological characteristics and assessment of aquatic/semi-aquatic vegetation.
18-22 March 2009 16–20 November 2009 4–7 November 2018	Frog surveys, including Growling Grass Frog	Targeted frog surveys were conducted with daytime scouting of suitable habitats followed by nocturnal surveys on two nights at each location. Subsequent habitat assessment of wetlands was undertaken to determine the condition and status of existing wetlands and related habitats and rated their suitability from low to high.
4 November 2009 – 19 February 2010	Fat Tailed Dunnart surveys	During all field work personnel routinely checked underneath ground cover and debris such as coarse woody debris, surface rocks and tin, etc., to identify evidence such as their diagnostic scats and sits (nests). Tile grids that were deployed primarily to survey for Striped Legless Lizard were also checked for the presence of Fat-tailed Dunnart (i.e., the species is known to use roof tiles for refuge at other sites west of Melbourne). Active searches were also conducted along collapsed sections of the stone walls.

12.4.4 Aquatic ecology assessment

The desktop aquatic ecology assessment reviewed a range of information sources to identify tributaries and gullies within the project site and characterise the associated aquatic values.

The suitability of watercourses on and near the project site was assessed through a site inspection, which considered previous records and known habitat characteristics. Habitat components, including proximity to watercourses and the character of instream and nearby vegetation were assessed.

Targeted fish surveys were carried out from 15–18 December 2009 to determine the status of native freshwater fish within and around the project site. The techniques used at each survey site depended on the depth, habitat type and water quality conditions present. Survey methods included:

- ten bait traps with light sticks designed to lure native fish species, deployed in suitable habitat at one site along Kangaroo Creek and two sites along the Moyne River
- dip netting across multiple sites, which involved sweeping a net through microhabitats suitable for small-bodied fish species
- two Fyke nets set at dusk at two locations for two consecutive nights.

No electrofishing was used due to high water salinity at all survey sites.

Aquatic surveys conducted for the proposed Shaw River Power Station Project (Ecology Partners, 2009a and Ecology Partners, 2009b), which is within the investigation area, were also considered. These included surveys for fish and macroinvertebrates, and assessment of aquatic habitats in the Moyne River, Back Creek and Shaw River.

12.5 Investigation area

The flora and fauna investigation area (termed study area in Appendix D – *Biodiversity)* for the database searches of existing flora and fauna species records and potential occurrence of EPBC Act matters was defined as the project site plus a buffer area of at least 10 kilometres from the project site boundary.

For several threatened species including the Southern Bent-wing Bat, Striped Legless Lizard, Swamp Skink and Growling Grass Frog, due to the scarcity of records within the investigation area, a larger area was considered.

Targeted surveys for threatened ecological communities and flora were also completed for the over dimensional route (termed over dimensional route study area in Appendix D – *Biodiversity*).

12.6 Existing conditions

The project is within the Victorian Volcanic Plain bioregion. Volcanic activity in the region has, over long geological period, deposited thin broad shields or long lava flows of basalt, creating extensive flat to undulating plains interspersed with volcanic cones. Within this landscape are scattered shallow lakes and incised watercourses. Native grasslands occur in areas where these flows have experienced long periods of weathering, producing heavy grey, red or black cracking clay soils, which are generally fertile but poorly drained. In contrast, the youngest relatively unweathered lava flows are known as stony rises and have thin soils and support woodland vegetation. Trees and shrubs are either absent or are restricted to watercourses, swamps or rocky hills and slopes bordering the plains.

Overall, species diversity of this bioregion is very low primarily because of its pastoral and agricultural history, dating from the late 1830s and early 1840s. In most areas the native plants have been replaced by pasture grasses and clovers, crop plants, and weeds. Remnants of the native flora are fragmented, and mostly confined to the sides of roads and railways, rocky areas or to small forest reserves that have not been cultivated or modified.

Budj Bim National Park (formerly known as Mount Eccles National Park) and Mount Napier State Park are about 12 kilometres and 20 kilometres north-west of the project site, respectively. Other reserves within 20 kilometres of the project site include Yambuk Coastal Reserve, Woolsthorpe Nature Conservation Reserve, Yambuk Wetlands Nature Conservation Reserve, Tower Hill Wildlife Reserve, as well as other smaller bushland and flora reserves. Commercial blue gum plantations are situated to the south-west of the project site.

The project site is relatively flat, supporting soils of volcanic origin on a dissected landscape featuring many rocky outcrops and wet depressions. The largest of these wet depressions is the Cockatoo Swamp complex that occurs in the central part of the site, to the west of Landers Lane. The Moyne River is to the east of the site, while the Shaw River flows through the north-western part of the site. Several smaller ephemeral tributaries also occur in the site.

The project site has been subject to extensive removal of native vegetation in the past and much of the area comprises rocky knoll country with lower depressions in the landscape that remain saturated after periods of heavy rain.

12.6.1 Terrestrial vegetation

The majority (about 90%) of the investigation area is comprised of introduced and planted vegetation, including grazing pasture, areas of cropping and wind breaks comprising non-indigenous species.

Ecological Vegetation Classes

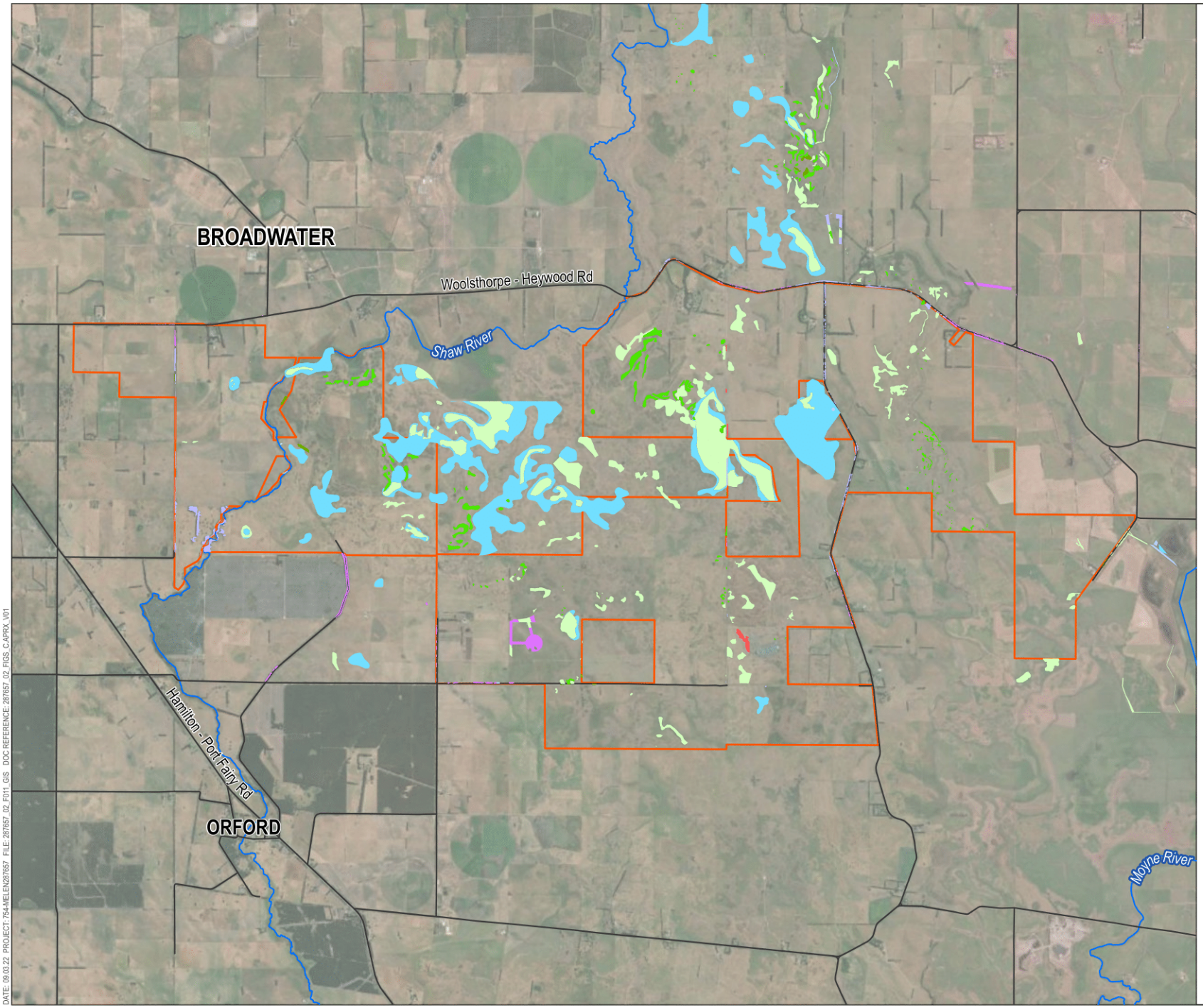
In Victoria, an EVC is the basic mapping unit for ecosystem assessment, biodiversity planning and conservation management. An EVC is described through a combination of its floristic, life form and ecological characteristics.

Nine EVCs were mapped within the investigation area. These were:

- Plains Grassy Wetland (EVC 125)
- Stony Knoll Shrubland (EVC 649)
- Higher-rainfall Plains Grassy Woodland (EVC 55_63)
- Basalt Shrubby Woodland (EVC 642)
- Heavier-soils Plains Grassland (EVC 132_61)
- Tall Marsh (EVC 821).
- Aquatic Herbland (EVC 653)
- Swampy Riparian Woodland (EVC 83)
- Swamp Scrub (EVC 53).

These EVCs occur in 684 mapped habitat zones (or patches) covering an area of 848 hectares, as shown in Figure 12.1. This includes 501 hectares of mapped wetlands, which are treated as native vegetation. All these EVCs have a bioregional conservation status of endangered. Average condition scores (using the Vegetation Quality Assessment method) for habitat zones based on site condition and landscape context were low (all less than 39), a likely reflection of their location within an active agricultural landscape. A detailed description of the main EVCs within the investigation area, along with their assessed condition and bioregional conservation status, is provided in Appendix D – *Biodiversity*.

Areas not supporting remnant native vegetation have a high cover (>90%) of exotic grass species, many of which have been direct seeded for use as pasture. Scattered native grasses are generally present in these areas, however, are less than the required 25% cover to be considered a remnant patch of native vegetation. Removal of embedded rock has also been undertaken to facilitate the direct seeding of pasture grasses.



LEGEND

- Road
- Watercourse
- Willatook Wind Farm boundary

Ecological vegetation class (EVC)

- Aquatic Herbland
- Plains Grassland
- Swamp Scrub
- Tall Marsh
- Unassessed
- Basalt Shrubby Woodland
- Higher Rainfall Plains Grassy Woodland
- Plains Grassy Wetland
- Stony Knoll Shrubland
- Swampy Riparian Woodland
- Current Wetlands

SOURCE:
Willatook Wind Farm boundary and EVCs from Wind Prospect.
Road and watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

N

0 1 2 km

SCALE 1:75,000
PAGE SIZE: **A4**
PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 12.1

Mapped EVCs within the project site

DATE: 09.03.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F011_GIS DOC REFERENCE: 287657_02_FIGS_CAPRX_V01

Figure 12.2
Plains Grassy Wetland (EVC 125)
(*Source: Nature Advisory*)

Figure 12.3
Basalt Shrubby Woodland (EVC 642)
(*Source: Nature Advisory*)

Figure 12.4
Stony Knoll Shrubland (EVC 649)
(*Source: Nature Advisory*)

Roadside reserves at areas potentially requiring upgrades for over dimensional loads (i.e., intersections) were dominated by pasture grasses. Six EVCs were recorded in these areas, being:

- Aquatic Herbland (EVC 653)
- Basalt Shrubby Woodland (EVC 642)
- Freshwater Meadow (EVC 680)
- Herb-rich Foothill Forest (EVC 23)
- Stony Rises Woodland (EVC 203)
- Tall Marsh (EVC 821).

These EVCs occurred in 18 patches covering an area of about 0.7 hectares, including DELWP mapped wetlands.

Individual trees

A total of 133 scattered trees were mapped in the investigation area, comprising:

- 75 large scattered trees (≥ 70 centimetres DBH for Eucalypts and ≥ 40 centimetres DBH for Wattles)
- 63 small scattered trees (< 70 centimetres DBH and < 40 centimetres DBH for Wattles).

No scattered trees were recorded in the over dimensional route study area.

Scattered tree: A native canopy tree that does not form part of a patch (can be a large or small trees). A tree is considered to be a large tree if it is greater or equal to the large tree benchmark diameter at breast height (DBH) for the relevant bioregional EVC.

Threatened ecological communities

Four threatened ecological communities listed under the EPBC Act were identified to have the potential to occur within the investigation area. Based vegetation field surveys and a review of published descriptions and condition thresholds, two of these ecological communities were identified within the investigation area. These communities, both listed as 'critically endangered' under the EPBC Act, are:

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain

  Two patches of Higher Rainfall Plains Grassy Woodland EVC (EVC 55_63) within the investigation area were found to meet the condition thresholds for Grassy Eucalypt Woodland of the Victorian Volcanic Plain EPBC Act listed ecological community. These patches are around 0.8 hectares in size.

- Seasonal Herbaceous Wetland of the Temperate Lowland Plain

  The Seasonal Herbaceous Wetland of the Temperate Lowland Plain EPBC Act listed ecological community is associated with the Plains Grassy Wetland EVC (EVC 125) (Threatened Species Scientific Committee (2012). Patches of Plains Grassy Wetland EVC surveyed in 2018 and 2021 were found to meet the threshold criteria for Seasonal Herbaceous Wetland of the Temperate Lowland Plain and therefore this community was recorded as present within the investigation area.

While the Natural Temperate Grassland of the Victorian Volcanic Plain and White Box-Yellow-Box-Blakeley's Red Gum Grassy Woodland and Derived Native Grassland ecological communities had the potential to occur in the investigation area based on a desktop review, neither were recorded or assessed as having the potential to occur during site surveys.

The desktop review indicated that seven ecological communities listed under the EPBC Act have the potential to occur in the over dimensional route study area, however, none of these were recorded during field surveys or assessed as having the potential to occur in these areas.

12.6.2 Flora

During the field assessments, 208 plant species were recorded. Of these, 123 (59%) were indigenous and 85 (41%) were introduced or non-indigenous native in origin.

The desktop review indicated a total of 43 indigenous species have the potential to occur in the investigation area based on database records. This included 18 species listed under the EPBC Act, and 35 species listed under the FFG Act.

An assessment of the likelihood of occurrence of each species was completed. Species rated as 'likely to occur' were those that have a very high chance of occurrence based on historical records in the investigation area and the presence of suitable habitat. Species rated as having 'potential to occur' were those for which suitable habitat exists, but recent records of the species are scarce. A total of 19 flora species listed under the EPBC Act (eight species) and/or FFG Act (16 species) are considered likely to occur or have the potential to occur within the investigation area. Five flora species listed under the EPBC Act (four species) and/or the FFG Act (four species) were considered likely to occur or have the potential to occur within the over dimensional road route.

The eight flora species assessed as likely to occur based on recent records within the investigation area and the presence of suitable habitat are shown in Table 12.5 with their conservation status, habitat requirements and distribution range.

Table 12.5 Listed species likely to occur in the investigation area

Name	Status[1]	Habitat	Range
Basalt Leek-orchid (*Prasophyllum viretrum*)	(– , cr)	Moist to wet grassland on dark basaltic loam.	Restricted distribution in remnant native grassland on heavy basalt soils in the Victorian Volcanic Plain.
Basalt Peppercress (*Lepidium hyssopifolium*)	(EN, en)	Eucalypt woodland with a grassy ground cover, low open Casuarina woodland with a grassy ground cover and tussock grassland. Now generally found amongst exotic pasture grasses and beneath exotic trees.	Patchy distribution from south-eastern NSW, through Victoria to eastern parts of Tasmania.
Clover Glycine (*Glycine latrobeana*)	(VU, , vu)	Native grasslands, dry sclerophyll forests, woodlands and low open woodlands with a grassy ground layer.	Found across south-eastern Australia.
Curly Sedge (*Carex tasmanica*)	(– , vu)	Seasonally wet, fertile, heavy basalt clay soils, usually around the margins of slightly saline drainage lines or freshwater swamps.	Known occurrences are localised around Heywood, Portland, Port Fairy, Karish (Lake Weeranganuk), Craigieburn, Kalkallo and Wollert.
Dense Leek-orchid (*Prasophyllum spicatum*)	(VU, cr)	Coastal and near-coastal heathland and heathy woodland in sandy soils, some of which may be seasonally waterlogged.	Distributed from the South Gippsland to the far south-east of South Australia.
Gorae Leek-orchid (*Prasophyllum diversiflorum*)	(EN, cr)	Wet grasslands or inundated swamps among tussocks.	Endemic to south-western Victoria. Populations are known to occur in a reserve near Orford, and on private land near Glenthompson and Lake Condah.
Matted Flax-lily (*Dianella amoena*)	(EN, cr)	Lowland grassland and grassy woodlands on well-drained to seasonally waterlogged fertile sandy loams to heavy cracking soils derived from sedimentary or volcanic geology.	Widely distributed from eastern to south-western Victoria.
Swamp Fireweed (*Senecio psilocarpus*)	(VU, –)	Occurs in herb-rich winter-wet swamps on volcanic clays or peaty soils.	Known from about 10 sites between 45 kilometres north of Melbourne, and Honans Scrub in south-eastern South Australia.

1. EPBC Act status: EN = endangered, VU = vulnerable, – = not listed under the EPBC Act.
FFG Act status: cr = critically endangered; en = endangered; vu = vulnerable, – = not listed under the FFG Act.

A further nine species were assessed as having the potential to occur in the investigation area due to either the presence of potential habitat within the investigation area, or recent records within the investigation area although marginal habitat. These include:

- Button Wrinklewort (*Rutidosis leptorhynchoides*) (EN, en)
- Lacey River Buttercup (*Ranunculus amplus*) (–, cr)
- Maroon Leek-orchid (*Prasophyllum frenchii*) (EN, en)
- Pale Swamp Everlasting (*Coronidium gunnianum*) (–, cr)
- Pretty Leek-orchid (*Prasophyllum anticum*) (–, cr)
- Purple Blown-grass (*Lachnagrostis punicea* subsp. *filifolia*) (–, en)
- Slender Stylewort (*Levenhookia sonderi*) (–, en)
- Swamp Diuris (*Diuris palustris*) (–, en)
- Swamp Flax-lily (*Dianella callicarpa*) (–, en).

Targeted for the above-listed flora species focused on suitable habitats within proposed areas of development. Based on these targeted surveys two flora species of conservation significance were recorded in the investigation area. These were:

- Swamp Everlasting (*Xerochrysum palustre;* Figure 12.5) listed as vulnerable under the EPBC Act, threatened under the FFG Act and vulnerable on the DELWP Advisory List. A total of 24 plants were recorded within a single patch of Plains Grassy Wetland (EVC 125) on private land.
- Trailing Hop-bush (*Dodonaea procumbens*; Figure 12.6) listed as vulnerable under the EPBC Act and DELWP Advisory List. Three plants were recorded in two patches of Basalt Shrubby Woodland (EVC 642) along Old Dunmore Road.

Figure 12.5
Swamp Everlasting recorded in the investigation area
(*Source: Nature Advisory*)

Figure 12.6
Flowers of trailing hop bush
(*Source: Brown, A. J. © 2021 Royal Botanic Gardens Board, CC BY-NC-SA 4.0*)

The remaining threatened flora species that were initially assessed as either likely to occur or having the potential to occur were not recorded.

Targeted flora surveys for threatened species were not completed in a small area (~0.3 hectares) of the proposed development footprint. It is proposed that this area be surveyed in late 2022 for completeness. Considering the survey effort to date and the commitment to undertake these targeted surveys prior to construction, Nature Advisory concluded there was sufficient information available for impact assessment purposes.

Based on targeted surveys, no listed flora species were assessed as having the potential to occur within roadside areas of the over dimensional road route.

Five declared noxious weed species listed under the *Catchment and Land Protection Act 1994* were recorded, including Blackberry (*Rubus fruticosus*), Gorse (*Ulex europaeus*), Perennial Thistle (*Cirsium arvense*), St John's Wort (*Hypericum perforatum*) and Sweet Briar (*Rosa rubiginosa*). In accordance with the *Catchment and Land Protection Act 1994*, noxious weed species recorded in the investigation area must be controlled.

12.6.3 Fauna

Fauna habitats

The fauna habitats across the project site and surrounding areas exist within a largely agricultural landscape that show evidence of sustained grazing and pastoral land-use. Most of the investigation area has been cleared, with large areas dominated by introduced grasses and pasture species.

Defined habitats within in the investigation area and their assessed quality for fauna habitat are outlined in Table 12.6.

Table 12.6 Key fauna habitats and quality within the investigation area

Habitat identified	Description	Fauna habitat quality
Modified native grassland	Largely restricted to roadsides with areas mapped as the Plains Grassy Woodland (EVC 55_63).	Provides 'stepping-stones' to nearby habitats. Assessed to be of moderate habitat quality.
Modified woodland and scattered trees	Largely restricted roadsides and some patches in agricultural land, and scattered remnant trees and Basalt Shrubby Woodland (EVC 642).	Provides some habitat connectivity within the highly modified agricultural landscape. Assessed to be of low to moderate habitat quality.
Rocky rise/stony knoll	Occurs in much of the southern section of the investigation area in grazing land and includes areas of native vegetation mapped as the Stony Knoll Shrubland (EVC 649).	Structure of rocky habitat providing important shelter for reptiles, such as skinks and lizards, and acting as 'stepping-stones' for some more mobile species of small mammals and snakes. Assessed to be of low to moderate habitat quality.
Rivers, creek and drainage lines	Vary from permanent streams (e.g., Shaw River and Moyne River) to ephemeral drainage.	Assessed to be of moderate habitat quality.
Swamps and marsh	The largest of these habitats is Cockatoo Swamp, which is spread out across agricultural land. Much of the original wetland habitat has been modified or drained. This area includes Plains Grassy Wetland (EVC 125).	Assessed to be of moderate habitat quality.
Planted vegetation	Planted exotic and native trees, usually as wind breaks.	Assessed to be of low habitat quality.
Artificial waterbodies	Includes farm dams and drainage lines	Waterbirds and some bat species would be likely to use these habitats. Assessed to be of low to moderate habitat quality.
Exotic pasture and crops	Covers much of the investigation area.	This habitat is largely grazed for farming purposes and provides little habitat or shelter for indigenous fauna. Assessed to be of low habitat quality.

Fauna

A total of 103 fauna species were recorded during field surveys for the project. These consisted of 19 mammals (including 11 bats identified to species level), 76 birds, three reptiles and five frogs. Five of the mammal species and five bird species observed were introduced species.

A review of existing information and online databases identified that 37 species listed under the EPBC Act and 48 species listed under the FFG Act have the potential to occur in the investigation area. The likelihood of occurrence of each of these species in the investigation area is detailed in Appendix D – *Biodiversity* and summarised in the following sections. In accordance with the risk-based approach outlined in Chapter 7 – *Assessment framework*, the following sections focus on those fauna communities most at risk of impacts from the project or have high conservation significance.

Of the listed species with potential to occur, a number were assessed as not having the potential to occur based on field surveys and habitat assessments.

Birds

A total of 96 bird species were recorded within the investigation area and surrounding areas between 2009 and 2020. This represents about half of bird species reported locally in the Victorian Biodiversity Atlas.

Some birds are sensitive to collision with turbines due to their flight behaviour, for example, high flying species or those that are less manoeuvrable. In addition to direct collision risk, some birds may change their behaviour in response to the presence of the wind farm.

During 2018 and 2019 bird utilisation fixed point surveys were completed. These surveys and incidental sightings recorded a total of 57 species of birds with the project site. The most common species recorded were Little Raven, Australian Magpie, Eurasian Skylark, Common Starling, Magpie-lark and Long-billed Corella. Overall, the five most common species represented more than two thirds of all birds recorded. Most bird sightings (95%) were recorded below 40 metres in height, with the remaining 5% being recorded between 40 and 250 metres in height (see Figure 12.7). The most common bird to fly regularly above 40 metres were the Eurasian Skylark, Sulphur-crested Cockatoo, Little Raven, Magpie and raptors. These are common species not listed as threatened. Raptors represented a very small portion of the overall community (2% of sightings).

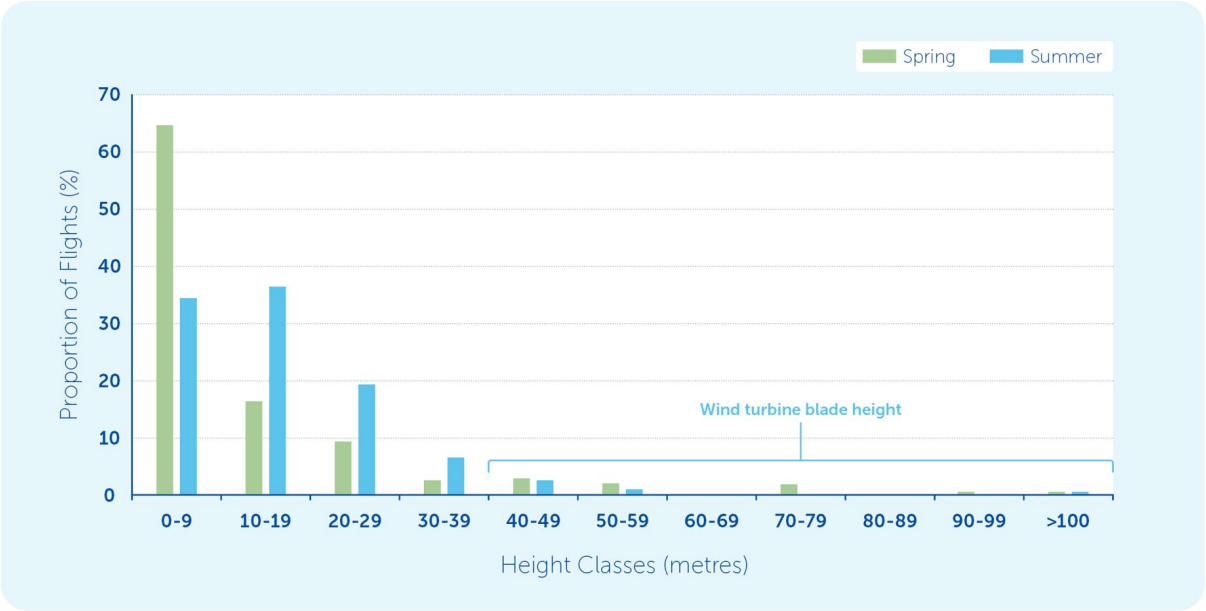


Figure 12.7 Bird flight heights recorded during utilisation surveys

The only listed species observed during the bird utilisation surveys was the Fork-tailed Swift, which is listed as a migratory species under the EPBC Act. While this species visits south-east Australia each summer, it was not assessed to be a regular visitor to the site. This species was recorded in low numbers.

Six raptor species were recorded, with Brown Falcon and Nankeen Kestrel being the most frequently recorded species. Raptors represented a small proportion of the total bird community recorded in the site. Wedge-tailed Eagles were rare, being recorded on only three occasions. While not recorded during surveys the Black Falcon and Little Eagle were assessed to have the potential to pass through the site.

A total of seven species of waterbirds were recorded during the 2018 and 2019 bird utilisation fixed point surveys. The Pacific Black Duck, White-faced Heron, and Australian Shelduck were the most common waterbirds, with most recorded flying close to the ground. Less abundant waterbirds observed were the Australian White and Straw-necked Ibises, White-necked Heron and Grey Teal. The highest concentrations of water birds were at Wild Dog Swamp to the east of the project site along the Moyne River floodplain. The Eastern Great Egret, Eastern Cattle Egret, Plumed Egret and Glossy Ibis were also assessed to potential occur locally in small numbers when seasonal conditions created ephemeral wetland areas.

Due to the presence of potentially suitable habitat at a range of wetlands and watercourses within the investigation area, surveys for migratory shorebirds and potential habitat were undertaken. From these surveys, Nature Advisory (Appendix D – *Biodiversity*) considered there was potential for five migratory wader species to occur within the site. Of these, the Sharp-tailed Sandpiper, Common Greenshank and Latham's Snipe were recorded, and the Curlew Sandpiper and Red-necked Stint were assessed to occasionally visit. These species were recorded in low numbers and were well below the criteria of a population of national importance of 0.1% of flyway population.

Nature Advisory determined there is little suitable habitat within the site for most migratory shorebirds, largely due to the highly ephemeral nature of most waterbodies, and limited extent of open water or exposed muddy shorelines. The lack of extensive habitat, and the small numbers of these species observed indicate the wetland areas within the site are unlikely to support important habitat of any of these species. Unlike the other migratory shorebirds that may use the project site, Latham's Snipe hides in dense vegetation near water by day and mostly forages in more open wetlands with soft, muddy substrates at night. Suitable habitat for Latham's Snipe occurs along Back Creek and nearby drains in the eastern part of site, as well as along the Shaw River and some deeper, more heavily vegetated wetlands.

The White-throated Needletail is an aerial species that forages while flying and is known to occur over forested areas. No White-throated Needletail were observed during field surveys and the site lacks areas of forested vegetation their preferred foraging habitat, indicating that site is unlikely to provide important habitat for the species.

Bats

Ten species of bats were recorded during bat surveys between 2009 and 2020. Eight of the species recorded are considered secure in their conservation status (i.e., not listed as threatened) and are widely distributed. Most calls in the site were from the ground-based detector indicating bats in these areas typically fly around ground level. Species recorded at a height of 45 metres were Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat, Little Forest Bat and White-striped Freetail Bat, but at a much lower frequency.

Two species recorded were listed threatened bats: the Southern Bent-wing Bat (EPBC Act Critically Endangered, FFG Act Critically Endangered) and Yellow-bellied Sheathtail-bat (FFG Act Vulnerable). A further four multi-species complexes were recorded, including the Long-eared bats (*Nyctophilus* spp.), Forest Bats (*Vespadelus* spp.) and Freetail Bat (*Ozimops* spp.) complexes. Species belonging to these species' complexes are not threatened.

The absolute abundance of bats cannot be measured from the number of bat calls recorded during any given time, however, calls can be used as an indication of relative abundance or activity.

Out of tens of thousands of recorded bat calls from all surveys, 150 were attributed to the Southern Bent-wing Bat and 16 to Yellow-bellied Sheathtail-bat.

Based on review of database records, the Grey-headed Flying-fox (*Pteropus poliocephalus*) was assessed as having the potential to occasional pass through the site, but due to limited suitable foraging habitat it was assessed to be unlikely to occur regularly.

Southern Bent-wing Bat

The Southern Bent-wing Bat (Figure 12.8) is a cave-dwelling bat with a restricted distribution, occurring only in south-east South Australia and south-west Victoria. The Southern Bent-wing Bat was listed as critically endangered under the EPBC Act in December 2007 and is also listed as critically endangered under the FFG Act. The species has been recorded at Heywood, Portland, Hamilton and Warrnambool in western Victoria, and also occurs between Robe and Naracoorte in south-east South Australia. In Victoria, it is usually recorded in forested areas but has been recorded widely in lower densities on the sparsely treed Victorian Volcanic Plain.

Figure 12.8
Southern Bent-wing Bat
(*Source: Terry Reardon and Steve Bourne; DELWP, 2020*)

At night, the species moves and forages in a range of habitats including forested areas, volcanic plains, wetlands and coastal vegetation. The species communally roosts in limestone caves, lava tubes, coastal cliff rock crevices and man-made tunnels. Small numbers have also been recorded roosting during the day in inland and coastal cliff caves. The Southern Bent-wing Bat recovery plan (DELWP, 2020c) lists at least 48 non-breeding roost sites in South Australia and 15 non-breeding roost sites in Victoria. Four of the known non-breeding roost caves are within 30 kilometres of the investigation area. The Warrnambool and Portland maternity caves are around 40 and 50 kilometres away from the site, respectively.

The Southern Bent-wing Bat are known to fly long distances between caves, particularly when dispersing from maternity caves. Recent tracking of the nightly foraging flights of individuals using miniature GPS/VHF units (~1.4 grams) showed that the minimum furthest straight-line distance travelled from the individuals' day roosting cave averaged 35 kilometres (with a range of 3–85 kilometres) (Bush et al., 2022). This same research investigated the importance of treed vegetation to the bats' flight paths. Preliminary analysis revealed that bat locations were closer to trees than would be expected from random movement alone. When foraging, lactating females have been recorded repeatedly returning to areas 23 to 25 kilometres from the Naracoorte maternity cave in a night (Bourne, 2010).

In another recent study, van Harten et al (2022) tagged a total of 2,966 Southern Bent-winged Bats with passive integrated transponder (PIT) tags. Antennas were used to detect bats in flight at a major maternity cave and a key non-breeding cave in south-east South Australia. They showed that direct movements between the two monitored caves occurred throughout the year, in all seasons. Individuals were able to fly the 72 kilometres between the maternity cave and a roosting cave in a single night in as little as 3.3 hours. The proportion of bats making this flight was typically below 0.5% of the tagged population, but several spikes were recorded in which up to 2% of the tagged population made this long-distance flight.

In late spring and summer, the Southern Bent-wing Bat congregates in "maternity caves" where the females give birth to and raise their young. van Harten et al (2022) showed that mass birthing occurred in November in the South Australian maternity cave, and presence of individuals at the maternity cave remained high in summer months. Lactation rates decreased in early February, suggesting the bats are being weaned at this time. Following weaning of juveniles, van Harten et al (2022) recorded a movement event in autumn months each year, which peaked in mid-March, with bats moving away from the maternity cave, and then returning in April and May.

Previously, the Southern Bent-winged Bat was thought to enter periods of torpor over winter months from mid-May to mid-September, including deeper hibernation from June to mid-August. van Harten et al (2022) found that while the activity of bats was significantly reduced from mid-June through July, there were bats active during this period. In spring, individuals were found to gradually return to the maternity cave. By October, daily encounter probability approached similar levels to that observed before winter dispersal (van Harten et al., 2022). In autumn and winter, after the young are weaned, these bats disperse over a large region. Southern Bent-wing Bat is believed to move into more widely dispersed, smaller non-breeding caves for winter (Churchill, 2008).

To ascertain the presence and use of the investigation area by the Southern Bent-wing Bat, extensive surveys (4,924 bat detector nights) were made at 100 locations across the site (Figure 12.9). Recordings were carried out in a variety of habitats that characterise the site. These showed that usage of the site by the species was infrequent with an overall average of 0.03 calls per detector night. The majority (60%) of calls were along the Shaw River and associated treed habitats in the south-west part of the site and in treed habitat in the eastern part of the site (Figure 12.9). The Shaw River site with the highest activity has large River Red Gums and riparian vegetation along the riverbank and a larger area of Blue Gum plantation immediately to the east. The eastern location was surrounded with planted trees. Potential preferred foraging habitat for the species was defined and is mapped in Figure 12.9.

Several other locations that had smaller numbers of confirmed calls comprised treed areas in road reserves and planted trees along fence lines. Habitats where higher activity has been recorded are not characteristic of the wider investigation area, which is largely open, treeless grasslands. Nature Advisory (Appendix D – *Biodiversity*) concluded the patterns of occurrence from field surveys indicates that, although the species may occasionally fly across the site, its core foraging habitat is on the margins of the site in areas of wooded vegetation away from construction activity and project infrastructure. Peer reviewer Biosis also concluded the site supports relatively low level of Southern Bent-wing Bat activity and that habitat characteristics of the site are likely to be no more or less attractive to the species than the broad range of similar agricultural land across much of the species' range (Appendix C2 – *Ecological independent peer review*).

Permanent wetlands, seasonally inundated swamps and ephemeral wetlands, particularly with terrestrial vegetation around the fringes, have been shown to provide potential foraging habitat for Southern Bent-wing Bat (Stratman, 2005; DELWP, 2020). To determine the use of these habitats, gradient surveys were conducted by placing bat recorders at increasing distances from waterbodies with simultaneous recording from paired control sites. These surveys were repeated to cover the range of water or 'fill' levels. Overall, low activity levels of Southern Bent-wing Bat were recorded near most watercourses, farm dams and ephemeral wetlands, with most sites failing to record the species. Based on the results of these surveys, Nature Advisory concluded the wetland and watercourse habitat across the site is not consistently or regularly used by the species, with vegetated riparian and treed areas visited more frequently (Appendix D – *Biodiversity*).

To investigate Southern Bent-wing Bat activity at height, bat call recording was carried out on the two meteorological masts at both ground level and at a height of 45 metres. The meteorological monitoring masts are in areas characteristic of proposed turbine locations in agricultural grasslands. While acknowledging that there are several limitations of this type survey method, no Southern Bent-wing Bat calls were identified at a height of 45 metres, but there were several records at ground level. This finding is consistent with other studies that have investigated flying heights of the Southern Bent-wing Bat using the same method. At nine other sites where Southern Bent-wing Bat calls were recorded there has been only one record above 45 metres, acknowledging that in all cases survey effort was greater at ground level (Appendix D – *Biodiversity*).

Nature Advisory note that while the species is capable of flying at height when departing their caves or flying above treed areas, their typical behaviour in open areas is to fly closer to the ground. As there is little treed habitat across the site and given the results of the field studies reported here from a number of Victorian wind farm sites, Southern Bent-wing Bat are unlikely fly above 40 metres in grassland areas.

Yellow-bellied Sheathtail-bat

The Yellow-bellied Sheathtail-bat is a wide-ranging species through tropical and sub-tropical Australia, occurring across most parts of eastern and northern Australia. It occurs in a range of habitat types including wet and dry sclerophyll forest, woodland, shrubland, grassland, mallee and desert. Individuals roost in tree hollows and are believed to be solitary for most of the year, occasionally forming small colonies. In Victoria, the species is a rare visitor in late summer and autumn and considered to be rare.

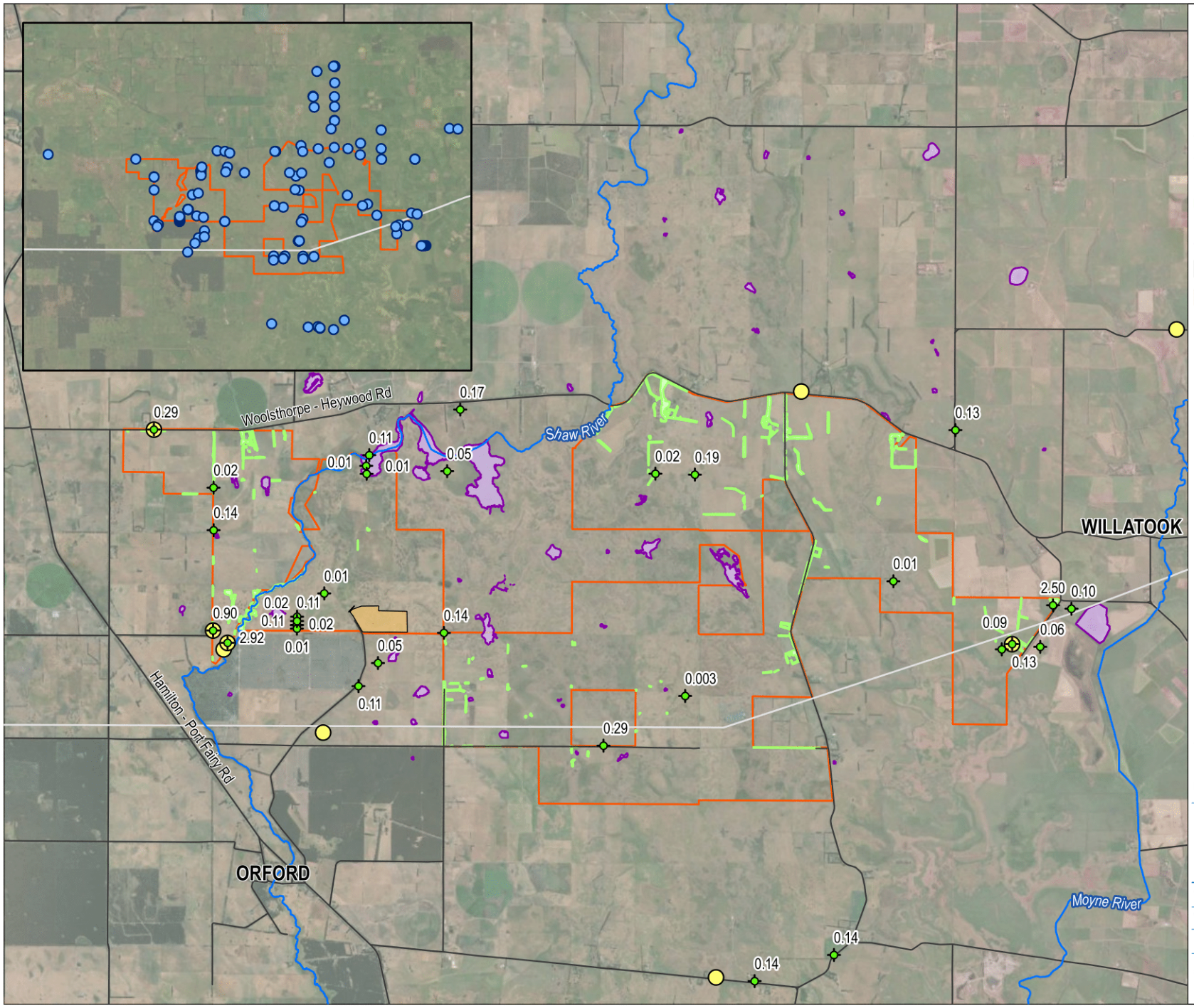
The Yellow-bellied Sheathtail-bat was recorded 16 times from nine locations (Figure 12.9) at a frequency rate of 0.003 calls per bat recording night. The survey locations at which this species was detected were widely distributed and did not show any clear patterns in relation to habitat characteristics. Nature Advisory concluded that, while the species may occasionally fly across the site, there are unlikely to be important foraging areas for the species where the species regularly visits.

The Yellow-bellied Sheathtail-bat is a high-flying species that usually flies fast and straight above the canopy but flies lower over open spaces and at the forest edge. No Yellow-bellied Sheathtail-bats were recorded from the detectors placed on the meteorological monitoring masts at 45 metres above the ground.

Grey-headed Flying-fox

The closest known roost of the Grey-headed Flying-fox is at Warrnambool, more than 30 kilometres from the closest proposed turbine. The Warrnambool camp has had up to 2,500 to 10,000 individuals recorded. In the past two years a temporary camp has established itself at a pine plantation northwest of Mortlake and is greater than 45 kilometres from the closest proposed turbine. Numbers at this camp are estimated between 2,500 and 9,999 (DAWE, 2022b). There were no records of Grey-headed Flying-fox within the 10-kilometre search region. The closest record of Grey-headed Flying-fox from the VBA was recorded in 2020 at Kirkstall approximately 15 kilometres from the closest proposed turbine.

Each night the flying-foxes leave their roost and spread out across the landscape in search of food resources, which include fruit and nectar from blossoms. They usually travel within 15 kilometres of roosting sites in search of food each night, although they have been reported moving out to 50 kilometres (Appendix D – *Biodiversity*). The project site is outside the usual nightly movements and is not located between the two closest camps. Grey-headed Flying-foxes feed on the nectar and pollen of native trees, in particular *Eucalyptus* and *Proteaceae* species, and fruits of rainforest trees and vines. They also forage in cultivated gardens and fruit trees.



LEGEND

- Bat recording sites
- Southern Bent-wing Bat
- Yellow-bellied Sheathtail-bat
- Road
- Watercourse
- Potential Southern Bent-wing bat habitat
- Modelled wetland areas
- Quarry area
- Willatook Wind Farm boundary

SOURCE:
Willatook Wind Farm boundary, quarry, wetlands and bat survey data from Wind Prospect.
Roads, transmission line and watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

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PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 12.9

Distribution of Southern Bent-wing Bat and Yellow-bellied Sheathtail-bat records

DATE: 31.05.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F031_GIS DOC REFERENCE: 287657_02_FIGS_CAPRX_V05

Other mammals

Eleven non-flying mammals were recorded during surveys for the project. This included the Black Wallaby (*Wallabia bicolor*), Koala (*Phascolarctos cinereus*) and Short-beaked Echidna (*Tachyglossus aculeatus*). Of the ten species recorded, six were introduced. This included the European Rabbit (*Oryctolagus cuniculus*), which was abundant across the site, and Red Fox (*Vulpes vulpes*).

There are two records of Fat-tailed Dunnart (*Sminthopsis crassicaudata*) within 10 kilometres of the site. Targeted surveys for the species were conducted using both active searches and tile grids, but none were detected. Nature Advisory concluded that, due to a lack of suitable habitat, the species was unlikely to occur at the site.

Frogs

Due to the presence of a range of suitable habitat in a range of waterbodies and tributaries within the site, targeted frog surveys were conducted in November 2009 and habitat assessments were conducted in 2018 and 2019. Six frog species were recorded, namely the Southern Bullfrog (*Limnodynastes dumerilii*), Striped Marsh Frog (*Limnodynastes peronii*), Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Growling Grass Frog (*Litoria raniformis*) (EPBC Vulnerable, FFG vulnerable), Common Froglet (*Crinia signifera*) and Southern Brown Tree Frog (*Litoria ewingii*). There is a record of the Brown Toadlet (listed as endangered under the FFG Act) from 1976, but the species was not recorded during project surveys.

Growling Grass Frog

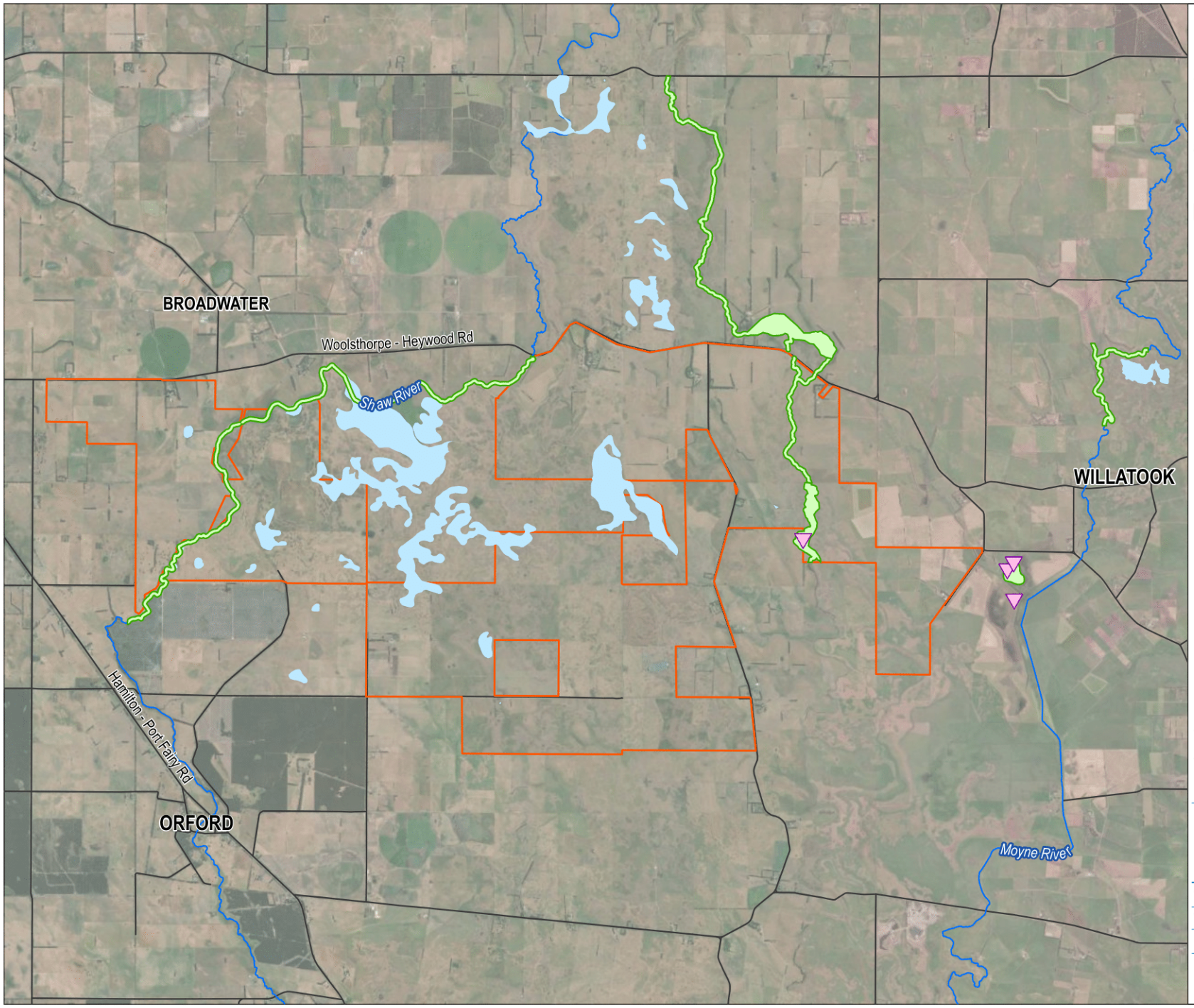
There are 22 records of the Growling Grass Frog from the south-west region extending to Warrnambool in the south-east and beyond Yambuk in the west and north to Hamilton. Many of these outlying records are historical (pre-2000), or come from the Mortlake area, coastal wetlands such as Tower Hill, and west of Port Fairy, well beyond the project site.

In the 2009 survey, a Growling Grass Frog was heard calling at or near a wetland south of Poynton's Road (likely to be Wild Dog Swamp). In 2018 and 2019, the aquatic habitats on and near the site were assessed for their suitability for Growling Grass Frog. The Growling Grass Frog inhabits areas of permanent water that are shallow and still or slowly moving, commonly around reservoirs, farm dams and swamps, especially those with bulrushes. It is usually associated with waterbodies that have areas of fringing and aquatic vegetation.

Most wetlands within the investigation area were found to be ephemeral and lacked sufficient fringing, floating or emergent vegetation of the type favoured by the species. A smaller number of wetlands and creek lines met the requirements for potential Growling Grass Frog habitat. These were usually creek lines serving as movement corridors or small farm dams that supported vegetation favoured by the species.

Back Creek (and potentially the Shaw River) are potential movement corridors providing connectivity to other habitats up- and downstream. Back Creek, a tributary of the Moyne River, is a narrow and relatively shallow and meandering ephemeral watercourse. During wetter periods, nearby swamps and low-lying areas can become inundated, but dry during summer to consist of isolated pools.

Potential Growling Grass Frog habitat across the project site is shown in Figure 12.10.



LEGEND

- Growling Grass Frog record
- Road
- Watercourse
- Potential Growling Grass Frog habitat
- Surveyed wetlands
- Willatook Wind Farm boundary

SOURCE:
Willatook Wind Farm boundary, wetlands and Potential Growling Grass Frog habitat from Wind Prospect.
Roads and watercourses from Vicmap.
Imagery from ArcGIS Online (various capture dates).

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PAGE SIZE: **A4**
PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 12.10

Potential Growling Grass Frog habitat

DATE: 23.05.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F032_GIS DOC REFERENCE: 287657_02_FIGS_CAPRX_V02

Reptiles

Ten reptiles have been recorded across the project site and neighbouring areas. This includes six lizards and four snakes. Two threatened species were recorded: Swamp Skink and Glossy Grass Skink, both listed as endangered under the FFG Act. Due to the presence of potentially suitable habitat in areas of remnant native grassland, the Striped Legless Lizard (EPBC Act listed as vulnerable, FFG Act listed as endangered) was also assessed as having the potential to occur.

Striped Legless Lizard

The Striped Legless Lizard inhabits dense native grasslands, often with rocky rises, that were once extensive on the volcanic plains of south-western Victoria. The project is situated south of the main concentration of Striped Legless Lizard records, with the closest record in Byaduk at least 24 kilometres north of the project site and made in 1904. Striped Legless Lizard targeted tile grid surveys were conducted in 2009 or 2018 within potential habitat but failed to record the species. Areas of potential habitat for Striped Legless Lizard are mapped in Appendix D – *Biodiversity* and were assessed to be disturbed, isolated and fragmented.

Nature Advisory concluded that, based on the long history of agricultural land use of the site, the degraded, isolated and fragmented state of potential habitat within the site, and the results of the targeted surveys, the site was assessed as unlikely to support a significant population of the species (if any at all).

Swamp Skink

The Swamp Skink is a medium-sized lizard that occurs in south-eastern Australia, from Mt Gambier in South Australia across the southern parts of Victoria, and extending into New South Wales on the far south coast. The species inhabits low-lying marshes and lagoon margins, paperbark and Melaleuca swamps, reedy habitats near rivers and lake, and tidal saltmarshes. There are six historical records of the species in the region dating back to 1965. Five of these records are from around Warrnambool, including three from Lake Pertobe. The other record was along the Moyne River about 10 kilometres south of the project site.

Trapping targeted the Swamp Skink for the project recorded one individual in habitat next to the Moyne River, about two kilometres east of proposed infrastructure. Detailed habitat assessments conducted across the site in 2018 concluded that an area along the Moyne River and one wetland contiguous with the Moyne River and its tributary provide potential habitat for the species. All other wetlands surveyed lacked dense ground layer vegetation, were ephemeral, lacked any noticeable freshwater crayfish burrows and showed signs of disturbance from domestic stock.

Glossy Grass Skink

The Glossy Grass Skink was found at one site during the tile grid surveys, along a roadside reserve. This species was considered to most likely occur in remnant native grassland and nearby areas that have not been impacted by stock grazing, which are limited in extent within the site.

Invertebrates

Detailed surveys for invertebrate species were not conducted for the project. The main invertebrate species of conservation significance with the potential to occur in the site was the Golden Sun Moth. A total area of 3.1 hectares of potential habitat (Plains Grassland) was mapped across the investigation area. This potential habitat occurs in small, fragmented patches and considered to be of low habitat quality. The project site is outside the known distribution of this species (occurring 27 kilometres southwest of the closest record). Based on habitat assessments in 2019, Nature Advisory concluded that, due to the lack of recent or regular records and the lack of availability of suitable habitat in the site supporting significant cover of either indigenous or exotic food plant species, it was unlikely that Golden Sun Moth occur in the site.

12.6.4 Aquatic fauna

Surface water features within and downstream of the investigation area include:

- Shaw River
- Back Creek (a tributary of Moyne River)
- Moyne River
- ephemeral drainage channels
- ephemeral wetlands.

These features are described in detail in Chapter 10 – *Surface water*.

Six fish species were collected along Moyne River within the study area and three species were collected in Shaw River (Table 12.7). This included two nationally significant species: Yarra Pygmy Perch (*Nannoperca obscura*) collected within the Moyne River sites and Dwarf Galaxias (*Galaxiella pusilla*) collected within an upstream tributary of the Shaw River. Earlier surveys (Ecology Partners, 2009a, b) also recorded the Dwarf Galaxias and Yarra Pygmy Perch in the Shaw River, and the Yarra Pygmy Perch in Back Creek. The location of these records is shown on Figure 12.11.

Table 12.7 Fish recorded during aquatic surveys

Name	Status[1]	Occurrence
Short Finned Eel (*Anguilla australis*)	–	Back Creek
Southern Pygmy Perch (*Nannoperca australis*)	–	Moyne River
Yarra Pygmy Perch (*Nannoperca obscura*)	VU, vu	Moyne River, Back Creek, Shaw River
Tupong (*Pseudaphritis urvillii*)	–	Moyne River
Common (*Galaxias Galaxias maculatus*)	–	Moyne River, Back Creek, Shaw River
Mountain (*Galaxias Galaxias olidus*)	–	Moyne River
Little Galaxias (*Galaxiella toourtkoourt)* (recorded as Dwarf Galaxias (*Galaxiella pusilla*))	VU, en	Shaw River

1. EPBC Act status: VU = vulnerable. FFG Act status: en = endangered, vu = vulnerable.

– = not listed under the EPBC Act or FFG Act.

Little Galaxias

Since the time of the aquatic surveys, the western portion of the Dwarf Galaxias population has been re-classified as a new species called the Little Galaxias (*Galaxiella toourtkoourt*) (Coleman et al., 2015). The Little Galaxias is endemic to south-eastern Australia from Barwon Downs in western Victoria to near the Coorong in south-eastern South Australia. The species is listed as threatened under the FFG Act.

Aquatic field surveys have recorded the Little Galaxias the Shaw River, an upstream tributary Kangaroo Creek, Back Creek and the Moyne River. The Little Galaxias a small fish found within western Victoria, in pockets around south-east Melbourne and in Gippsland in well vegetated slow flowing, still, shallow temporary or permanent freshwater habitats including swamps, drains and backwaters of streams and creeks.

The impact of European settlement on shallow freshwater wetlands, the preferred habitat of the Little Galaxias, has been severe. Many wetlands have been lost, and much of what remains has been affected by one or more degrading processes. Considerable areas of shallow freshwater wetlands have been drained for agriculture, urban and industrial development, and wetlands are still being lost in some areas, especially on the outer urban fringe. In addition, damage from unrestricted stock access has a major impact on shallow wetlands through disturbance, infilling and siltation, increased turbidity, and removal and destruction of instream and riparian habitat.

Yarra Pygmy Perch

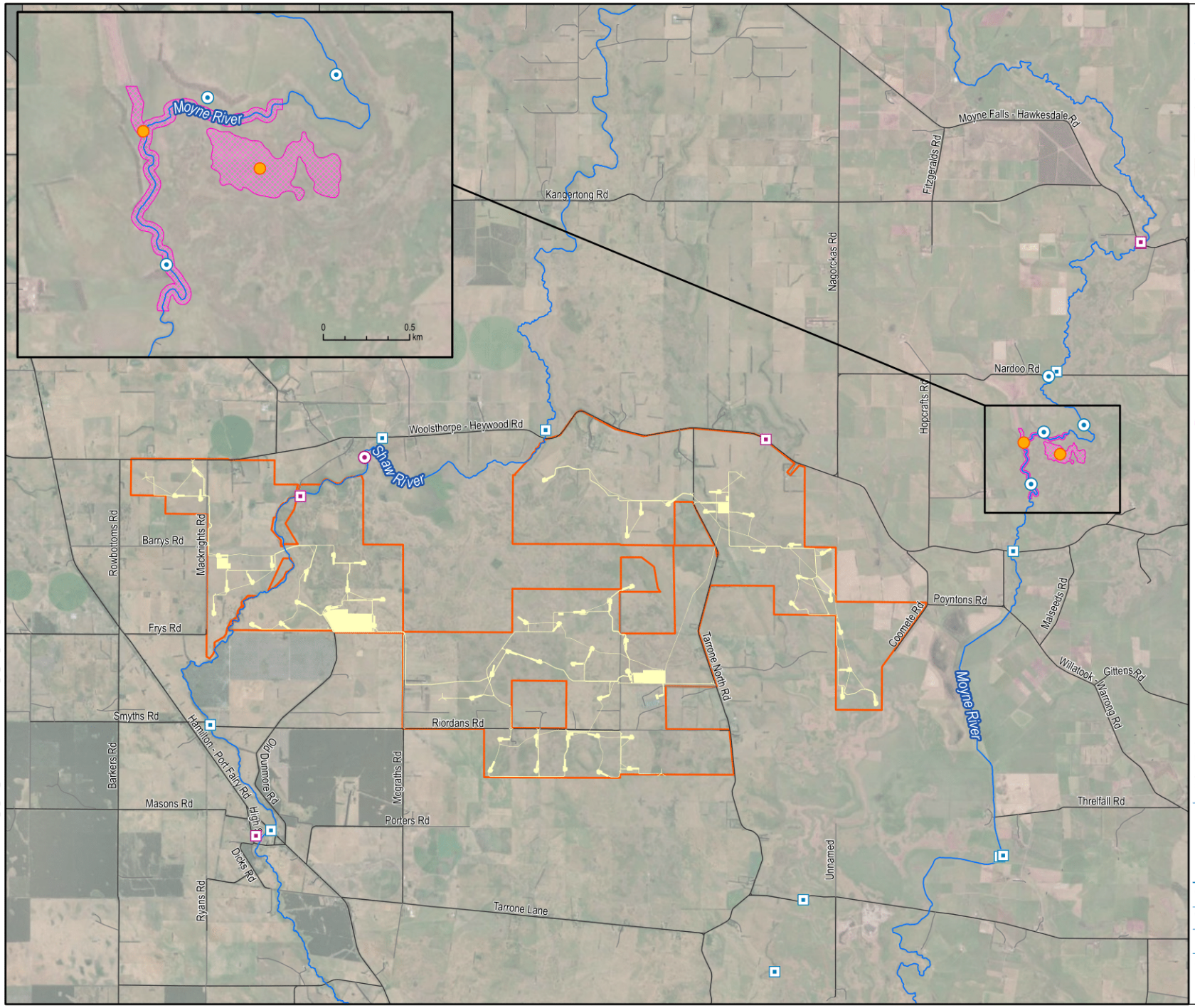
The Yarra Pygmy Perch is a small perch-like fish found in the Maribyrnong basin in southern Victoria, west to the Millicent Coast drainage basin in the south-east of South Australia, including the Barwon, Corangamite, Hopkins, Portland, and Glenelg River basins. The species typically occurs in slow-flowing or still waters that possess large amounts of aquatic vegetation (particularly emergent vegetation) such as lakes, ponds and slow-flowing rivers.

The main process contributing to wetland loss and degradation in Victoria has been total or partial drainage. This decline has been especially severe in shallow wetlands, with more than 90% of this habitat type being lost in some parts of the state, with the loss being particularly severe on private land. The fragmented and patchy nature of its remaining habitat across the landscape, and variability of this habitat between seasons and years, makes the species extremely vulnerable to local extinctions.

The Yarra Pygmy Perch is known to occur in a range of environmental conditions and can persist in watercourses of reduced water quality. This would indicate they have a degree of tolerance to temporary changes in water quality.

Hairy Burrowing Crayfish

The Hairy Burrowing Crayfish (listed as vulnerable under the FFG Act) is a short-ranged endemic species found in Western Victoria and has been recorded in a Moyne River tributary six kilometres east of Willatook (Figure 12.11). Burrow chimneys from crayfish were observed in one section along the Moyne River and adjacent wetland during field surveys for the project and attributed to the Hairy Burrowing Crayfish.



LEGEND

- Watercourse
- Road
- Track
- Construction footprint
- Willatook Wind Farm boundary

EHP records (2018)

- Little Galaxias
- Yarra Pygmy Perch

VBA records (2022)

- Little Galaxias
- Yarra Pygmy Perch

NA records

- Hairy Burrowing Crayfish
- Hairy Burrowing Crayfish habitat

SOURCE:
Willatook Wind Farm boundary from Wind Prospect.
Watercourses from Vicmap.
Aquatic fauna locations from Nature Advisory.
Imagery from ArcGIS Online (various capture dates).

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PAGE SIZE: **A4**
PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 12.11

Significant aquatic fauna records

DATE: 09.03.22 PROJECT: 754-MELEN287657 FILE: 287657_02_FIG5_GIS DOC REFERENCE: 287657_02_FIGS_GAPRX_V01

12.7 Impact assessment

12.7.1 Impact pathways

Development of the project has the potential to impact terrestrial and aquatic biodiversity values via distinct impact pathways during construction, operation, and to a lesser extent, decommissioning of the project.

Construction impact pathways

Construction impact pathways include:

- direct habitat loss from vegetation clearance and physical disturbance associated with construction earthworks
- habitat degradation from the introduction or spread of invasive species or pathogens, edge effects, barrier effects, hydrological changes, groundwater drawdown, deposition of eroded sediments, or from contamination caused by accidental spills of hazardous materials
- reduced abundance and/or diversity of flora and fauna populations because of:
  - injury, death or displacement of flora and fauna from vegetation clearing and earthworks, or collision with vehicles
  - changes to available habitat (including food sources, shelter and nesting or roosting sites) due to habitat loss and degradation
  - increased disturbance (through project-related activity such as noise, vibration and lighting) disrupting the behaviour of fauna and potentially reducing reproductive success.

Edge effects are ecological alterations linked with development of sudden, artificial edges of forest fragments. These changes can include greater exposure to sunlight and wind and altered vegetation structure and composition.

Barrier effect occur when there are barriers that cause habitat isolation and can reduce the ability to move through the landscape.

Operational impact pathways

Once operating, the project may impact biodiversity mostly through the interaction with wind turbine infrastructure. The most likely impact is the death or injury of birds and bats via collision with turning blades. 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, such as eagles.

In addition to direct collision risk, birds may change their behaviour in response to the presence of the wind farm. They may be reluctant to fly through or over the wind farm (barrier effect) or they may avoid areas near the turbines (alienation). Either or both of these may restrict access to existing habitats. The degree of impact would depend on the species affected. However, other disturbance such as human activity or vehicle/machinery movements would reduce once construction activities are complete.

Impacts on bats can arise from direct collision with operating wind turbine blades or towers, or barotrauma caused by air pressure differences near rotating wind turbine blades and the wider area. Bat deaths from collisions with wind turbine blades or towers is the most likely effect on bats because of the project.

12.7.2 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.

To limit bat collisions with wind turbines, a key element of the project design has been to selectively place wind turbines in areas of treeless agricultural land. This included placing turbines at least 215 metres away (inclusive of blade) from remnant and planted treed vegetation. This selective placement would minimise the likelihood of collisions with turbines since there is known to be a strong relationship with treed areas and bat abundance (e.g., Lumsden and Bennett, 2005).

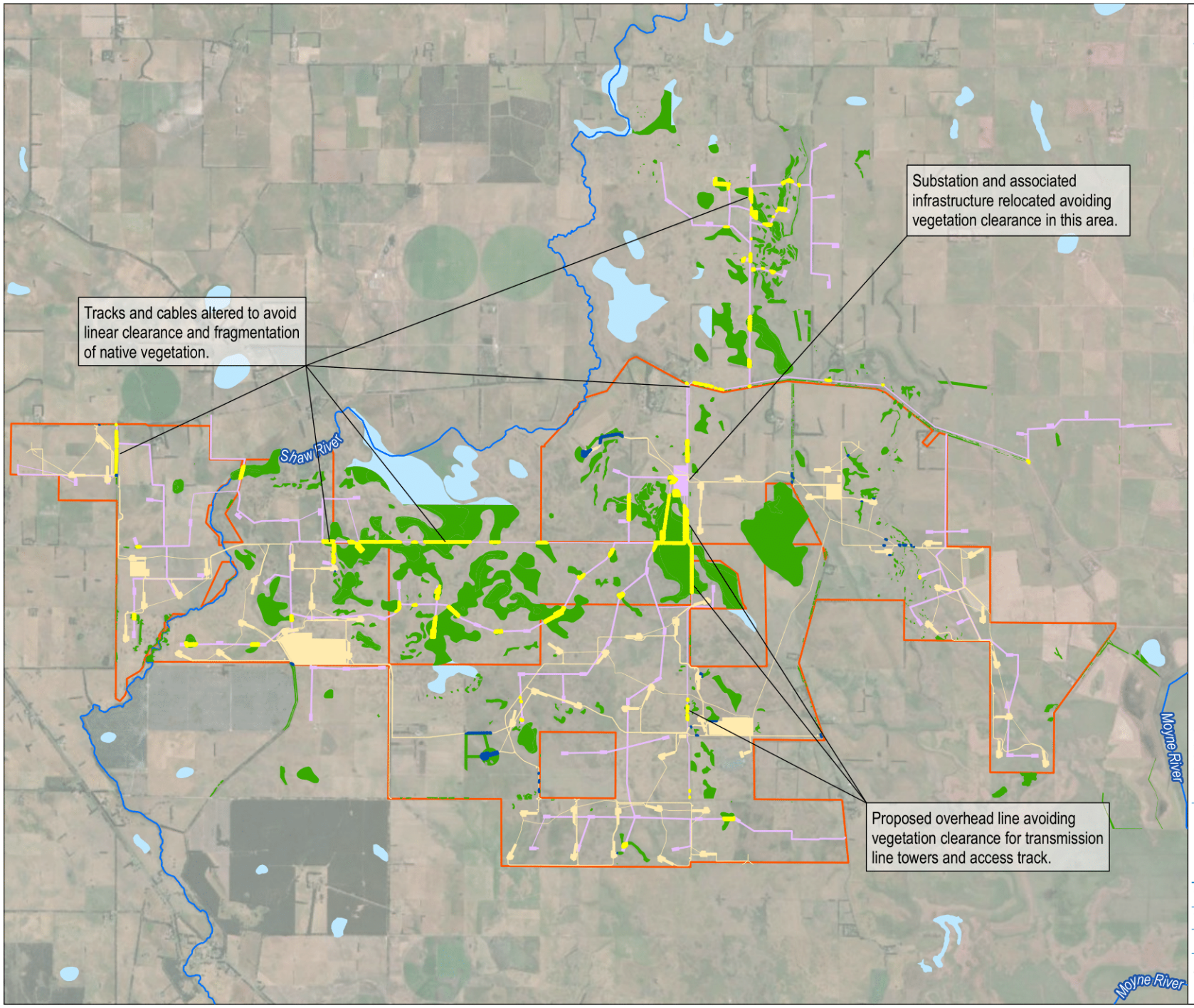
Key design measures are identified in square parentheses e.g., [BHD01].

Native vegetation avoid and minimise statement

Native vegetation surveys have progressively refined the understanding of native vegetation coverage and habitat for threatened flora and fauna across the site. As described in Chapter 4 – *Project alternatives and design development*, throughout the design process there have been significant efforts made to avoid the clearance of native vegetation.

The proposed development footprint consists of 222 hectares of expected ground disturbance. As the development footprint has been derived in accordance with the ‘avoid’ and ‘minimise’ statement (as contained in Appendix D), most of the native vegetation has been avoided and would be retained.

The original project design as envisaged in 2010, which largely avoided areas of native vegetation, would have resulted in the need to remove at least 20 hectares of native vegetation. A range of subsequent design changes were made as part of the project’s concept design that was referred to DELWP in 2018, including re-routing of site access tracks and underground cabling, repositioning three wind turbines and associated hardstands, and repositioning a further four hardstands. As a result, the referred concept design would have resulted in the need to remove at least 9 hectares of native vegetation. Further avoidance measures were carried out throughout the EES process to arrive at the current project design, estimated to result in the clearance of 4.6 hectares of native vegetation [see design measure BHD01]. Areas of proposed native vegetation clearance and areas of avoided native vegetation clearance are shown in Figure 12.12.



LEGEND

- Watercourse
- Concept design construction footprint
- Current project construction footprint
- Areas of native vegetation (mapped EVCs)
- DELWP mapped wetlands
- Areas of avoided vegetation clearance
- Proposed areas of vegetation clearance
- Willatook Wind Farm boundary

SOURCE:
Willatook Wind Farm boundary, EVC and construction footprints from Wind Prospect.
Watercourses from Vicmap.
Wetlands from DELWP.
Imagery from ArcGIS Online (various capture dates).

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PROJECTION: **GDA 1994 MGA Zone 54**

WIND PROSPECT

WILLATOOK WIND FARM

FIGURE 12.12

Areas of proposed and avoided native vegetation clearance

DATE: 04.02.22 PROJECT: 754-MELEN287657 FILE: 287657_02_F049B_GIS DOC REFERENCE: 287657_02_FIGS_E.APRX_V02

Seasonal wetlands

Due to the relative flat topography and influence of lava flows, there are areas within the project site that are inundated during winter and spring. The largest of these habitats is Cockatoo Swamp. A 100-metre buffer was placed around all wetlands mapped in the Victorian Wetland Inventory to exclude all project infrastructure [SWD11]. This area was selected as a means of avoiding:

- physical disturbance to wetlands and their fringes
- limiting surface water runoff and entrained sediment loads reaching these ephemeral wetlands from construction works zones
- reducing disturbance to fauna from construction activities (for example noise, movement and light from development)
- limiting the potential for collisions within turbines for birds and bats foraging in these ephemeral wetlands.

A single, large buffer was placed around a series of wetlands that form the Cockatoo Swamp in response to potential breeding by Brolga. The total buffered area is 2,657.8 hectares and includes areas in-between these wetlands. A detailed justification for this buffer is described in Chapter 11 – *Brolga*.

While designed to avoid potential impacts to Brolga, this buffer also further reduces potential impacts to other fauna, for example disturbance to fauna from construction activities or movements of birds through this area.

In several instances ecological field surveys mapped seasonal wetland communities beyond the wetland buffers that were placed around Victorian Wetland Inventory wetlands.

Watercourses and riparian zones

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.

Watercourses including the Shaw River, Back Creek and smaller drainages, were buffered by 100 metres [SWD12] to prevent:

- unnecessary disturbance to the watercourses or their banks
- potential downstream effects from construction activities such as sedimentation of waters.

Smaller drainage lines within the project site are ephemeral, but their environmental importance from a hydrological and ecological perspective is recognised. These ephemeral drainages were buffered by 30-metres to:

- limit physical disturbance to the drainages
- limit surface water runoff, and entrained sediment loads reaching these ephemeral drainages from construction works zones.

Watercourse crossings for access tracks and electrical cables are needed to connect wind turbines and associated infrastructure. As such, there are instances where the watercourse buffers are crossed by access tracks and electrical cables. These locations are shown in Figure 10.1 in Chapter 10 – *Surface water.*

Other key design measures for watercourse crossings are detailed in Chapter 10 – *Surface water*.

Habitat buffers

Growling Grass Frog was recorded at one location along Back Creek. As such, riparian vegetation was mapped as potential habitat for a resident population of the species. Except for a single access track and cable crossing, all wind farm infrastructure has been located more than 100 metres from the outer edge of mapped Growling Grass Frog Habitat [BHD02].

Based on the results of bat recording for the project and consideration of findings from other investigations (Appendix D – *Biodiversity*), a 215 metre buffer from remnant and planted treed vegetation was applied to wind turbines [BHD03].

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) [BHD04]. 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. This data shows decreasing bird and bat strikes with increasing turbine blade height.

12.7.3 Management controls

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 12.8.

Table 12.8 Biodiversity management measures

Biodiversity impact	Project phase	Management measures	Number
Impacts to areas of native vegetation	Pre-construction	Measures to manage native vegetation during construction would include: • obtain appropriate approvals and permits before any vegetation removal • appropriate offsets would be secured in accordance with state and Commonwealth legislation and policy • locate temporary infrastructure areas (parking areas, stockpiles, laydowns etc) in already cleared areas • ensure all construction personnel are appropriately briefed before works start • ensure no construction personnel, machinery or equipment are placed inside vegetation/tree protection zones (see BH02) • conduct seasonally dependent pre-clearance surveys for threatened flora species in areas of suitable habitat proposed to be disturbed and not already surveyed for threatened species.	BH01

	Construction	The approved vegetation clearing extent, including retained patches of vegetation within the construction footprint, would be clearly demarcated and identified during the construction stage as follows:
		• All project personnel would need to attend an induction that outlines environmental management requirements. This would include information on the biodiversity values of the project area specifically areas of threatened flora and fauna habitat.
		• Erecting flagging, bunting and signage, construction fencing or fauna-specific temporary fencing in areas of special concern and appropriate buffers as follows:
		  - Growling Grass Frog habitat
		  - Patches of Plains Grassy Wetland
		  - Areas of mapped EVCs
		  - Tree protection zones
		  - any other areas of special concern noted during pre-clearance inspections.
		• Clearly mark accessways to prevent establishment of secondary tracks and disturbance to native vegetation.
			BH02

Biodiversity impact	Project phase	Management measures	Number
	Construction and operations	Revegetation of disturbed areas including: • planting locally occurring native shrubs, trees and groundcover plants, selected in consultation with DELWP, to recreate the target vegetation community • incorporating rocks, logs, dead trees and stumps in the restoration and rehabilitation works to provide fauna habitat • maintaining plantings in accordance with the rehabilitation sub-plan • managing weeds and pest animals.	BH03
Habitat degradation due to weeds and pests	Pre-construction, construction and operation	The following measures would be carried out to manage biosecurity risks: • consult with landholders about property specific biosecurity management arrangements/plans which are in place and followed by landholders • undertake a baseline weed survey of representative locations within the development footprint to identify locations of existing weed infestations • inspection and certification of all vehicles and construction machinery upon arrival at site. Vehicles and construction machinery cannot access the site until certified as clean • vehicles and construction machinery would not go outside of the construction footprint or approved roads and tracks unless undertaking survey or property management activities as agreed with the landowner • incorporate washdown stations at strategic locations • monitor the condition of disturbed areas post-construction and undertake remedial measures, as required, with the aim that all disturbed areas are re-profiled to a stable landform consistent with original contours and drainage lines and vegetated with a self-sustaining, non-pest species sterile groundcover (on consultation with landholder requirements).	BH04

Biodiversity impact	Project phase	Management measures	Number
Bird and bat collisions with wind turbines	Pre-construction, operation	Implement a bird and bat adaptive management plan to be approved by DELWP Environment, DAWE and the responsible authority. The objectives of the bird and bat adaptive management plan would be to: • implement a monitoring program to estimate the impact of the project on at-risk birds and/or bats that can reasonably be attributed to the operation of the project, as an indicator of population impact • directly record impacts on birds and bats through carcass searches • document an agreed decision-making framework that identifies impact triggers requiring a management response to reduce impacts and the management activities that will be considered; and • identify matters to be addressed in periodic reports on the outcomes of monitoring, the application of the decision-making framework, mitigation measures and their success. Strategies to be employed to ensure that any impact triggers are detected would include the following: • operational phase bat utilisation surveys (see BH06) • carcass searches under turbines (see BH07) • scavenger and detectability trials (see BH08,09) • statistical analysis of the results of carcass searches to derive estimates of mortality levels and rates • reporting. The bird and bat adaptive management plan would use an adaptive management approach where management measures are adapted to manage and mitigate impacts more effectively based on the findings of the monitoring program. It is intended that the results of the initial monitoring program would inform the requirements of the ongoing monitoring program, depending on detected bird and bat impacts, and identify additional targeted carcass searching and surveys to be carried out to inform ongoing management and mitigation strategies. The design and implementation of the bird and bat mortality monitoring program would be comprehensive and science-based. It would involve frequent monitoring of a sample of turbines for a minimum of two years duration, that begins when the first turbine is commissioned. Impact triggers for threatened species would occur if a threatened bird or bat species (or recognisable parts thereof) listed under the EPBC Act or FFG Act are found dead or injured within the search area under a turbine, or within 100 metres of it, either during any formal mortality search or incidentally by wind farm personnel. Once triggered, an appropriate response would be initiated, and reporting requirements outlined in the decision-making framework would occur. The proposed decision-making framework for identifying and mitigating impacts on threatened bird and bat species is shown in Figure 12.13.	BH05

Biodiversity impact	Project phase	Management measures	Number
	Operation	As part of the bird and bat adaptive management plan, further ultrasonic bat surveys in spring and summer/autumn would be conducted in the first two years of operation. Songmeter ultrasonic bat detectors would be used to monitor bat activity at height (on nacelle or meteorological masts) paired with a bat detector up to one metre off the ground. The Songmeters would operate between sunset and sunrise over a six-week period, in November and February/March when Southern Bent-wing bat are most active.	BH06
	Operation	As part of the bird and bat adaptive management plan, a mortality monitoring program would be conducted either using searches on foot along pre-determined transects by an adequately trained ecologist or via searches by a trained scent dog. Monitoring would consist of searches of 20 randomly selected turbines out to a distance of 120 metres once per month for a period of two years. A second follow-up search, a 'pulse search', would be undertaken to 60 metres during the warmer months (September to April) when microbats are more active.	BH07
	Operation	As part of the bird and bat adaptive management plan, a scavenger trial would be conducted to ascertain the rate at which carcasses are removed by scavengers. The trials would be conducted twice over the two year monitoring period. Carcasses (in three size groups) would be randomly placed under selected turbines with motion sensor cameras used to monitor scavenger activity taking place.	BH08
	Operation	As part of the bird and bat adaptive management plan, detectability trials would be conducted to test the rate at which the trained searchers, or scent detection dog, detect carcasses under wind turbines	BH09
Direct impacts to fauna	Construction	Measures to limit fauna strike would include: • apply a speed-limit on private access tracks to reduce the risk of fauna mortality from vehicle strike • traffic movements would be minimised during the night, dusk and dawn periods in areas of remnant native vegetation.	BH10

Biodiversity impact	Project phase	Management measures	Number
Direct impacts to Growling Grass Frog	Pre-construction, construction	The following mitigation measures would be carried out to manage potential impacts to the Growling Grass Frog: • prepare and implement a Growling Grass Frog Management Plan • minimise disturbance of banks, channels and vegetation in watercourses (i.e., movement corridors) identified as potential habitat for Growling Grass Frog, where possible • where essential wind farm infrastructure (e.g., access roads, underground cabling trenches) intersects an area identified as potential habitat for Growling Grass Frog, specific action would be undertaken as outlined in the Construction Environmental Management Plan. The Construction Environmental Management Plan would describe appropriate disturbance mitigation measures in relation to sensitive habitat areas such as watercourse banks, channels and nearby vegetation. Other actions would include: – preparation of a salvage and translocation protocol, which would be carried out if a Growling Grass Frog is found during construction works – conducting pre-construction surveys of affected habitats with Growling Grass Frog translocated to nearby sections of watercourses in accordance with the translocation protocol – install temporary frog exclusion fencing either side of construction areas to prevent frogs from moving into works areas while construction is underway – induct all workers on the site to recognise Growling Grass Frog with the requirement to alert the site manager when found – reduce the construction footprint as much as reasonably practicable in areas identified as potential Growling Grass Frog habitat – schedule the construction of crossings to occur outside the frog's breeding season when conditions are dry, where possible – adopt the culvert design standards (from DELWP 2017f) that facilitate passage of Growling Grass Frog – restore and enhance affected areas of watercourse to at least their pre-construction condition – implement measures (from Murray et al. 2011) to reduce the introduction and spread of the pathogen Chytrid Fungus.	BH11
Direct impacts to Striped Legless Lizard	Pre-construction, construction	The following mitigation measures would be carried out to manage impacts to the Striped Legless Lizard: • All workers on the site would be inducted to recognise this species and alert the site manager when found • If a Striped Legless Lizard is found during construction works, a salvage and translocation protocol would be prepared. • Where possible, surface and embedded rocks will not be removed from the site and where possible these would be reintroduced where they are removed temporarily.	BH12

Biodiversity impact	Project phase	Management measures	Number
Impacts to aquatic habitats	Pre-construction, construction	Where practicable, all trenched watercourse crossings will be constructed during no or low flow conditions. Bridges and culverts would be designed to allow flow beneath the roads along their natural flow paths. The watercourse crossings construction method would be dependent on the site conditions of the crossing location. All watercourse crossings and culvert and bridge designs would conform to relevant local Council, Glenelg Hopkins Catchment Management Authority and DELWP guidelines. To further mitigate potential impacts to Dwarf Galaxias and Yarra Pygmy Perch, work would be undertaken in accordance with the following measures: • Microsite crossings to avoid deeper pools of water. • Use a minimised construction workspace for watercourse crossings (maximum width 10 m). • Using fish friendly culverts for the proposed crossings of Back Creek. • Establish no-go zones with buffers around waterbodies adjoining the project footprint to prevent any disturbance to the biodiversity values present within these areas. • Flow diversion measures would be installed where construction of trenched watercourse crossings during no flow conditions is not possible. Flow diversion measures may include pumps to ensure that water can be moved from one side of crossing to the other, screened inlets (or other appropriate equipment) to minimise the entrapment of aquatic fauna, and outlet structures that are designed to avoid scouring of the channel. • Where watercourses are trenched, all obstructions to flow would be removed as soon as practicable after the cable has been laid and backfilled. • Watercourses would be reinstated such that bank stability at the crossing location is the same or better than before construction starts. Stabilising materials such as rock armouring, hydro mulch, jute matting or other suitable geotextile materials would be applied to watercourse banks where necessary. • Stabilising terrestrial habitat with soil and bank protection materials, including biodegradable matting or similar geotextile products.	BH13

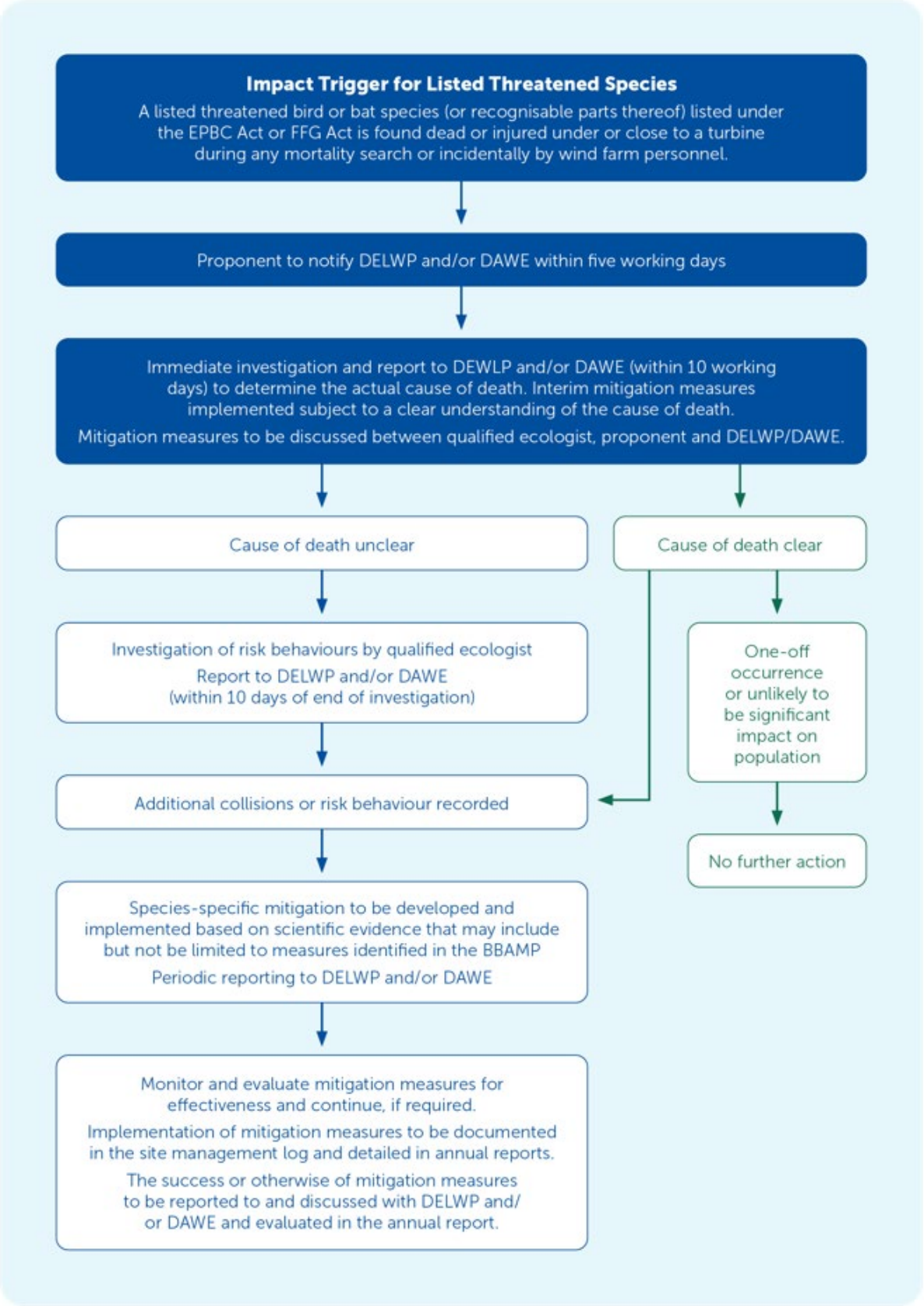

Figure 12.13 **Proposed decision making framework for identifying and mitigating impacts on threatened bird and bat species within the bird and bat adaptive management plan**

If Southern Bent-wing Bat collision mortality is recorded the following actions would be initiated:

- immediate investigation to determine if the impact was a one-off event or potential to be ongoing
- mortality monitoring program (BH07) would be expanded to cover all turbines and the frequency increased to once a fortnight in the subsequent six weeks
- incident report prepared for provision to the responsible authority and DELWP.

Depending on the findings of the incident report, further mitigation may be implemented for any turbines deemed to be at-risk, including:

- varying turbine cut in speed to 4 m/s where turbines
- low speed turbine curtailment (e.g., during high activity periods)
- investigating the use of ultrasonic deterrents.

12.7.4 Offsets

Native vegetation unable to be retained during the design and construction phases would be offset according to the *Guidelines for the removal, destruction or lopping of native vegetation*. The amount of native vegetation required to be offset for the project is presented in Table 12.9 and discussed in detail in Appendix D – *Biodiversity*.

Table 12.9 Project offset requirements

Aspect	Offset requirement
Wind farm site	
General offset amount	1.206
Vicinity	Glenelg Hopkins Catchment Management Authority boundary or the Moyne municipal district
Minimum strategic biodiversity value	0.312
Large trees to be offset	6 large trees
Over dimensional route	
General offset amount	0.014
Vicinity	Glenelg Hopkins Catchment Management Authority boundary or the Moyne/ Glenelg municipal districts
Minimum strategic biodiversity value	0.683

As impacts to 0.49 hectares of Seasonal Herbaceous Wetland (Freshwater) of the Temperate Lowland Plain cannot be avoided or mitigated, an offset package in line with the *EPBC Act Environmental Offsets Policy* (Department of Sustainability, Environment, Water, Population and Communities, 2012) will be provided. This would include an Offset Strategy including location, size, condition and environmental values within the identified offset, as well as an Offset Management Plan that would detail how the offset will be secured, managed and monitored to meet the defined environmental outcomes.

12.7.5 Residual effects

After the development of design measures and management controls, an assessment of residual effects and impacts 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 from very low to very high using the criteria outlined in Table 12.10.

Table 12.10 Impact criteria for biodiversity impacts

Rating	Criteria
Very high	The effects on ecological values extend beyond the study area at a regional level. 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 area 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.
Moderate	Loss or alteration to ecological value that is readily detectible, 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 project disturbance 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 isolated areas within the project disturbance footprint.

Terrestrial vegetation and ecological communities

Ecological Vegetation Classes

The primary impact pathway resulting the direct loss and/or degradation of native vegetation and associated listed ecological communities is from vegetation clearance, earthworks and physical disturbance. The project also has the potential to indirectly degrade native vegetation and associated listed ecological communities via introduction or spread of weeds and pathogens and deposition of eroded sediments.

As the project has been developed in accordance with the 'avoid' and 'minimise' principles, the majority of the native vegetation and wetland habitat remaining on the site for native fauna has been avoided and would be retained. Construction of the project would result in the loss of up to 4.6 hectares of native vegetation and six large trees.

Six EVCs would be affected by vegetation clearance as presented in Table 12.11. As discussed in Section 12.6.1, average condition scores for habitat zones based on site condition and landscape context were low (<39), a likely reflection of their location within an active agricultural landscape. Furthermore, the average condition score for zones to be impacted was 21, reflecting the effort to avoid impacts to higher-quality native vegetation.

Table 12.11 Estimated vegetation losses from the project

EVC	Mapped area (hectares)	Estimated clearance (hectares)	Area to be retained (hectares)	Proportion of loss within the study area (%)
Plains Grassy Wetland	250.0	1.31	248.7	0.5%
Stony Knoll Shrubland	51.3	0.74	50.6	1.4%
Basalt Shrubby Woodland	19.2	1.91	17.3	9.9%
Higher-rainfall Plains Grassy Woodland	16.8	0.08	16.8	0.5%
Heavier-soils Plains Grassland	3.1	0.022	3.1	0.7%
Swampy Riparian Woodland	0.07	0.066	0	100%

The area of native vegetation proposed to be cleared occurs in patches of relatively poor condition (average condition score of 29). This represents about 0.5% of native vegetation mapped within the project site. With a range or measures in place and opportunities for further reductions of vegetation clearance made during detailed design, the overall impact of vegetation clearance was assessed by to be low, with effects contained within the project disturbance footprint unlikely to reduce the overall viability of these communities.

Potential impacts to seasonal wetlands are assessed in Chapter 9 – *Groundwater* and Chapter 10 – *Surface water*.

Project construction works also have the potential degrade existing native vegetation via several pathways. Construction works have the potential to spread weeds and pathogens, 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.

Weeds and pathogens may be lodged and transported in construction plant and equipment and then driven through the project site. Plant and equipment used within the project site also can spread weeds and pathogens to other areas causing potential infestations further afield. Key measures to minimise this risk has been including washdown stations at all entry points and gates. Construction works would also be subject to management requirements for weeds and pathogens such as vehicle hygiene protocols and soil management, which would be incorporated into the project Environmental Management Plan. With these measures implemented the impact of introduction or spread of weeds and pathogens was assessed to be low.

Threatened ecological communities

Two nationally threatened ecological communities occur in the investigation area and have the potential to be impacted. These are the Seasonal Herbaceous Wetland of the Temperate Lowland Plain and the Grassy Eucalypt Woodland of the Victorian Volcanic Plain.

Seasonal Herbaceous Wetland of the Temperate Lowland Plain

A total of 19.6 hectares of Seasonal Herbaceous Wetland of the Temperate Lowland Plain were mapped within the investigation area. In addition, 204.6 hectares was mapped as potential Seasonal Herbaceous Wetland of the Temperate Lowland Plain. The project is predicted to directly impact 0.49 hectares of mapped Seasonal Herbaceous Wetland of the Temperate Lowland Plain. This represents 2.6% of the mapped ecological community within the investigation area. No areas mapped as potential Seasonal Herbaceous Wetland of the Temperate Lowland Plain would be cleared.

This clearance would occur within four separate patches of mapped Seasonal Herbaceous Wetland of the Temperate Lowland Plain ranging from 0.002 hectares to 0.25 hectares and affecting between 0.3% and 19.5% of four separate defined patches. In addition, to direct physical disturbance, alteration of existing hydrological drainage patterns or natural seasonal filling regime have the potential to indirectly impact Seasonal Herbaceous Wetland of the Temperate Lowland Plain ecological community. As discussed in Chapter 10 – *Surface water*, the construction of roads and wind turbine foundations has the potential to alter existing drainage patterns if not accounted for during design. Hydrological effects have the potential to occur over a larger area, due to the nature of the shallow topographical relief of floodplain systems. During the project design, hydrological flood modelling was used to inform the placement of turbine locations. Similarly, modelling of flood and flow velocity would be considered for the sizing of culverts to ensure flow pathways are not affected by the project.

With the implementation of these measures, the creation of buffers around wetlands and the implementation of an approved offsets package, the impact to Seasonal Herbaceous Wetland of the Temperate Lowland Plain ecological community within the site was assessed to be low.

Grassy Eucalypt Woodland of the Victorian Volcanic Plain

A total of 0.8 hectares of Grassy Eucalypt Woodland of the Victorian Volcanic Plain has been mapped within the investigation area and these areas have been avoided during project design. A further 2.2 hectares of Heavier-soils Plains Grassland EVC has the potential to support this community. These areas have been avoided during the design of the project and therefore no impacts Grassy Eucalypt Woodland of the Victorian Volcanic Plain (confirmed or potential) were predicted.

Flora

Residual impacts on flora populations as a direct result of habitat loss are most influenced by the spatial extent and severity of the habitat loss and the nature of the population. Higher residual impacts have the potential to occur where the project disturbance overlaps with a species habitat. As such this impact assessment focuses on those species that are of conservation significance, often having a restricted distribution or specific habitat requirements.

Two species of conservation significance were recorded in the investigation area: Swamp Everlasting and Trailing Hop-bush. Another seventeen species of conservation significance were assessed as having the potential to occur based on recent records within 10 kilometres, described in Section 12.6.2.

Swamp Everlasting

Swamp Everlasting grows in swamps and bogs typically within Plains Grassy Wetland within the Victorian Volcanic Plain bioregion. Targeted surveys across the project site recorded a single patch of Swamp Everlasting plants. This area was avoided during the project design process.

Clearance of 1.3 hectares of Plains Grassy Wetland EVC would reduce potential habitat for the species. However, avoidance measures made during project design would ensure that 99.5% of Plains Grassy Wetland EVC within the site would be retained.

A small area (0.3 hectares) of Plains Grassy Wetland that would be cleared has the potential to provide habitat for the species and has not yet been surveyed. Surveys in this area for Swamp Everlasting would be conducted prior to construction and if located species-specific management measures developed.

With these measures in place, a very low impact on Swamp Everlasting in the site was predicted.

Trailing Hop-bush

Trailing Hop-bush grows in low-lying areas that are often wet in winter and are known to occur in Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland EVCs. Targeted surveys across the project site recorded Trailing Hop-bush in two patches of Basalt Shrubby Woodland along Old Dunmore Road, which would not be impacted by the project.

Clearance of 2.0 hectares of Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland EVCs would reduce potential habitat for the species. However, avoidance measures made during design would ensure around 95% of these EVCs within the project site would be retained.

A very small area (0.05 hectares) of Basalt Shrubby Woodland that would be cleared has the potential to provide habitat for the species and has not been surveyed. Surveys in this area for Trailing Hop-bush would be conducted in these areas prior to construction and if located species-specific management measures developed.

With these measures in place, a very low impact on Trailing Hop-bush in the site was predicted.

Other flora species of conservation significance

Basalt Leek-orchid, Basalt Peppercress, Button Wrinklewort, Clover Glycine, Matted Flax-lily, Pale Swamp Everlasting and Pretty Leek-orchid have similar habitat preferences, occurring on heavy clay soils associated with grassland or grassy woodland. While these species were not recorded during targeted surveys, they have the potential to occur within the Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland EVCs. Based on avoidance measures made during design, around 95% of these EVCs within the project site would be retained. Based on the avoidance measures of potential habitats for these species, a very low impact as a result of the project is predicted.

Curly Sedge, Dense Leek-orchid, Gorae Leek-orchid, Lacey River Buttercup, Maroon Leek-orchid, Purple Blown-grass, Slender Style-wort, Swamp Diuris, Swamp Fireweed and Swamp Flax-lily are known to occur in Plains Grassy Wetland EVC. While these species were not recorded during targeted surveys, potential habitat in Plains Grassy Wetlands occurs in the investigation area. Based on avoidance measures made during project design, 99.5% of Plains Grassy Wetland would not be impacted, likewise buffers around ephemeral wetlands and watercourses further reduce the risk of encountering these species in construction areas. Based on the avoidance measures of potential habitats for these species, a very low impact as a result of the project is predicted.

Birds

The assessment of potential impacts to Brolga is provided in Chapter 11 – *Brolga.*

The development of the project has the potential to impact the existing bird populations present in the project site through two impact pathways.

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. At this time, there would also be increased noise, vibration and lighting that has the potential to disrupting the behaviour of birds. Once operating, impacts to birds include bird death or injury from collisions with wind turbines, and indirect impacts from habitat disruption and displacement due to the presence of wind turbines.

The clearance of native vegetation was assessed as unlikely to have a material effect on local bird populations, with the scale of disturbance in any one location likely result in behaviour shifts or minor displacement of several individuals. Likewise, the construction disturbance is likely to have a temporary effect on a small number of individuals at any one point in time. The impact of project construction on the overall bird community within the site was assessed to be very low.

Post-construction monitoring of bird deaths from turbine collisions is now a typical condition of operating wind farms. This enables predictions about the likely impact to birds from the project by comparing operating wind farms in similar contexts.

During operation of the project there would be expected to be some bird deaths from collisions with wind turbines. Considering the bird community present within the site is represented by common and well represented species, the impact to the overall bird population (excluding threatened and species at risk) was assessed to be very low.

Migratory terrestrial birds

The Fork-tailed Swift often flies above 40 metres but has rarely been recorded colliding with wind turbines. In the unlikely event there are collisions with wind turbines the impact to the population estimated to be around 100,000 was assessed to be very low.

Collisions of White-throated Needletails in small numbers have been recorded at other operating wind farms (Appendix D – *Biodiversity*). If there were any mortality of the individuals from collisions with project wind turbines the impact to the population was assessed to be low.

Migratory shorebirds

The creation of the large Cockatoo Swamp turbine free buffer and other wetland buffers reduces the likelihood of collisions of these species with turbines. In the unlikely event there is mortality of the individual Sharp-tailed Sandpipers, Common Greenshanks, Curlew Sandpipers and Red-necked Stints from collisions with wind turbines the impact to these populations is likely to be very low.

As Latham's Snipe may occur in a wider variety of sites than other migratory shorebirds it could potentially be disturbed during construction of the watercourse crossing over Back Creek where it may roost in areas of dense vegetation. Given that limited numbers of Latham's Snipe are predicted to occur in the site, and the availability of other habitat both within and nearby the project site, the impact to the species was assessed to be very low.

Raptors

Based on monitoring of collisions at Macarthur Wind Farm and elsewhere, it is likely there would be instances of collision of these species with project wind turbines. In terms of overall impacts to the local populations of these species, each of these species is distributed widely across Australia and is not considered to be secure (i.e., not threatened). They also have larger ranges and dispersal abilities. As such, the overall effect of this mortality was assessed to be low.

The Black Falcon and Little Eagle (listed under the FFG Act as critically endangered and vulnerable, respectively) have the potential to occur occasionally at the project site, though these species were not recorded during field surveys. If an individual Black Falcon was to fly across the project site, there is potential to collide with a turbine due to its flight behaviour and collisions with this species is known to occur at other wind farms in south-eastern Australia. The Little Eagle occurs in a variety of habitats though shows a preference for woodland habitats. The species is known to fly at heights of wind turbines, which puts it at risk of collision. In the unlikely event there were to be a collision(s) of individuals of these species while moving through the landscape, it was predicted that these are unlikely to have a material impact on the population and a such a low impact was predicted.

Water birds

The creation of the large Cockatoo Swamp turbine free buffer and other wetland buffers reduces the likelihood of collisions of these species with turbines. In the unlikely event there is mortality of the individual(s) from collisions with wind turbines the impact to these populations is likely to be very low.

Bats

Based on on-site bat recording and comparing the results of post construction monitoring of bat deaths, it is likely there would be bat turbine collisions. Species most likely to be affected would be White-striped Freetail Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat and Little Forest Bat. Each of these species are common species that are widely distributed and considered to be secure (i.e., not threatened). Considering the bat activity in the site is lower compared to other areas, avoidance of treed and forested areas, and that the minimum blade tip is higher than most operating wind farms, the overall impact to bats (excluding threatened species) was assessed to be low.

Southern Bent-wing Bat

There have been eight reported deaths of the Southern Bent-wing Bat from collisions with wind turbines. As such there is a risk that individuals may collide with operating turbines. The *National Recovery Plan for the Southern Bent-wing Bat Miniopterus orianae bassanii* (DELWP, 2020c) states the impacts from wind farms on the population is unclear at this stage, though the risk increases the closer the wind farm is to a maternity site or migratory route. Risks mentioned in the plan include cave destruction during construction, mortalities due to collisions, and altered access to foraging areas. The plan notes a range of threats have been suggested as potential factors in this decline, including loss and modification of roosting and foraging habitat, human disturbance, pesticides, disease, drought and climate change affecting food availability. However, it also notes there is little empirical evidence to clearly identify the main cause/s of the current decline.

The project is not close to a significant roosting site for the Southern Bent-wing Bat. The site is also not a key foraging area for the species. Compared to ten other studies of bats, some of the lowest levels of Southern Bent-wing Bat activity was recorded at the project site despite the highest survey effort being conducted.

Based on the presence and activity of the Southern Bent-wing Bat, the behaviour of the species, and design measures to minimise the risk of collision, the likelihood of collisions with project wind turbines was assessed as to be very low. Notwithstanding, as the species is critically endangered any mortality is considered significant.

As part of a bird and bat adaptive management plan, a monitoring program to record bat collisions would be implemented. If mortality of the species is recorded, an appropriate response would be initiated, and reporting requirements outlined in the decision-making framework within Appendix D – *Biodiversity*. With these measures in place the impact to the Southern Bent-wing Bat was assessed to be low.

Yellow-bellied Sheathtail-bat

The Yellow-bellied Sheathtail-bat was identified from bat recording at nine sites with a very low frequency rate.

The Yellow-bellied Sheathtail-bat is potentially susceptible to collision with wind turbines in treed areas. The species has been recorded colliding with wind turbines interstate, further north in its range where it is more abundant (Appendix D – *Biodiversity*). However, analysis of post construction monitoring of bat deaths from turbine collisions at 15 Victorian wind farms between 2003 to February 2018 did not record any deaths of the species (Moloney et al., 2019).

While it is possible that Yellow-bellied Sheathtail-bats may collide with project wind turbines if they fly across the site, this is likely to be very infrequent. Given the very small number of calls recorded, despite considerable survey effort, and the fact that most calls were from habitat outside the proposed wind farm layout, it is considered unlikely the project would result in many (if any) collisions. In the unlikely event there is mortality of the individual(s) from collisions with wind turbines the impact to the population was assessed to be very low.

Grey-headed Flying-fox

It is considered unlikely the Grey-headed Flying-fox would visit the project site regularly if at all due to the lack of food resources that would attract the flying-fox to the area. Turbine free buffers of 215 metres have been incorporated into the design around treed areas to further mitigate potential collision risk. Therefore, the overall impact was assessed to be very low.

Frogs and reptiles

With the implementation of appropriate management measures, impacts to the overall frog and reptile assemblages (excluding threatened species) were assessed to be low.

Growling Grass Frog

While the project design generally avoids potential Growling Grass Frog habitat (and has removed six additional crossings from the concept design) there are two proposed crossings of potential movement corridors of Back Creek and the Shaw River. This is predicted to remove approximately 0.14 hectares of Growling Grass Frog habitat at the Back Creek crossing and 0.12 hectares of sub-optimal habitat at the Shaw River crossing. Crossings of the Moyne River have been avoided.

To limit the impact of proposed watercourse crossings a range of measures are proposed that would form a Growling Grass Frog Management Plan. These include completing pre-clearance surveys for the species, implementing a salvage and translocation protocol, installing temporary frog exclusion fencing at crossing points, reducing the construction footprint within mapped habitats, adopting recommended crossing designs by DELWP (2017c) to ensure habitat connectivity is maintained, and promptly restoring and enhancing affected areas. A range of further measures would be carried out as part of the Construction Environmental Management Plan to minimise impacts to these watercourses, which are also relevant to minimising impacts to the Growling Grass Frog. These are described in Chapter 10 – *Surface water*.

With the implementation of design and control measures, impacts to the Growling Grass Frog via physical disturbance of watercourse crossings were assessed to be localised (at crossing points), for a short duration. With rehabilitation re-instating habitat and maintaining connectivity, the impact on the population of the Growling Grass Frog was assessed to be low**.**

Striped Legless Lizard

A number of management controls are proposed to minimise potential impacts to the Striped Legless Lizard if the species is discovered, including inducting workers as to the importance of the species and distinguishing features, and ensuring that any individuals discovered during construction are reported. If a Striped Legless Lizard is found during construction works, a salvage and translocation protocol would be carried out. With these measures in place, impacts on the Striped Legless Lizard from the project were assessed to be very low.

Swamp Skink

No direct impacts on Swamp Skink were predicted due to the distance of project infrastructure to potential habitat. Hydrological changes to potential habitat as an indirect impact of project construction was also not considered as a credible impact pathway due to this habitat being upstream of the project. As such no impact to the Swamp Skink population was predicted.

Glossy Skink

With measures in place to avoid additional impacts on remanent vegetation, the overall impact to the Glossy Skink was assessed to be negligible, with effects contained within the project disturbance footprint unlikely to reduce the overall viability of the local population.

Aquatic ecology

Project construction disturbance at watercourse crossings would be localised (at crossing points), for a short duration with rehabilitation re-instating or improving these habitats and connectivity being maintained. The impact on the aquatic fauna populations (excluding threatened fish) was assessed to be low with any reductions on habitat quality predicted to be localised and temporary.

Little Galaxias

To minimise potential environmental impacts to Little Galaxias, Shaw River and Back Creek crossings have been minimised and crossing structures would be designed to maintain appropriate flow capacity, and to minimise the extent of disturbance and vegetation removal within the watercourse and the duration which construction activities take place. Appropriate sediment control structure would also be used to capture suspended solids and stream banks would also be promptly rehabilitated.

Construction activities would result physical disturbance to creek beds and associated aquatic habitats at two crossing points and resulting reduction in water quality (primarily increased suspended sediment) at these points. However, based on the ecology of the species, and the availability of refuge habitats the magnitude of construction impacts on the species was assessed as low.

During operations, the main potential impact pathway would be altered hydrological connectivity and drainage. This, however, is not predicted to occur on the basis that detailed designs would be informed by detailed hydrological modelling with hydrological connectivity maintained. As such a very low impact on the Little Galaxias was predicted to occur during operations.

Yarra Pygmy Perch

Construction activities would result physical disturbance to creek beds and associated aquatic habitats at two crossing points and resulting reduction in water quality (primarily increased suspended sediment) at these points in the Shaw River and Back Creek. Based on the ecology of the species, and the availability of refuge habitats the magnitude of construction, impacts on the species was assessed as low.

During operations, the only potential impact pathway would be due to altered hydrological connectivity and drainage. However, this is not predicted to occur on the basis that detailed designs will be informed by detailed hydrological modelling with hydrological connectivity maintained. As such a very low impact on the Yarra Pygmy Perch was predicted to occur during operations.

Hairy Burrowing Crayfish

No impacts on the species as a result of the project were predicted due to their absence from the project site.

12.7.6 Impact assessment summary

A summary of the biodiversity impact assessment is shown in Table 12.12 below, with the full assessment presented in Appendix D – *Biodiversity*. 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 12.12 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 and habitat	Vegetation clearance and physical disturbance as a result of project construction.	Construction	• Avoidance of 99.5% of native vegetation through design [BHD01]. • During detailed design, seek to micro-site infrastructure to native vegetation. • Secure necessary vegetation offsets (BH01). • Erect flagging, bunting or temporary fencing around areas of vegetation to be retained (BH02). • Clearly mark accessways to prevent establishment of secondary tracks and disturbance to native vegetation (BH02).	Construction of the project would result in the clearance of up to 4.6 hectares of EVCs and six large trees.	The area of native vegetation proposed to be cleared occurs in patches of relatively poor condition (average condition score of 21). This represents about 0.5% of native vegetation mapped within the project site. The overall impact of vegetation clearance was assessed to be **low** with effects contained within the project disturbance footprint unlikely to reduce the overall viability of these communities.
	Indirect degradation of native vegetation as a result of introducing or spreading weeds.	Construction	• Incorporate washdown stations at strategy locations (BH04). • Implementation of vehicle hygiene protocols and soil management and rehabilitation measures (BH04). • Monitor the condition of disturbed areas would be completed post-construction and remedial measures undertaken, as required (BH04).	Isolated weed outbreaks that could be readily managed from standard weed control measures.	With these measures implement the impact of introduction or spread of weeds and pathogens was assessed to be **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Seasonal Herbaceous Wetland of the Temperate Lowland Plain	Vegetation clearance and physical disturbance as a result of project construction. Potential modification hydrological drainage patterns or natural seasonal filling regime.	Construction	• Selectively avoiding mapped Plains Grassy Wetland [BHD01]. • Construction of roads and wind turbine foundations would be informed by hydrological flood modelling. • Infrastructure free buffers applied around all wetlands on the Victorian Wetland Inventory [SWD11].	The project is predicted to reduce the extent of Seasonal Herbaceous Wetland of the Temperate Lowland Plain ecological community by 0.49 hectares.	The majority of mapped areas of the ecological community have been avoided and 99% of Plains Grassy Wetland EVC has been avoided. With the implementation of these measures impacts to these communities and habitats were assessed to be **low.**
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Vegetation clearance and physical disturbance as a result of project construction. Indirect degradation of native vegetation as a result of introducing or spreading weeds.	Construction	• Erect flagging, bunting or temporary fencing around areas of vegetation to be retained. • Clearly mark accessways to prevent establishment of secondary tracks and disturbance to native vegetation.	Areas of the ecological community have been avoided through the design of the project.	No impacts to the ecological community are predicted.
Swamp Everlasting	Vegetation clearance and physical disturbance as a result of project construction.	Construction, operation	• Selectively avoiding mapped Plains Grassy Wetland [BHD01]. • Construction of roads and wind turbine foundations would be informed by hydrological flood modelling. • Infrastructure free buffers applied around wetlands on the Victorian Wetland Inventory [SWD11].	No direct impacts to Swamp Everlasting are predicted with known population of the species avoided. The project would remove 1.3 hectares of Plains Grassy Wetland that has the potential to provide habitat for Swamp Everlasting.	The known population of Swamp Everlasting within the project site has been avoided and 99% of Plains Grassy Wetland EVC would not be impacted by the project. With the implementation of these measures impacts to this species were assessed to be **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Trailing Hop-bush	Clearance of about 2 hectares of Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland, which provides potential habitat for the species.	Construction	• Avoidance of Trailing Hop-bush [BHD01]. • The known population would clearly be marked and signed as a no-go area (BH02).	No direct impacts to Trailing Hop-bush are predicted with known population of the species avoided.	The known population of Trailing Hop-bush within the project site has been avoided and 95% of EVCs with the potential to provide habitat for the species were also avoided. With the implementation of these measures impacts to this species were assessed to be **very low**.
Basalt Leek-orchid, Basalt Peppercress, Button Wrinklewort, Clover Glycine, Matted Flax-lily, Pale Swamp Everlasting and Pretty Leek-orchid	Clearance of about 2 hectares of Heavier-soils Plains Grassland, Higher-rainfall Plains Grassy Woodland and Basalt Shrubby Woodland, which have the potential to provide habitat for these species.	Construction	• Avoidance measures resulted in around 95% of EVCs with the potential to provide habitat for these species would be retained [BHD01].	No direct impacts to these species predicted with no known population of the species recorded despite targeted surveys.	Despite targeted surveys no known populations of these species were recorded. A small area of low-quality native vegetation with the possibility to provide habitat for these species would be impacted. With measures in place to avoid potential habitat degradation, a **very low** impact to these currently unknown populations is predicted.
Curly Sedge, Dense Leek-orchid, Gorae Leek-orchid, Lacey River Buttercup, Maroon Leek-orchid, Purple Blown-grass, Slender Style-wort, Swamp Diuris, Swamp Fireweed and Swamp Flax-lily	Clearance of 1.3 hectares of Plains Grassy Wetland, which has the potential to provide habitat for these species.	Construction	• Selectively avoiding mapped Plains Grassy Wetland [BHD01]. • Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology. • Infrastructure free buffers applied around wetlands on the Victorian Wetland Inventory [SWD11].	No direct impacts to these species predicted with no known population of the species recorded despite targeted surveys. About 1.3 hectares of Plains Grassy Wetland with the potential to provide habitat for the species is proposed to be cleared.	Despite targeted surveys no known populations of these species were recorded. A small area of low-quality native vegetation with the possibility to provide habitat for these species would be impacted. With measures in place to avoid potential habitat degradation (e.g., via altered hydrology), a **very low** impact to these currently unknown populations is predicted.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Bird community	Direct habitat loss and disturbance from project construction	Construction	• Avoidance of 99.5% of native vegetation through design [BHD01]. • During detailed design, seek to micro-site infrastructure to native vegetation Secure necessary vegetation offsets (BH01). • Erect flagging, bunting or temporary fencing around areas of vegetation to be retained (BH02). • Clearly mark accessways to prevent establishment of secondary tracks and disturbance to native vegetation (BH02).	The scale of disturbance in any one location likely to be limited to temporarily altered behaviour of resident birds or minor displacement of several individuals. Likewise, the construction disturbance is likely to have a temporary effect on a small number of individuals at any one point in time.	Construction works were assessed to be unlikely to have a material effect on local bird populations and therefore a **very low** impact was predicted.
	Collision or interaction with wind turbines.	Operation	• Selectively place wind turbines in areas of treeless agricultural land [BHD01]. • Maintain a minimum blade tip height of 40 metres [BHD04].	Predicted to be approximately three to seven bird deaths per turbine per year. This is predicted to reduce the abundance of local populations of the Eurasian Skylark, Sulphur-crested Cockatoo, Little Raven, Magpie, Nankeen Kestrel and Brown Falcon.	Considering the bird community present within the project site is represented by common and well represented species, the impact to the overall bird population was assessed to be **very low**.
Migratory terrestrial birds: Fork-tailed Swift and White-throated Needletail	Collision or interaction with wind turbines.	Operation	• Maintain a minimum blade tip height of 40 metres [BHD04]. • Avoidance of forested areas for locating wind turbine locations [BHD01].	The Fork-tailed Swift was recorded during surveys in low numbers. The species often flies above 40 metres but has rarely recorded colliding with wind turbines. Collisions of White-throated Needletails in small numbers have been recorded at other operating wind farms, therefore there is a risk that any individuals occurring in the site could collide. The collision of a small number of individuals is not expected to lead to a long-term decrease in the size of the local population.	In the unlikely event there are collisions with wind turbines the impact to the population of Fork-tailed Swift was assessed to be **very low**. No White-throated Needletails were observed during field surveys and the site lacks areas of forested vegetation, their preferred foraging habitat. If there were any collisions of White-throated Needletail with project wind turbines the impact to the population was assessed to be **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Migratory shorebirds: Sharp-tailed Sandpiper, Common Greenshank, Curlew Sandpiper and Red-necked Stint	Collision or interaction with wind turbines.	Operation	• The creation of the large Cockatoo Swamp turbine free buffer and other wetland buffer. • Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology [SW01]. • Maintain a minimum blade tip height of 40 metres [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bird collisions, would be carried out (BH05).	Collision or interaction with wind turbines is not predicted to be likely, but due to the potential presence of a small number of these migratory shorebird species the hazard exists.	In the unlikely event there is mortality of the individual Sharp-tailed Sandpipers, Common Greenshanks, Curlew Sandpipers and Red-necked Stints from collisions with wind turbines the impact to these populations is likely to be **very low**.
Latham's Snipe	Collision or interaction with wind turbines.	Operation	• The creation of the large Cockatoo Swamp turbine free buffer and other wetland buffers. • Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology [SW01]. • Maintain a minimum blade tip height of 40 metres [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bird collisions, would be carried out (BH05).	As Latham's Snipe may occur in a wider variety of sites than other migratory shorebirds it could potentially be disturbed during construction of watercourse crossings where it may roost in areas of dense vegetation.	Given that limited numbers of Latham's Snipe are predicted to occur in the site, and the availability of other habitat both within and nearby the project site, the impact to the species was assessed to be **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Raptors	Collision or interaction with wind turbines.	Operation	• Selectively place wind turbines in areas of treeless agricultural land [BHD01]. • Maintain a minimum blade tip height of 40 metres [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bird collisions, would be carried out (BH05).	Raptors were recorded at very low rates during surveys representing 2 to 4% of all observations and even lower rates of those individuals being recorded in the rotor swept area. It is likely there would be instances of collision of these species with project wind turbines.	In terms of overall impacts to the local populations of these raptor species, each of these species is distributed widely across Australia and is not considered to be secure (i.e., not threatened). They also have larger ranges and dispersal abilities. The overall effect of this mortality was assessed to be **low**.
Black Falcon and Little Eagle	Collision or interaction with wind turbines.	Operation	• Selectively place wind turbines in areas of treeless agricultural land [BHD01]. • Maintain a minimum blade tip height of 40 metres [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bird collisions, would be carried out (BH05).	The Black Falcon and Little Eagle have the potential to occur in the project site occasionally, although not being recorded during surveys and are rare regionally.	In the unlikely event there were to be a collision(s) of individuals of these species while moving through the landscape, these are not predicted to have a material impact on the population and a such a **low** impact is predicted.
Water birds	Collision or interaction with wind turbines.	Operation	• The creation of the large Cockatoo Swamp turbine free buffer and other wetland buffers. • Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology (SW01). • Maintain a minimum blade tip height of 40 metres [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bird collisions, would be carried out (BH05).	Collision or interaction of water birds with wind turbines is not predicted to be likely, but due to the potential presence of a small number of these species the hazard exists.	In the unlikely event there is mortality of water bird individual(s) from collisions with wind turbines the impact to these populations is likely to be **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Bat community	Collision or interaction with wind turbines.	Operation	• Selectively place wind turbines in areas of treeless agricultural land [BHD01]. • Maintain a minimum blade tip height of 40 metres [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bird collisions, would be carried out (BH05).	It is likely there would be bat turbine collisions of the White-striped Freetail Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Large Forest Bat and Little Forest Bat with operating turbine blades. These may reduce the local population of each of these species, which are widely distributed and considered to be secure (i.e., not threatened).	Considering the bat activity in the project site is lower compared to other areas, the avoidance of treed and forested areas for turbine placement and the minimum blade tip is higher than most operating wind farms, the overall impact to bats (excluding threatened species) was assessed to be **low**.
Southern Bent-wing Bat	Collision or interaction with wind turbines.	Operation	• Placing turbines at least 215 metres away (inclusive of blade) from remnant and planted treed vegetation [BHD03]. • Restricting the minimum height of turbine blades to above 40 metres from the ground [BHD04]. • Implementing a bird and bat adaptive management plan, a monitoring program to record bat collisions would be carried out (BH05).	Based on the presence and activity of the Southern Bent-wing Bat, the behaviour of the species, and design measures to minimise the risk of collision, the likelihood of collisions with project wind turbines was assessed to be very low.	As Southern Bent-wing Bat is critically endangered, any mortality is considered significant. With the design and adaptive management plan in place, the impact to this species was assessed to be **low**.
Yellow-bellied Sheathtail-bat	Collision or interaction with wind turbines	Operation	• Placing turbines at least 215 metres away (inclusive of blade) from remnant and planted treed vegetation [BHD03]. • Restricting the minimum height of turbine blades to above 40 metres from the ground [BHD04]. • a bird and bat adaptive management plan, a monitoring program to record bat collisions would be carried out (BH05).	There is the possibility that Yellow-bellied Sheathtail-bat could collide with project wind turbines if they fly across the site, but any such movements are predicted to be infrequent. Given the very small number of calls recorded, despite considerable survey effort, and the fact that most calls were from habitat outside the proposed wind farm layout, it is considered unlikely the project would result in many (if any) collisions.	In the unlikely event there is mortality of Yellow-bellied Sheathtail-bat individual(s) from collisions with wind turbines, the impact to the population was assessed to be **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Grey-headed Flying-fox	Collision or interaction with wind turbines.	Operation	• Placing turbines at least 215 metres away (inclusive of blade) from remnant and planted treed vegetation [BHD03]. • Restricting the minimum height of turbine blades to above 40 metres from the ground [BHD04]. • Implement a bird and bat adaptive management plan, a monitoring program to record bat collisions, would be carried out (BH05).	While not recorded during surveys for the project, the Grey-headed Flying-fox has the potential to occasionally fly over the project site. In the unlikely event there is mortality of the individual(s) from collisions with wind turbines such an instance was assessed to be unlikely to lead to a long-term decrease in the size of an important population of a species.	It is unlikely Grey-headed Flying-fox would visit the project site regularly if at all due to the lack of food resources that would attract this species to the area. In the unlikely event there is mortality of the individual(s) from collisions with wind turbines, the impact to the population was assessed to be **very low**.
Overall frog and reptile assemblages	Direct habitat loss and disturbance from project construction.	Construction	• Avoidance of 99.5% of native vegetation through design. • Project infrastructure has been sited more than 100 metres from watercourses, except for required watercourse crossings. • Revegetate temporarily disturbed areas in accordance with the rehabilitation sub-plan (BH03).	Localised areas of vegetation clearance and physical disturbance has the potential to impact local populations of frogs and reptiles.	With the implementation of appropriate management measures, impacts to the overall frog and reptile assemblages (excluding threatened species) was assessed to be **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Growling Grass Frog	Physical disturbance of habitat and associated reduced water quality at watercourse crossings. Constructing crossings through habitat can create barriers that pose a risk to connectivity with nearby populations.	Construction	• Conduct pre-clearance surveys for the species (BH11). • Implementing a salvage and translocation protocol, if necessary (BH11). • Installing temporary frog exclusion fencing at crossing points (BH1). • Reducing the construction footprint within mapped habitats, adopting recommended crossing designs by DELWP (2017c) to ensure habitat connectivity is maintained, and promptly restoring and enhancing affected areas (BH11). • Project infrastructure would be located more than 100 metres from potential Growling Grass Frog habitat, except for several waterway crossings [BHD02]. • Revegetate temporarily disturbed areas in accordance with the rehabilitation sub-plan (BH03).	Two creek crossings for cables and access tracks would impact around 0.2 hectares of potential Growling Grass Frog habitat. Impacts to the local Growling Grass Frog population via physical disturbance of watercourse crossings were assessed to be localised (mainly at crossing points) for a short duration, with rehabilitation re-instating habitat and maintaining connectivity. Watercourse crossing were assessed to be unlikely to result in a long-term decrease in the size of the local population of the species or to fragment an existing population of Growling Grass Frog.	With the implementation of design and control measures, impacts to the Growling Grass Frog via physical disturbance of watercourse crossings were assessed to be localised (mainly at crossing points), for a short duration, with rehabilitation re-instating habitat. The impact on the population of the Growling Grass Frog was assessed to be **low**.
Striped Legless Lizard	Physical disturbance of habitat.	Construction	• If the species is unexpectedly discovered including implementing a salvage and translocation protocol would be implemented (BH12). • If a Striped Legless Lizard is found during construction works, a salvage and translocation protocol would be carried out (BH12).	Despite conducting targeted surveys in 2009 or 2018, no Striped Legless Lizards have been recorded. Based on the long history of agricultural land use of the site, habitats are unlikely to support a significant population of the species (if any at all). Therefore, there is a low likelihood that the site supports an important population of the species.	With management controls in place, impacts on the Striped Legless Lizard were assessed to be **very low.**

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Swamp Skink	Altered hydrology resulting in degradation of potential habitat.	Construction, operation	• Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology [SW01].	No direct impacts on Swamp Skink were predicted due to the distance of project infrastructure to potential habitat. Hydrological changes to potential habitat as an indirect impact of project construction was also not considered as a credible impact pathway due to this habitat being upstream of the project.	No impact to the Swamp Skink population was predicted.
Glossy Skink	Physical disturbance of habitat.	Construction	• Avoidance of 99.5% of native vegetation through design [BHD01]. • During detailed design, seek to micro-site infrastructure to native vegetation Secure necessary vegetation offsets (BH01). • Erect flagging, bunting or temporary fencing around areas of vegetation to be retained (BH01). • Clearly mark accessways to prevent establishment of secondary tracks and disturbance to native vegetation (BH01).	Construction of the project would result in the clearance of up to 4.6 hectares of native vegetation in patches of relatively poor condition. Therefore, the magnitude of potential habitat loss for the Glossy Skink is predicted to be limited.	With measures in place to avoid additional impacts on remanent vegetation, the overall impact to the Glossy Skink was assessed to be **negligible**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Aquatic fauna (general)	Physical disturbance to watercourses and associated aquatic habitats at crossing points and/or reduced water quality in the immediate vicinity of construction activities.	Construction	• The number of watercourse crossings was minimised (including the removal of three crossings in the conceptual design). • Project infrastructure has been sited more than 100 metres from watercourses, except for required watercourse crossings [SWD12]. • Crossings structures would be designed to maintain appropriate flow capacity, and to minimise the extent of disturbance and vegetation removal within the watercourse and the duration which construction activities take place [SWD04]. • Appropriate sediment control structure would also be used to capture suspended solids. Stream banks would also be promptly rehabilitated [SW04].	Physical disturbance to watercourses and associated aquatic habitats at crossing points with associated temporary increase in sedimentation. Likely impacts to aquatic fauna (excluding threatened fish species) are predicted to be localised and temporary.	Project construction disturbance at watercourse crossings would be localised (at crossing points), for a short duration, with rehabilitation re-instating or improving these habitats and connectivity being maintained.
Little Galaxias	Physical disturbance to watercourses and associated aquatic habitats at crossing points of Back Creek and to a lesser extent Shaw River for accessways and cables.	Construction	• Use of fish friendly culverts for the Shaw River and Back Creek crossings (BH13). • Micro-siting access tracks and cable crossings to avoid deeper pools of water (BH13). • Limiting the construction workspace for watercourse crossings over potential habitat for the species (BH13). • Reinstating crossings such that bank stability at the crossing location is the same or better condition (BH13).	The main impact to Little Galaxias was predicted to be physical disturbance to aquatic habitats at watercourse crossing points, primarily for the Back Creek and to a lesser extent Shaw River. These crossings would be expected to temporarily increase sedimentation from construction at the watercourse crossing locations.	Based on the predicted level of impact, it is unlikely that the project would lead to a long-term decrease in the size of a population of Little Galaxias and therefore a **low** impact was predicted during construction.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Altered hydrology resulting in degradation of potential habitat or reduced habitat connectivity.	Operation	• Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology (SW01). • During the detailed design, each watercourse crossing would be designed to accommodate the required design capacity, based on peak velocity and depth estimates predicted by hydrological modelling designs (SWD04). • Use of fish friendly culverts for the Shaw River and Back Creek crossings (BH13).	With design and management controls in place the project would be unlikely to alter the hydrology of the Back Creek and Shaw River catchments. Any changes to run-off likely to be localised around wind turbines and other infrastructure components and unlikely to alter the overall dynamics of the catchment.	Impacts to Little Galaxias as a result of altered hydrology were assessed to be of **very low**.
Yarra Pygmy Perch	Physical disturbance to watercourses and associated aquatic habitats at crossing points of Back Creek and to a lesser extent Shaw River for accessways and cables.	Construction	• Use of fish friendly culverts for the Shaw River and Back Creek crossings (BH13). • Micro-siting access tracks and cable crossings to avoid deeper pools of water (BH13). • Limiting the construction workspace for these watercourse crossings (BH13). • Reinstating crossings such that bank stability at the crossing location is the same or better condition (BH13).	Yarra Pygmy Perch are assumed to be present in the Shaw River (and upstream tributary of the Kangaroo Creek), Back Creek and the Moyne River. The main impact was predicted to be physical disturbance to aquatic habitats at watercourse crossing points, primarily for Back Creek and to a lesser extent Shaw River. These crossings would be expected to temporarily increase sedimentation from construction at the watercourse crossing locations.	Based on the predicted level of impact, it is unlikely that the project would lead to a long-term decrease in the size of a population of Yarra Pygmy Perch and therefore a **low** impact was predicted during construction.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Altered hydrology resulting in degradation of potential habitat or reduced habitat connectivity.	Operation	• Construction of roads and wind turbine foundations would be informed by hydrological flood modelling to maintain existing hydrology (SW01). • During the detailed design, each watercourse crossing would be designed to accommodate the required design capacity, based on peak velocity and depth estimates predicted by hydrological modelling designs (SWD04). • Use of fish friendly culverts for the Shaw River and Back Creek crossings (BH13).	With design and management controls in place the project would be unlikely to alter the hydrology of the Back Creek and Shaw River catchments. Any changes to run-off likely to be localised around wind turbines and other infrastructure component and unlikely to alter the overall dynamics of the catchment.	Impacts to Yarra Pygmy Perch as a result of altered hydrology were assessed to be of **very low**.

12.8 Conclusion

The project site has been used for sheep and cattle farming for more than 100 years and the majority of the site is comprised of introduced and planted vegetation. Fragmented areas of nine native EVCs were mapped within or near the project site. The project is estimated to result in the removal of 4.6 hectares of native vegetation and six large trees.

Two nationally listed threatened ecological communities were identified during field surveys, both listed as 'critically endangered'. These are the Grassy Eucalypt Woodland of the Victorian Volcanic Plain and Seasonal Herbaceous Wetland of the Temperate Low Plain. Avoidance has been the primary measure to mitigate potential impacts and as a result no impacts on Grassy Eucalypt Woodland of the Victorian Volcanic Plain were predicted, while clearance of 0.49 hectares Seasonal Herbaceous Wetland of the Temperate Low Plain was assessed to have a low residual impact.

Two plant species of conservation significance were recorded during field surveys: Swamp Everlasting and Trailing Hop-bush. The known populations of these species were avoided during the project design, as well as most areas that provide potential habitat for these species. Impacts to other threatened flora that have the potential to occur in the project site were minimised. As such, a very low impact on threatened flora because of the project was predicted.

A range fauna species listed as threatened or migratory under the EPBC Act and/or FFG Act either reside within or have the potential to use the project site. These include several migratory bird species, three bat species (including the Southern Bent-wing Bat) and a number of aquatic and semi-aquatic species including the Growling Grass Frog, Little Galaxias (formally Dwarf Galaxias) and Yarra Pygmy Perch. Given the relatively poor condition of the vegetation and habitat, and the small amount of predicted disturbance in any one location, construction impacts to these species were assessed to be either very low or low (depending on the species).

During the operation of wind farms, some birds and bats are known to collide with turbine blades. Some species are more susceptible based on their flying behaviour, for example, high flying species and those that are less manoeuvrable. The project has developed a range of measures to mitigate potential impacts to fauna populations, including creating habitat buffers to minimise disturbance and committing to having a minimum turbine blade height of 40 metres to minimise potential collision risk with birds and bats.

Due to their possible presence at the project site, there is a risk that Southern Bent-wing Bats may collide with operating turbines. Based on the activity of the Southern Bent-wing Bat on the site, the behaviour of the species, and design measures to minimise the risk of collision, the likelihood of collisions with project wind turbines was assessed to be very low. As the species is critically endangered, any mortality is considered significant. As part of a bird and bat and avifauna adaptive management plan, a monitoring program to record bat collisions would be implemented. If mortality of the species is recorded, defined trigger responses would be executed. With these measures in place, the impact to the Southern Bent-wing Bat was assessed to be low.