regional roads victoria

9 Biodiversity and habitat

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CONTENTS (Continued)

Tables

Figures

9.1 Overview

This chapter provides an overview of the potential impacts to biodiversity and habitat associated with the construction and operation of the project, and proposed mitigation measures to manage these impacts. This chapter has been informed by the flora and fauna impact assessment provided in EES Appendix C: *Flora and fauna impact assessment*, as well as the relevant findings from EES Appendix L: *Surface water impact assessment* and EES Appendix H: *Noise and vibration impact assessment*.

The flora and fauna survey design was based on relevant State and Commonwealth survey guidelines and best practice methods, as detailed in EES Appendix C: *Flora and fauna impact assessment*.

Targeted threatened flora surveys were undertaken over a number of visits to maximise the detection of a range of species. These surveys were undertaken for threatened plant species that were assessed as having a moderate or greater likelihood of occurrence, based on known distributions and habitat types present within the study area. The threatened vegetation surveys targeted communities listed under the EPBC Act and *Flora and Fauna Guarantee Act 1988* (FFG Act) considered to be possibly present within the study area.

Habitat hectare assessments were completed to determine the condition of native vegetation in the context of the local area and the relevant bioregions.

Field surveys for threatened fauna species were undertaken between November 2016 and March 2021, using a suite of methods specific to each of the targeted species. Only species with a moderate or high likelihood of occurrence were targeted during the surveys. These species included Growling Grass Frog, Brown's Toadlet, waterfowl and other waterbirds (e.g. Brolga, Eastern Great Egret), Brush-tailed Phascogale, Golden Sun Moth and Striped Legless Lizard.

The flora and fauna surveys allowed RRV to gain an understanding of the biodiversity and habitat values within the study area and enabled the assessment of potential impacts the project poses to those values. These assessments included the potential 'indirect' impacts on fauna behaviour from noise, vibration and lighting.

Construction of the project will require the removal of approximately 47.95 ha of vegetation and habitat, which includes 32.8 ha of FFG Act listed Victorian Temperate Woodland Bird Community and 0.312 ha of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains. Up to 348 large trees (both in patches and scattered) and 7 small scattered trees have the potential to be impacted by the project. The total number of trees lost will be assessed during the detailed design phase through an arborist assessment..

The project is expected to impact habitat for significant flora species, however, impacts to these species are considered to be low with the implementation of recommended mitigation measures.

The impact from the construction and operation of the project is not considered to be significant for all fauna species except Golden Sun Moth, where the project will require the removal of 1.672 ha of confirmed habitat and 9.431 ha of high potential habitat. The appropriate offsets for this species will be identified and secured in the next phase of the project once the detailed design is confirmed.

9.2 EES objectives

The evaluation objective set in the *Scoping Requirements for Beaufort Bypass Environment Effects Statement* (DELWP 2016) relevant to the biodiversity and habitat assessment is:

> ***Biodiversity:*** *To avoid and minimise adverse effects on native vegetation, as well as habitat for threatened flora and fauna species and ecological communities, including those listed under the FFG Act, and address the offset requirements for predicted losses consistent with relevant policy.*

This chapter discusses the key issues identified in the scoping requirements relevant to biodiversity and habitat and outlined in Table 9.1 below.

Table 9.1 EES key issues – Biodiversity and habitat

Key issues
Loss or degradation of native vegetation and habitat for threatened species and communities, including those listed under the FFG Act and DELWP Advisory List.
Degradation to local and downstream ecology of aquatic environments.
The impact of the road bypass on wildlife movement within continuous vegetation linkages.

Specific aspects to be addressed were also detailed in the scoping requirements. These are detailed in Table 9.2 below.

Table 9.2 EES requirements – Biodiversity and habitat

EES requirements
Priorities for characterising the existing environment
Characterise the distribution and quality of biodiversity values that could be affected by the proposed project, including remnant native vegetation, large old trees, terrestrial and aquatic habitat for threatened species and patterns of wildlife movement in the area.
Accurately identify remnant vegetation on private and public road reserves using the current definition of native vegetation as outlined in the Victorian Native Vegetation Clearing Guidelines.
Identify the existence or likely existence of any threatened species or communities listed under the FFG Act and DELWP Advisory List.
Identify any potentially threatening processes that could result from the proposed project under the FFG Act and any declared weeds or pathogens.
This characterisation is to be informed by relevant databases, literature and appropriate seasonal or targeted surveys. In the absence of positive identification of listed species, but where suitable habitat is identified, a precautionary approach to the further investigation of their occurrence should be applied, where practicable.
Design and mitigation measures
Identify potential and proposed alignment and design alternatives, as well as mitigation measures which could avoid or minimise significant effects on biodiversity values, including native vegetation, large old trees and any listed threatened ecological communities or flora and fauna species.
Assessment of the expected or predicted effectiveness of mitigation measures, within the proposed alignment, any statutory or policy basis for the mitigation measures, the proponent's ability to implement these measures as well as monitoring and auditing of effectiveness of the proposed mitigation measures.
Assessment of the cumulative effect on biodiversity values and extent of remaining remnant vegetation on a regional scale and the effectiveness of the proposed mitigation measures in addressing regional ecological effects.

EES requirements
Identify mitigation measures to avoid or reduce negative impacts on the environment including wildlife movement and connectivity (e.g. suitable fencing and overhead or under-road wildlife crossings including in relation to bridges for waterway crossings).
Assessment of likely effects
Assess the likely direct and indirect effects of each alignment alternative on wildlife movement and biodiversity values, including native vegetation, large old trees, listed threatened flora and fauna species and ecological communities, including those listed under the FFG Act and DELWP Advisory List.
Approach to manage performance
Identify proposed offset measures to address requirements for alternatives that may be implemented, in accordance with the *Permitted Clearing of Native Vegetation Biodiversity Assessment Guidelines* (2013) (updated to the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017)) and the relevant requirements of the Pyrenees Planning Scheme.
Provide an offset strategy to address these requirements for the final alignment options examined in the EES, to identify feasibility and availability of offsets.
Identify any additional, proposed measures to manage residual effects on biodiversity values during construction of the proposed project, as part of the Environmental Management Framework.
Commit to undertake appropriate management plans.

9.3 Legislation and policy

The relevant legislation and government policies related to biodiversity and habitat are outlined in Table 9.3.

Table 9.3 Relevant legislation and government policies

Legislation / policy	Description	Relevance to project
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999	The EPBC Act is the Commonwealth Government's central piece of environmental legislation, and applies to all Australian territory and waters. Under the EPBC Act, Commonwealth Government approval is required where an action is likely to have a significant impact on defined Matters of National Environmental Significance. There are nine Matters of National Environmental Significance to which the EPBC Act applies. These are: • world heritage sites • national heritage places • wetlands of international importance (often called 'Ramsar' wetlands after the international treaty under which such wetlands are listed) • nationally threatened species and ecological communities • migratory species • Commonwealth marine areas • nuclear actions • the Great Barrier Reef Marine Park • a water resource, in relation to coal seam gas development and large coal mining development. A 'significant impact' is defined under the EPBC Act as '*an impact that is important, notable, or of consequence, having regard to its context or intensity*'. If a project is likely to have a significant impact on one of the nine Matters of National Environmental Significance, the 'action' must be referred to the Commonwealth Department Agriculture, Water and the Environment. This 'referral' is then released to the public for comment.	At least two out of the nine matters are relevant to the study area. This includes nationally threatened species and ecological communities and migratory species. An EPBC Act referral for the project was submitted to the Commonwealth Minister for the Environment, who has deemed the project a controlled action to be assessed under a State accredited assessment process (EES).
State		
Environment Effects Act 1978	Under the *Environment Effects Act 1978*, projects that could have a 'significant effect' on Victoria's environment can potentially require an EES. This Act applies to any public works '*reasonably considered to have or be capable of having a significant effect on the environment*'. The Minister for Planning is the responsible person for assessing whether this Act applies.	On 22 July 2015, the Minister for Planning determined that an EES would be required under the *Environment Effects Act 1978* to assess the potential environmental effects of a project to select a bypass alignment from a number of alternatives. The EES allows stakeholders to understand the likely environmental effects of the alternative alignments and how they would be managed in the next construction phase of the proposal.

Legislation / policy	Description	Relevance to project
Flora and Fauna Guarantee Act 1988	The FFG Act was established to provide a legal framework for enabling and promoting the conservation of all Victoria's native flora and fauna, and to enable management of potentially threatening processes. One of the main features of the FFG Act is the listing process, where native species and communities of flora and fauna, and the processes that threaten native flora and fauna, are listed in the schedules of the FFG Act. This assists in identifying those species and communities that require management to survive, and identifies the processes that require management to minimise the threat to native flora and fauna species and communities within Victoria. A permit from DELWP is required to 'take' listed flora species that are 'protected flora' from public land. A permit is not required under the FFG Act for private land, unless listed species are present and the land is declared 'critical habitat' for the species. Protected flora are all listed species, species which belong to listed communities, and other species which have been included on the protected flora list, managed by the DELWP.	A total of seven fauna species currently listed under the FFG Act were recorded during surveys completed for the study area. A permit to 'take' protected flora will be required the project under the FFG Act. Specifically, a permit under the FFG Act will be required for the removal of one Matted Flax-lily plant, which occurs on public land along Back Raglan Road. Additionally, the removal of any non-threatened flora on the protected flora list, or any members of the FFG Act-listed community Victorian Temperate Woodland Bird Community that occurs on public land, will require a permit under the FFG Act. Reform under the FFG Act through the *Flora and Fauna Amendment Act 2019* will elicit changes to the listed species under FFG Act protection. The construction phase of the project will need to consider the FFG listing advice of the day.
Guidelines for the removal, destruction or lopping of native vegetation	The *Guidelines for the Removal, Destruction or Lopping of Native Vegetation* (DELWP 2017)have been designed to manage the risk to Victoria's biodiversity associated with the removal of native vegetation. The assessment pathways are classified as: • **Basic:** limited impacts to biodiversity • **Intermediate:** could impact on large trees, endangered Ecological Vegetation Classes and/or sensitive wetlands or coastal areas • **Detailed:** could impact large trees, endangered Ecological Vegetation Classes, sensitive wetlands and coastal areas and could significantly impact on habitat for rare and threatened species. The assessment pathway is determined by the extent and location of the impacts. All locations within Victoria are classified as following: • **Location 3:** includes locations where the removal of less than 0.5 ha of native vegetation could have a significant impact on habitat for a rare or threatened species • **Location 2:** includes locations that are mapped as endangered Ecological Vegetation Classes and/or sensitive wetlands and coastal areas that are not included in Location 3 • **Location 1:** includes all remaining locations.	The project will require a 'Detailed Assessment Pathway' due to the amount of native vegetation that is proposed for removal (i.e. more than 0.5 ha of native vegetation in all location categories to be removed). Assessment of the project against the application requirements for a permit to remove native vegetation, as outlined in the *Guidelines for the removal, destruction or lopping of native vegetation* , is provided in Section 9.9.1.

Legislation / policy	Description	Relevance to project
Wildlife Act 1975	The *Wildlife Act 1975* is the primary legislation in Victoria for the protection of wildlife. The *Wildlife Act 1975* requires that wildlife research (including fauna salvage and translocation) is regulated through a permit system, which is managed by DELWP. Section 42 of the Wildlife Regulations 2013 states that a person must not damage, disturb or destroy any wildlife habitat unless that person is authorised to damage, disturb or destroy wildlife habitat under any Act.	Destruction of wildlife habitat for this project will be approved through the *Planning and Environment Act 1987*. As such, the project would be exempt from Section 42. Any persons involved in any proposed fauna removal, salvage, capture or relocation of fauna during mitigation measures must hold a current Management Authorisation under the *Wildlife Act 1975*.
Catchment and Land Protection Act 1994	The *Catchment and Land Protection Act 1994* is the principal legislation relating to the management and protection of water catchments in Victoria. It provides for regional authorities, in this instance the Glenelg Hopkins Catchment Management Authority, and requires development not to contribute to land degradation through earthworks, or the introduction of pest animals or weeds. Weeds declared as noxious under the *Catchment and Land Protection Act 1994* are known to or have the potential to result in detrimental environmental and/or economic impact.	The project will likely cross some of the locations of some *Catchment and Land Protection Act 1994* weeds and as such, will need to limit the spread of these weeds and seek appropriate permits if declared weeds are to be transported from site.
Planning and Environment Act 1987	The *Planning and Environment Act 1987* sets out the assessment, processes and procedures for the use and development of land (including land covered by water), as outlined in the Victoria Planning Provisions and relevant Planning Schemes. Planning Schemes have a number of approval requirements, including planning permits for use and development of land use activities. The project is within the Pyrenees municipality and therefore the Pyrenees Planning Scheme applies to the project. Clause 12: Environment and Landscape Values of the Pyrenees Planning Scheme provides for consideration of the impacts of land use and development in terms of the protection and conservation of biodiversity, waterways and landscapes. Land use and development should avoid impacting on important areas of biodiversity, and ensure there is no net loss to biodiversity as a result of native vegetation clearance, including consideration of cumulative impacts, fragmentation of habitat, and the spread of pests into the environment (Clauses 12.01-1S Protection of Biodiversity and 12.01-2S Native Vegetation Management).	The potential for the project to impact on biodiversity values, including native vegetation removal and potential impacts on threatened fauna (including habitat connectivity and ecological communities) has been assessed in EES Appendix C: *Flora and fauna impact assessment*. This is considered reflect the objectives of Clauses 12.01-1S Protection of Biodiversity and 12.01-2S Native Vegetation Management of the Pyrenees Planning Scheme.

9.4 Methodology

The methodology used in the assessment of potential flora and fauna impacts on the construction and operation of the project were developed in consultation with RRV, DELWP, the National Herbarium of Victoria and the Commonwealth Department of Agriculture, Water and Environment (formerly the Department of the Environment and Energy). The flora and fauna survey design was based on relevant State and Commonwealth survey guidelines and best practice methods, as detailed in EES Appendix C: *Flora and fauna impact assessment*.

Survey methods

- **Random meander:** a technique involves targeting a particular (or several) threatened plant species and traversing areas of suitable habitat in no set pattern
- **Parallel line traverses:** traverses across suitable habitat using set distances apart.
- **Stratified meander:** combines traversing suitable habitat using a timed meander within a stratified grid-cell survey design.
- **Parallel line traverses:** traverses across suitable habitat using set distances apart.

The assessment included:

- a literature and database review to determine the ecological values and potential constraints
- extensive field work to ground-truth the findings of the literature and database review
- a review of the risk posed to the environment by the project to focus the assessment of impacts
- assessment of the potential impacts to native vegetation, threatened ecological communities, significant flora and fauna species, connectivity and cumulative impacts from the project
- identification and development of mitigation measures to manage potential impacts
- assessment of the residual impacts to native vegetation, threatened ecological communities, significant flora and fauna species, connectivity and cumulative impacts
- significant impact assessments for Matters of National Environmental Significance from the project.

Further details of the methodology undertaken for the flora and fauna assessment can be found in EES Appendix C: *Flora and fauna impact assessment*.

9.4.1 Literature and database review

Relevant and available documents were reviewed for information on past land uses, and presence of vegetation communities and flora and fauna. Relevant databases were searched for records of threatened species within a 10 km radius of the centre of the study area.

This review was used to prepare a list of threatened flora and fauna species, ecological communities, migratory species and any significant habitat previously recorded or predicted to occur in the study area and the broader locality (listed and preliminary listed under the EPBC Act and FFG Act).

Beaufort has been previously considered for a potential bypass and other Western Highway upgrades. As such, a number of previous ecological and environmental studies have been undertaken within or near the study area. A review of these studies was undertaken to provide context to the current study area. Two key studies were important in establishing the foundation of the biodiversity investigations for the project:

- *Western Highway Bypass Project – Beaufort. Stage 1 – Flora, Fauna and Aquatic Assessment* (GHD 2015)
- *Threatened Species Targeted Assessments Beaufort Bypass* (WSP | Parsons Brinkerhoff 2016).

9.4.2 Field surveys

The survey information was used to:

- establish the current site condition and habitats
- determine the likelihood of species occurring within the study area
- assess potential impacts of the construction and operation of a bypass on ecological values (including native vegetation, significant species, threatening processes and ecological character)
- assess the potential for cumulative impacts
- develop mitigation measures for significant species and inform design to avoid impacts where practicable.

Flora and vegetation surveys

Field surveys were undertaken using a range of methods specific to each of the targeted species or vegetation communities. The survey times were spread out over the seasons to maximise the detection of targeted species' flowering periods, and targeted surveys were adapted to suit variations in the seasons such as wetter, colder springs, which might delay flora germination or flowering.

Habitat hectare assessments were completed to determine the condition of native vegetation in the context of the local area and the relevant bioregions, as per the methodology outlined in *Vegetation Quality Assessment Manual-Guidelines for applying the Habitat Hectares scoring method* (Department of Sustainability and Environment 2004). The habitat hectare method involves making visual qualitative and quantitative assessments on various characteristics of native vegetation according to established criteria that are set against an optimum benchmark (benchmark optimal values vary for each Ecological Vegetation Class). This process considers the 'site condition' and 'landscape context' (i.e. habitat score), which is expressed as a percentage or on a scale of 0.00 to 1.00 (with 1.00 indicating the site meets or exceeds all benchmark criteria).

Areas defined as a 'patch' within the study area were subject to habitat hectare assessments. As per the *Guidelines for the removal, destruction or lopping of native vegetation* , a native vegetation 'patch' is defined as:

- *an area of vegetation where at least 25 per cent of the total perennial understorey plant cover is native, or*
- *any area with three or more native canopy trees where the drip line of each tree touches the drip line of at least one other tree, forming a continuous canopy, or*
- *any mapped wetland included in the DELWP 'current wetlands' map.*

The survey design was based on relevant State and Commonwealth survey guidelines. Targeted threatened flora surveys were undertaken over a number of visits to maximise the detection of a range of species. These surveys were undertaken for threatened plants that were assessed as having a moderate or greater likelihood of occurrence, based on known distributions and habitat types present within the study area, as identified by WSP ecologists. Details of the field surveys are presented in Table 9.4. Habitat hectare assessment were undertaken throughout the survey program from 2016-2018.

Table 9.4 Summary of targeted threatened flora surveys

Dates of targeted survey	Objectives or species targeted	Type of survey effort
Targeted flora surveys		
12–16 September 2016	Earlier flowering target species included Spiral Sun-orchid *Thelymitra mathewsii, Pterostylis smaragdyna,* spider-orchids *Caladenia* spp. (and other early flowering orchids), *Acacia aspera subsp. parviceps, Diuris behrii, Pimelea spinescens and* Yarra Gum *Eucalyptus yarraensis.*	Random meander and parallel line traverses.
19–21 October 2016	Early to mid-Spring flowering orchids (e.g. *Diuris behrii, Caladenia* spp.) and Pale-flower Cranesbill *Geranium sp. 3.*)	Random meander and parallel line traverses.
30 November to 2 December 2016	Focused on surveying in wetland areas throughout the majority of the study area as the water levels had dropped throughout the swamps and the climate was conducive to good plant growth and flowering. Conducted targeted surveys for threatened wetland flora species including Swamp Everlasting, Swamp Fireweed, River Swamp Wallaby-grass, Plump Swamp Wallaby-grass and Floodplain Fireweed.	Random meander through zonation of wetlands.
15 & 16 December 2016	Ben Major Grevillea and late flowering orchids.	Stratified meander survey method.

Dates of targeted survey	Objectives or species targeted	Type of survey effort
14–17 February 2017	Survey of the rail corridor were undertaken from Smiths Lane to Racecourse Road and either side of the crossing of the Western Highway. Targeted threatened grassy woodland species such as Matted Flax-lily and Ben Major Grevillea.	Random meander and parallel line traverses.
20–22 June 2017	Survey for large trees in remnant patches and scattered trees. Incidental observations for winter flowering orchids (e.g. helmet orchids) and other plants which can be identified in most seasons (e.g. Matted Flax-lily).	Random meander and parallel line traverses.
20 September 2017 26 September 2017 18–19 October 2017 15 November 2017	Targeted surveys for early to mid-Spring targeted orchids, mostly through unsurveyed areas. Repeat visits through those areas in 2017. Survey for large trees in remnant patches and scattered trees and refine native vegetation mapping (habitat hectare assessments).	Random meander and parallel line traverses.
8–9 January 2018 23 & 24 January 2018 17 January 2018 31 January 2018	Survey for large trees in remnant patches and scattered trees and refine native vegetation mapping (habitat hectare assessments).	Random meander and parallel line traverses.
5–7 June 2019	Survey for large trees in remnant patches and scattered trees.	Random meander and parallel line traverses.
Threatened vegetation surveys		
19–21 October 2016	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.	Targeted meander through zonation of wetlands.
30 November to 2 December 2016	Focused on surveying in wetland areas throughout the majority of the study area as the water levels had dropped throughout the swamps and the climate was conducive to good plant growth and flowering. Target Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.	Targeted meander through zonation of wetlands.
15 & 16 December 2016	Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.	Targeted meander through zonation of wetlands.
14–17 February 2017	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland. Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains.	Random meander and parallel line traverses.
20–22 June 2017	Incidental surveys for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.	Random meander.
20, 26 September 2017 18–19 October 2017 15 November 2017	Incidental surveys for White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.	Random meander and parallel line traverses.

Tree surveys

Given community concern expressed for large trees in other sections of the Western Highway projects, it was considered of high importance to ensure that all trees likely to be impacted by the project were surveyed in the field. Due to the large number of trees throughout the study area, tree surveys focused on assessing the 250 m wide alignment corridor and the trees at interchanges (i.e. the locations where impacts may occur outside of the project area due to new or upgraded interchanges). All large trees in patches and all scattered trees in these areas were recorded.

Tree assessment criteria

- **Scattered tree:** A native canopy tree that does not form part of a patch (can be a large or a small tree).
- **Large tree in a patch:** A native canopy tree with a diameter at breast height greater than or equal to the large tree benchmark for the relevant bioregional Ecological Vegetation Class, within a patch.

Fauna surveys and habitat mapping

The fauna surveys were undertaken between November 2016 and March 2021. The survey design was based on relevant State and Commonwealth survey guidelines, with field assessments undertaken in the most appropriate season as recommended in the relevant State and Commonwealth guidelines. Only those species with a moderate or high likelihood of occurrence were targeted during surveys. These included:

- Growling Grass Frog
- Brown's Toadlet
- waterfowl and other waterbirds (e.g. Brolga, Eastern Great Egret)
- Squirrel Glider
- Brush-tailed Phascogale
- Golden Sun Moth
- Striped Legless Lizard.

Additionally, fauna habitats of key species were mapped, as well as recording any incidental observations or evidence of fauna.

A desktop review and likelihood of occurrence assessment for aquatic fauna within the study area was undertaken by Streamline Research. Based on a previous aquatic fauna study completed for the project, only one species was targeted for the aquatic fauna investigation by Streamline Research, namely Little Galaxias. The main creeks targeted for these surveys were Yam Holes Creek and minor tributaries Cumberland, Cemetery and Ding Dong Creeks. As the Little Galaxias has been recorded in Mount Emu Creek, a nearby connecting creek, it was also targeted as part of this investigation (although outside of the project study area). Yam Holes Creek floodplain wetlands were also examined.

A summary of the surveys, fauna species targeted, and type of survey effort is provided in Table 9.5.

Table 9.5 Summary of targeted threatened fauna surveys

Dates of targeted survey	Species targeted	Type of survey effort
Terrestrial fauna		
30 November 2016 1 December 2016	Growling Grass Frog *Litoria raniformis* and Brown Toadlet *Pseudophryne bibronii* targeting suitable habitat including the surrounding terrestrial habitat within 10 metres of all waterbodies.	Call playback, active search and incidental survey.
2–14 December 2016 16 January 2017	Squirrel Glider *Petaurus norfolcensis* and Brush-tailed Phascogale *Phascogale tapoatafa.*	Hair Tubes, Camera Traps and Spotlighting.
Summer 2016/2017	Golden Sun Moth *Synemon plana* Surveys were undertaken when the commencement of the flight season was confirmed by the Victorian DELWP endorsed Golden Sun Moth email group.	Active Search

Dates of targeted survey	Species targeted	Type of survey effort
December 2018	Golden Sun Moth *Synemon plana* habitat assessments were intended to map known or potential habitat. In December 2018, two incidental surveys from roadsides were undertaken at several sites in the study area, and as such habitat mapping was updated.	Incidental surveys
20 October 2016 - 19 September 2017 16 October 2019 – 16 January 2020	Striped Legless Lizard *Delma impar* Surveys primarily undertaken during the active period of the species (between September and May).	Tile surveys
November 2016 – July 2017	Waterfowl and other waterbirds (brolga & eastern great egret). Incidental observations of waterbirds at waterbodies within and adjacent to the study area were undertaken between November 2016 – July 2017.	Incidental
November 2020 December 2020	Growling Grass Frog *Litoria raniformis* Evening surveys undertaken, with Growling Grass Frog's calling at nearby reference sites.	Call playback, active search and incidental survey.
February 2021 March 2021	Arboreal mammals and owls.	Camera Traps, Elliot traps and Spotlighting.
Aquatic fauna		
22–23 November 2016	Little Galaxias *Galaxiella toourtkoourt*	Dip netting

Connectivity

A specific *Wildlife Connectivity Impact and Mitigation Assessment* was undertaken by the University of Nottingham, School of Environmental and Geographical Sciences as part of the flora and fauna impact assessment (EES Appendix C: *Flora and fauna impact assessment*). The aim of the assessment was to assess current and future levels of connectivity for wildlife resulting from the project.

Connectivity

Linkages between habitat areas; the extent to which particular ecosystems are joined with others; the ease with which organisms can move across the landscape (Department of the Environment and Energy).

The *Wildlife Connectivity Impact and Mitigation Assessment* modelled landscape connectivity for five different species (referred to as 'conservation targets'). The connectivity was characterised and modelled for each conservation target using modelling methods that simulate how animals move through the landscape based on their movement ecology and habitat preferences, and how they respond to anthropogenic land cover. The connectivity models were used to assess the current connectivity in the landscape without the project (i.e. base case scenario), which was then compared to predicted levels of impacts on connectivity across the four possible alignment options. In addition, the potential effects of mitigation was also tested.

9.4.3 Impact assessment

The impact assessment was undertaken for the project area, with the calculation of areas of impacts determined using the construction footprint as described in Section 9.5 below.

The construction footprint provides a realistic indication of the maximum extent of likely impacts for the functional design, however, it is noted that detailed design may result in a revised area of impact. Any changes are likely to result in lower impacts on ecological values as the footprint is refined, as they will need to take into consideration the project's no-go zones.

Cumulative impacts

Cumulative impact assessments consider the effects of multiple actions or impacts on the environment and are undertaken to ensure the incremental effects of multiple actions in a given area are considered and assessed holistically for their combined impact.

As part of this EES, a cumulative impact assessment was undertaken for those specific threatened species and ecological communities determined in the existing conditions assessments to have a moderate or higher likelihood of occurrence within the study area. Following consultation with the DELWP Technical Reference Group, the assessment was carried out taking into account four other projects currently underway or completed within a 20 km radius (defined as the Cumulative Impact Assessment Area). The additional projects included:

- Stage 1 of the Western Highway Upgrade (Burrumbeet to Beaufort)
- Stage 2A of the Western Highway Upgrade (Beaufort to Buangor)
- Stage 2B of the Western Highway Upgrade (Buangor to Ararat and Buangor Bypass)
- Stockyard Hill Wind farm.

In addition to the Cumulative Impact Assessment Area, the assessment considered the impacts at three other spatial scales: State of Victoria, Central Victorian Uplands Bioregion and Victorian Volcanic Plains Bioregion.

The location of these projects and bioregions in relation to the Beaufort Bypass study area are shown in Figure 9.1.

The cumulative impact assessment analysis involved calculating the area of mapped habitat or modelled distribution of each species and ecological community within the project footprint. The potential impact areas across all five projects were tallied to provide a total cumulative impact area for the project. This area was then calculated as a percentage of the species distribution modelled to occur within each of the three spatial scales. For the detailed cumulative impact assessment methodology and limitations of the assessment, refer to Appendix N of EES Appendix C: *Flora and fauna impact assessment*.

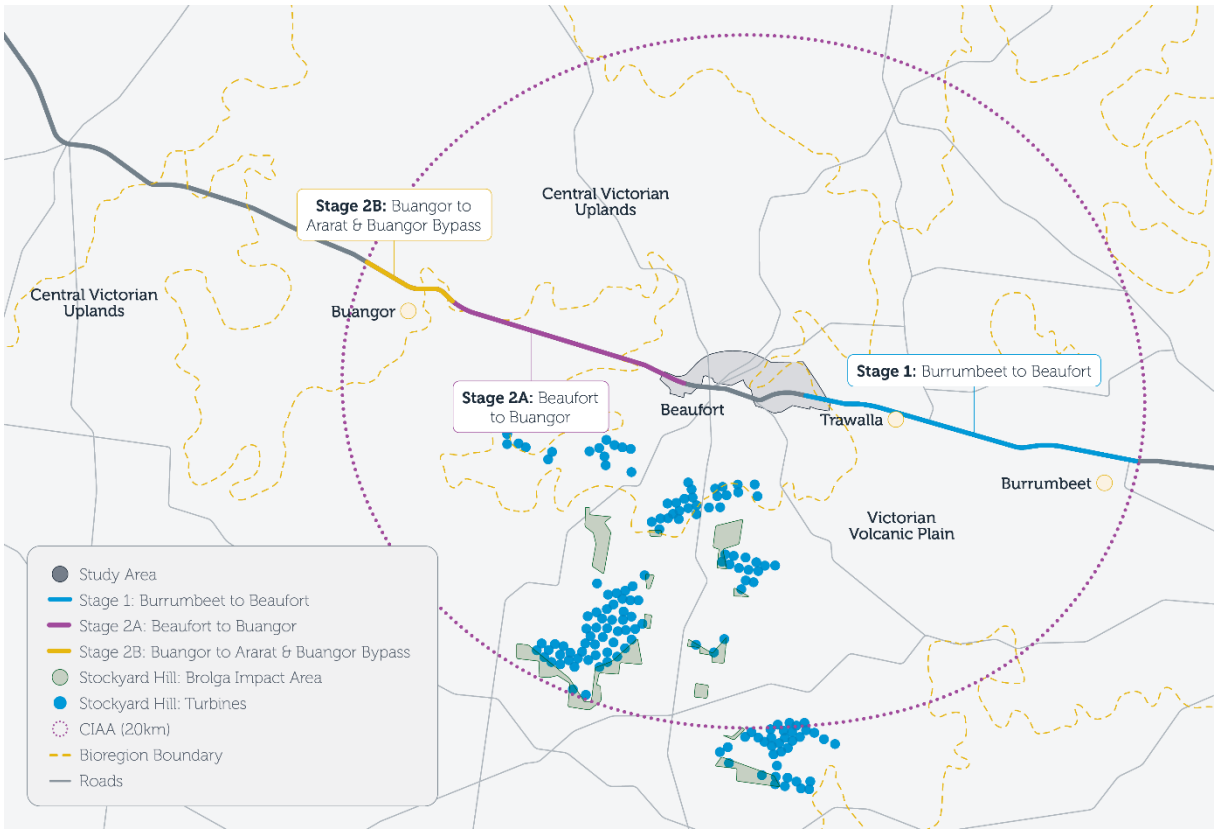

Figure 9.1 Proposed spatial boundary for cumulative impacts

9.5 Study area

The study area for the project includes approximately 1,800 ha of land north of the Beaufort township. This study area and the Beaufort township were assessed to determine potential impacts to biodiversity and habitat and constraints associated with the project.

9.5.1 Construction footprint

For the preferred alignment (C2), a **construction footprint** was defined for calculation of impacts to biodiversity and habitat. This footprint is the area within which impacts on ecological values are assumed to occur, and includes areas required for creek realignments (calculated using a 5 m buffer of the creek realignment area).

The construction footprint occurs within the project area (refer to Figure 9.2). Significant ecological values outside the construction footprint but within the project area will be protected by no-go zones. These are areas where vegetation is fenced off to ensure it is not impacted during construction. No access should occur in no-go zones except for access for conservation works, supervised by an ecologist.

The project area, to be defined by a Specific Controls Overlay (Figure 9.2), is the footprint for the permanent and temporary construction and ancillary facilities for the project. The siting of ancillary construction infrastructure will be defined during the detailed design phase, however indicative locations where laydown areas and haul roads can be placed without impacting the Yam Holes Creek floodplain, areas of recorded vegetation and habitat is depicted in the Figure 4.2a to 4.2d in EES Chapter 4: Project description.

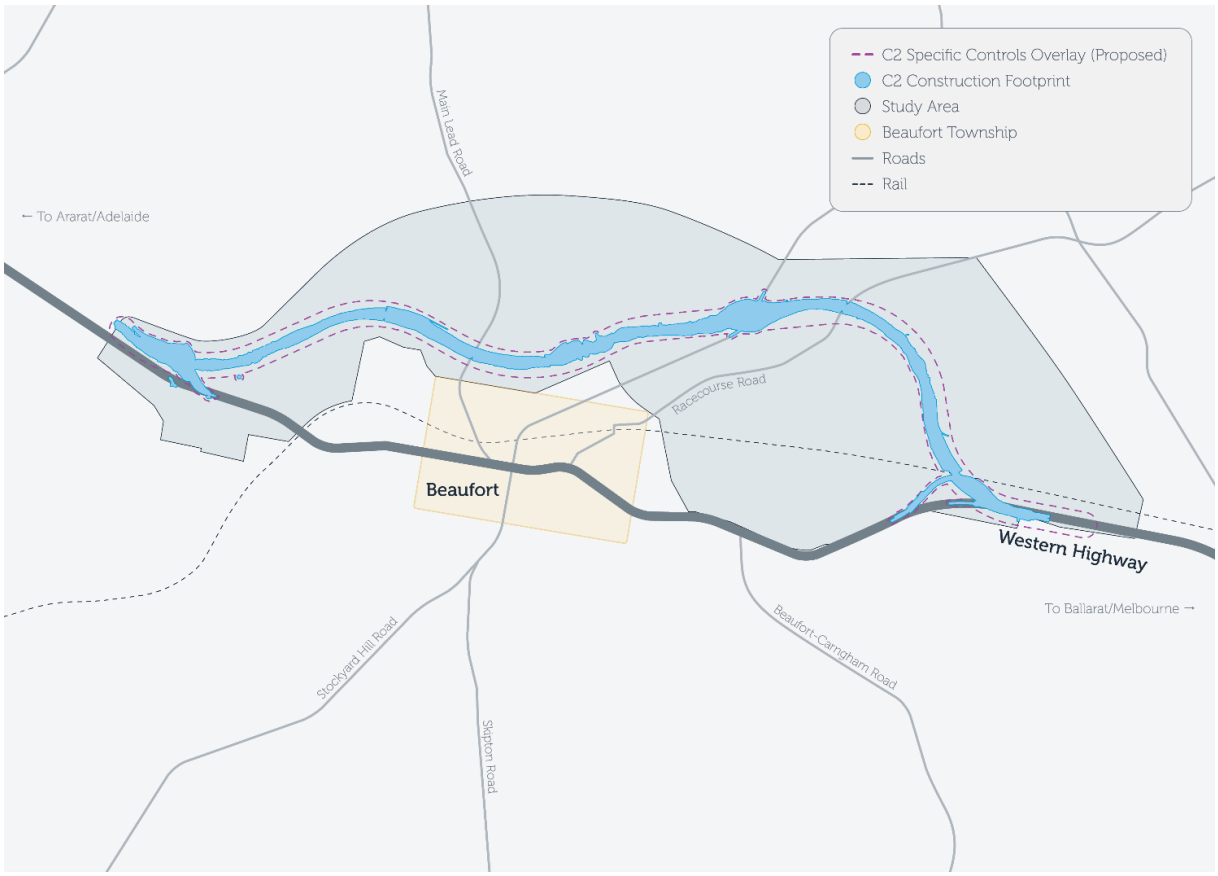

Figure 9.2 Specific controls overlay (project area) and construction footprint

9.6 Existing conditions

9.6.1 Vegetation Communities

Ecological Vegetation Classes

Sixteen Ecological Vegetation Classes were mapped within the study area, which comprises 919 ha of combined native vegetation out of the total study area extent of 1,825 ha. The Ecological Vegetation Classes and corresponding conservation significance and extent within the study area are summarised in Table 9.6 below. For full descriptions of the Ecological Vegetation Classes refer to EES Appendix C: *Flora and fauna impact assessment*. The location of the mapped Ecological Vegetation Classes is shown in Figure 9.3a-e.

An **Ecological Vegetation Class** is an area of vegetation displaying broadly similar botanical characteristics reflecting consistent environmental and structural conditions.

Each Ecological Vegetation Class has a **conservation status** assigned for it for the bioregion in which it occurs. These conservation statuses are categorised by DELWP as follows:

- **Endangered (E):** Contracted to less than 10% of former range or less than 10% of pre-European extent remaining.
- **Vulnerable (V):** 10–30% pre-European extent remains.
- **Depleted (D):** Greater than 30% and up to 50% pre-European extent remains.
- **Rare (R):** Rare by geographic occurrence but neither depleted, degraded nor currently threatened to an extent that would qualify as any of the above categories.
- **Least Concern (LC):** Greater than 50% pre-European extent remains and subject to little to no degradation over a majority of its area.

Table 9.6 Ecological Vegetation Classes within the study area

Ecological Vegetation Class number	Ecological Vegetation Class (and description)	Status code	Indicative locations within the study area
67	**Alluvial Terraces Herb-rich Woodland** Open woodland to 15 m high, with disturbed understorey of herbs and grasses.	E	On broad alluvial plains and ephemeral drainage lines throughout the study area.
306	**Aquatic Grassy Wetland** Seasonal wetland dominated by floating grasses interspersed with aquatic species.	E	Limited to two locations, one along Racecourse Road and another swamp along Smiths Lane.
653	**Aquatic Herbland** Semi-permanent to seasonal wetland dominated by herbaceous aquatic species.	E	Distributed in a number of natural wetlands throughout the study area as well as formed drainage lines and farm dams.
308	**Aquatic Sedgeland** Species-poor vegetation dominated by robust inundation-tolerant sedges.	E	Distributed in several wetlands and farm dams throughout the study area.
656	**Brackish Herbland** Short herbland dominated by species tolerant of mildly saline conditions and intermittent inundation.	E	Limited distribution in the study area in low lying areas along Martins Lane where salinity discharge is evident.

Ecological Vegetation Class number	Ecological Vegetation Class (and description)	Status code	Indicative locations within the study area
68	**Creekline Grassy Woodland** Eucalypt-dominated woodland to 15 m with occasional shrub layer over a mostly grassy/sedgy to herbaceous ground-layer.	E	Low-gradient ephemeral to intermittent drainage lines throughout the study area.
22	**Grassy Dry Forest** Low to medium height forest of eucalypts to 20 m tall with sparse shrub layer of medium height and ground layer dominated by a high diversity of drought-tolerant grasses and herbs.	D	South of the western tie in, valleys either side of the camp hill summit and scattered areas within the study area to the east of camp hill summit.
175	**Grassy Woodland** A variable open eucalypt woodland to 15 m tall over a diverse ground layer of grasses and herbs. The shrub component is usually sparse.	E	Scattered patches located near the Eastern tie in, along Racecourse Road and approximately 1 km east of the western tie in.
20	**Heathy Dry Forest** Overstorey is a low, open eucalypt forest to 20 m tall with understorey dominated by a low layer of shrubs.	LC	Patches east of Racecourse Road and at the Camp Hill Summit.
125	**Plains Grassy Wetland** Grassy-herbaceous wetland typically species-rich on the outer verges when relatively intact.	E	Limited distribution in the study area in low lying areas along Martins Lane, Racecourse Road and Smiths Lane where it occurs in association with related wetland Ecological Vegetation Classes Aquatic Grassy Wetland, Plains Sedgy Wetland complexes.
767	**Plains Grassy Wetland/Brackish herbland Complex** Contains the structural dominants of Plains Grassy Wetland in association with herbaceous species characteristics of Brackish Herbland.	E	Limited distribution in the study area in low lying areas along Martins Lane where salinity discharge is evident, as well as an area along Racecourse Road west of the sewage treatment plant.
755	**Plains Grassy Wetland/Aquatic Herbland Complex** Contains the structural dominants of Plains Grassy Wetland with aquatic herbs also prevalent.	E	Only mapped in one wetland in the study area along Racecourse road in association with Aquatic Grassy Wetland.
55	**Plains Grassy Woodland** An open eucalypt woodland to 15 m tall with sparse grassy understorey dominated by exotic pasture grasses with scattered wallaby grasses *Rytidosperma* spp.	E	Two small areas within the study area on flat/gently undulating plains.
647	**Plains Sedgy Wetland** Primarily sedgy-herbaceous vegetation, sometimes with scattered or fringing eucalypts with aquatic herbs dominating ground layer.	E	Distributed along wet depressions in the Yam Holes Creek Valley.

Ecological Vegetation Class number	Ecological Vegetation Class (and description)	Status code	Indicative locations within the study area
821	**Tall Marsh** Wetland dominated by tall emergent graminoids (herbaceous grass), typically in thick, species poor swards. The structure is variously rushland, sedgeland or reedbed, in association with other wetland Ecological Vegetation Classes.	E	Limited distribution in the study area in low lying areas along Racecourse Road west of the sewage treatment plant.
47	**Valley Grassy Forest** Woodland to open forest to 25 m tall with a variety of eucalypts. The shrub layer is typically dominated by Hedge Wattle *Acacia paradoxa* and Blackwood *Acacia melanoxylon*, while the ground layer usually carries a high diversity of herbs and grasses.	V	Distributed along valley floors and smaller creek valleys in the Yam Holes Creek Valley.

There are extensive areas of cleared land throughout the study area, of which some supports modified native vegetation or pasture with greater than 25% perennial native vegetation. Additionally, there are many scattered trees, of which a large proportion are large old trees.

Several wetlands in DELWP's legacy dataset 'Wetlands 1994' and DELWP's 'Current Wetlands' layer occur in the study area. Some of these were observed to still be present in the study area and have been mapped as Ecological Vegetation Classes and, where applicable, the EPBC Act-listed ecological community 'Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plain' (refer to Figure 9.6).

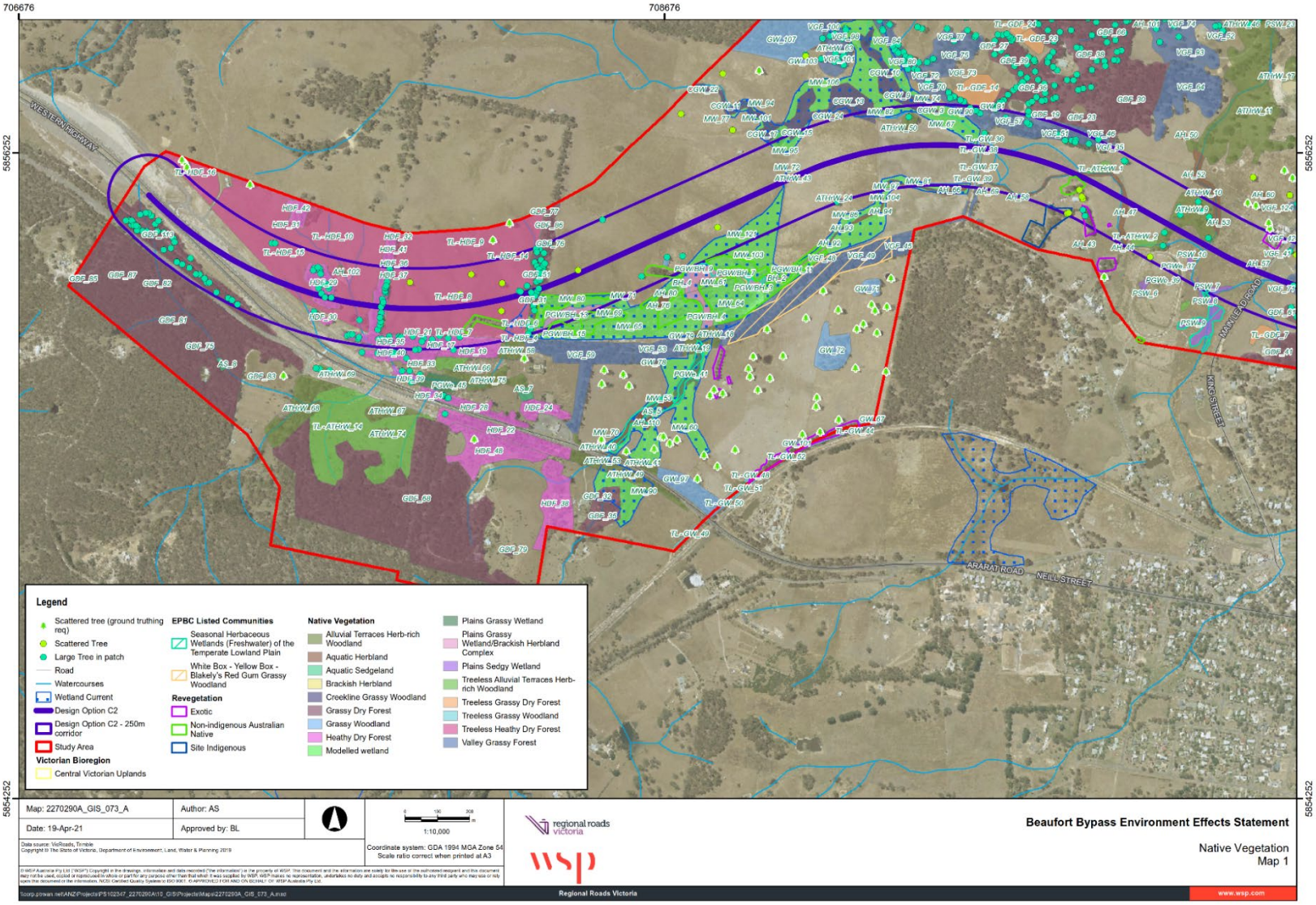

Figure 9.3a Ecological Vegetation Classes within the study area – map 1

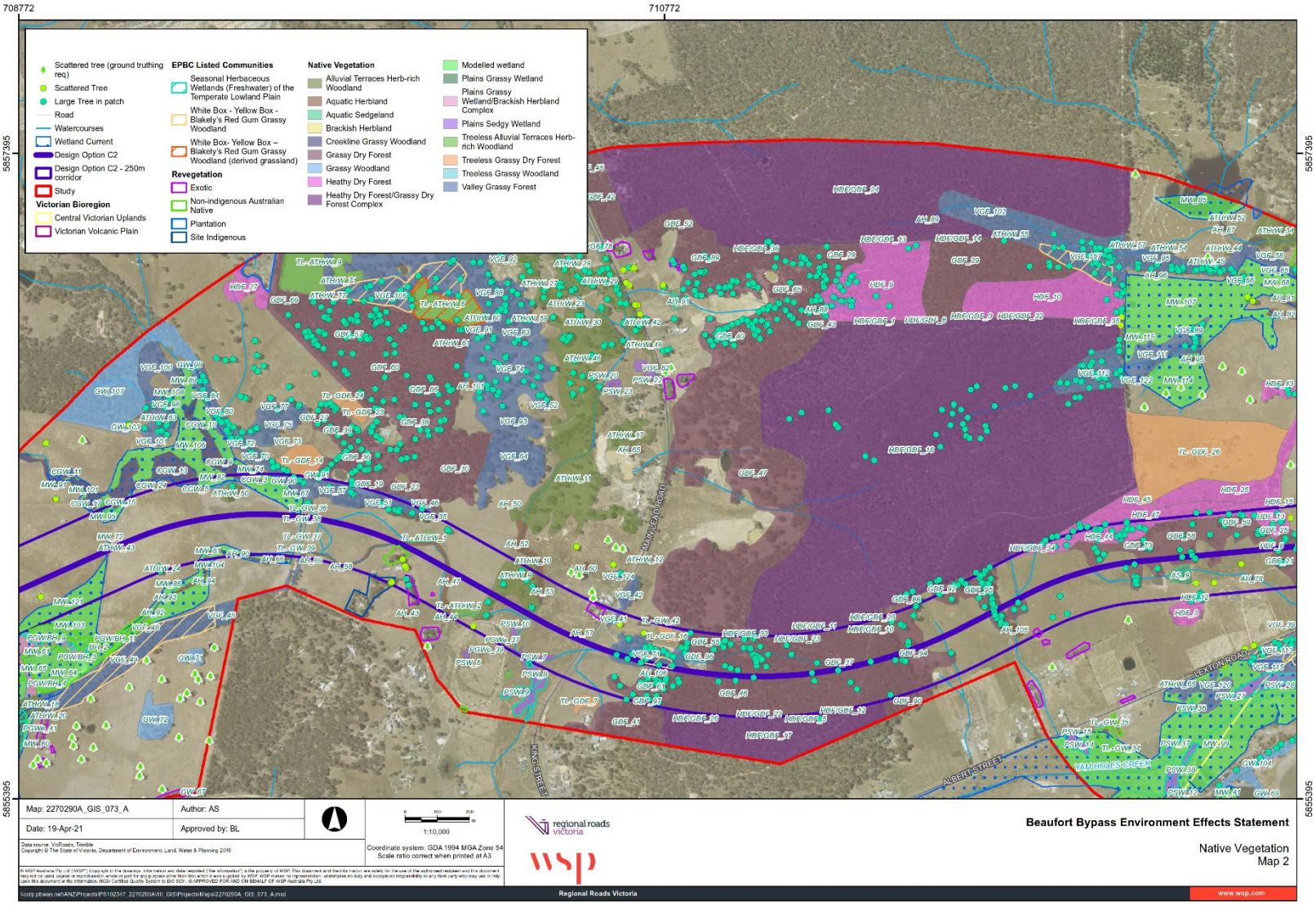

Figure 9.3b Ecological Vegetation Classes within the study area – map 2

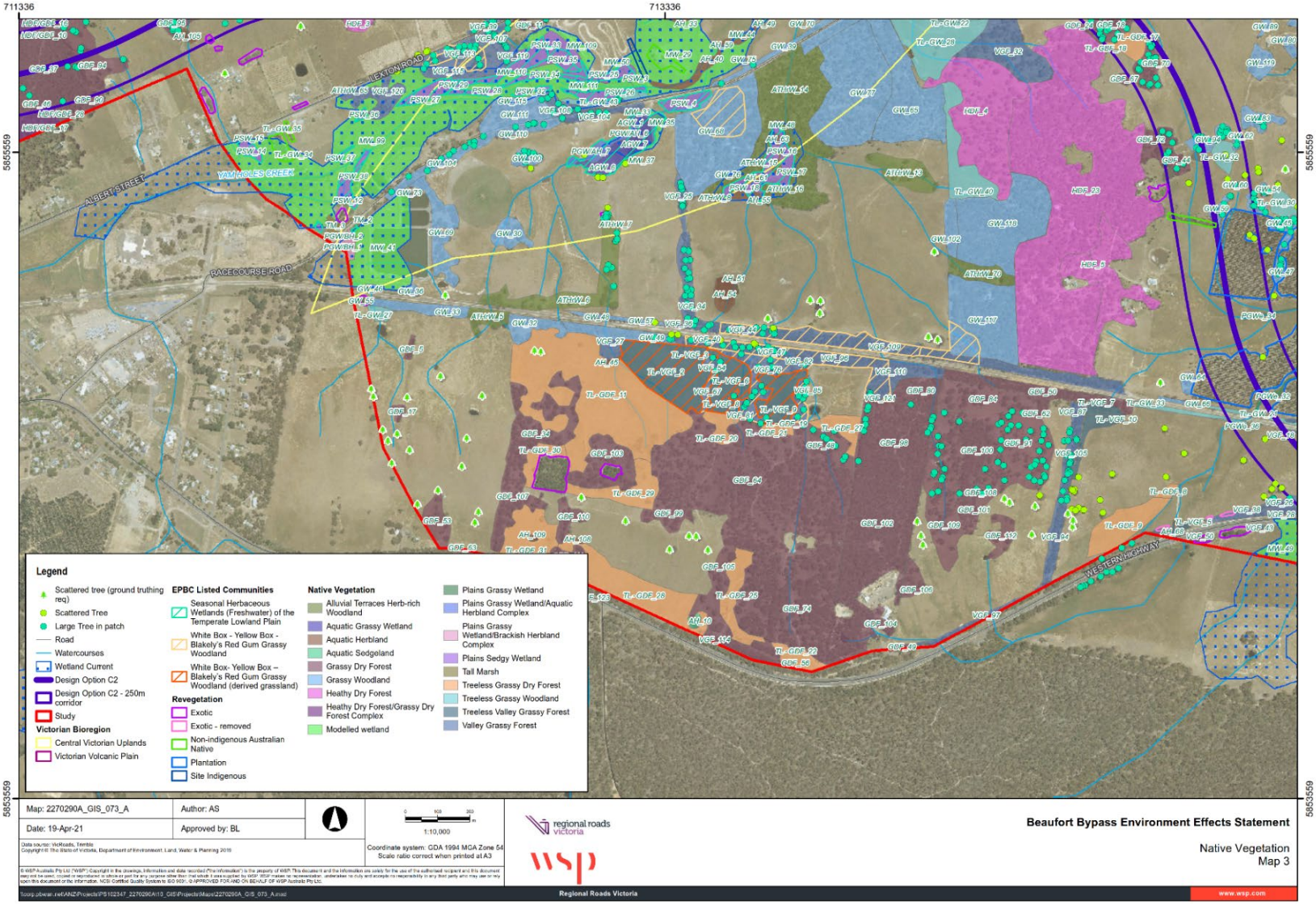

Figure 9.3c Ecological Vegetation Classes within the study area – map 3

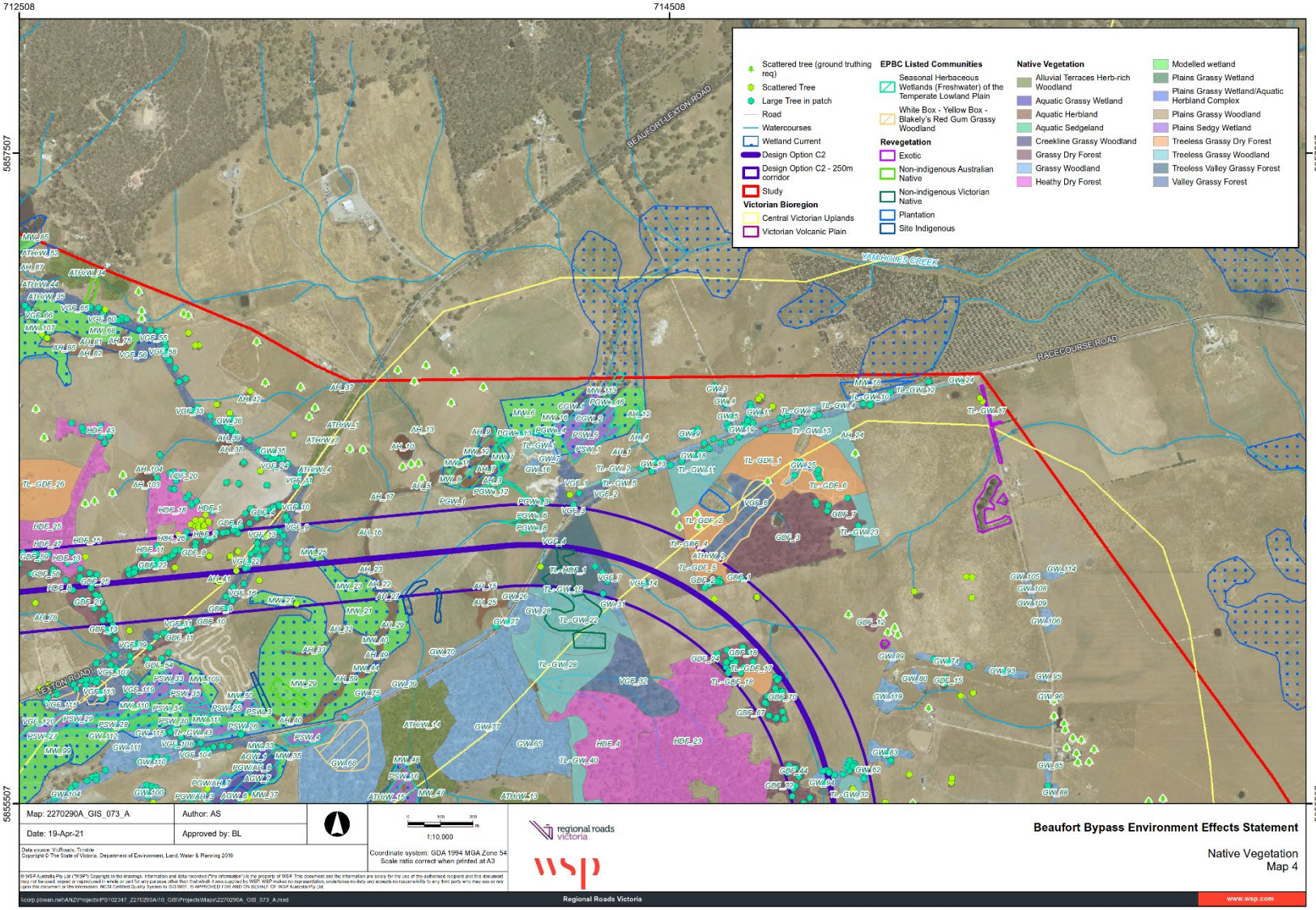

Figure 9.3d Ecological Vegetation Classes within the study area – map 4

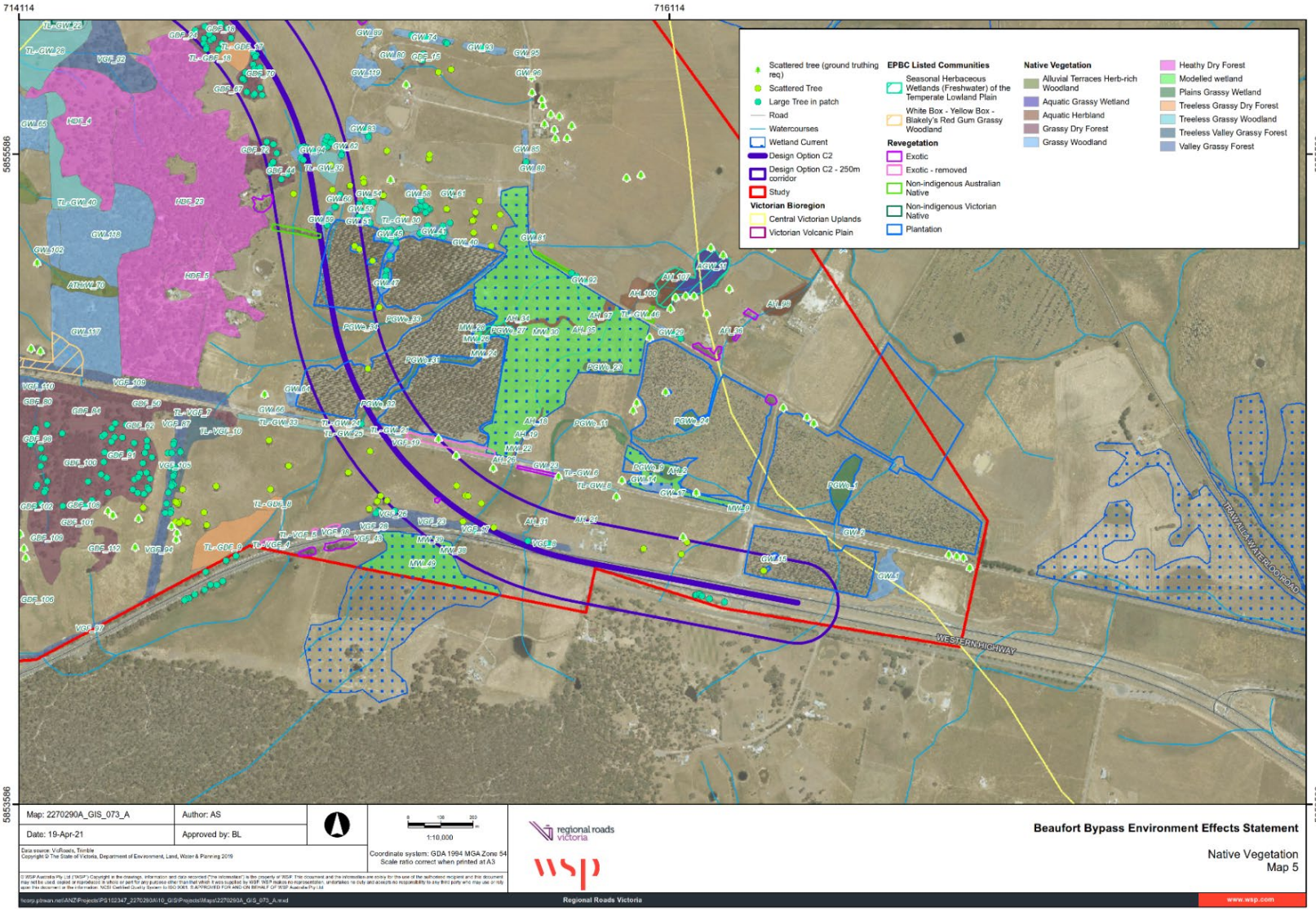

Figure 9.3e Ecological Vegetation Classes within the study area – map 5

Threatened ecological communities

Two EPBC Act listed ecological communities were recorded within the study area (shown in Figure 9.6):

- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plain (threatened)
- White Box- Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Grasslands (threatened).

These vegetation communities are described below in Table 9.7.

One FFG Act listed threatened community was recorded within the study area (shown in Figure 9.7):

- Victorian Temperate Woodland Bird Community.

This community is discussed further in Section 9.6.3.

Another EPBC Act community, Natural Temperate Grassland of the Victorian Volcanic Plain, was also recorded in the study area during past surveys, however, more thorough consideration of the diagnostic characteristics of this community has been undertaken and it is no longer considered to be present or to have been present in the past.

Table 9.7 EPBC Act listed ecological communities

EPBC Act listed ecological community	EPBC Act status	Description
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plain	Critically endangered	These are freshwater wetlands that are typically inundated on a seasonal basis through rainfall then dry out over summer. The vegetation structure is treeless and dominated by herbs, grasses and sedges and includes flora, fauna and micro-organisms present in both wet and dry periods. Refer to Figure 9.4.
White Box- Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Grasslands	Critically endangered	The ecological community can occur either as woodland or derived native grassland (i.e. grassy woodland where the tree overstorey has been removed). The Box-Gum Grassy Woodlands and Derived Grasslands were previously widespread across the slopes and tablelands of the Great Dividing Range throughout Queensland, New South Wales, Australian Capital Territory and Victoria. Refer to Figure 9.5.
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically endangered	The community is dominated by a ground layer of native tussock-forming perennial grasses along with a number of herbs and small shrubs or subshrubs. Trees and large shrubs are sparse to absent. The study area occurs in a transition area from the Central Victorian Uplands into the Victorian Volcanic Plain bioregion, indicated by the change in geology and a flatter landscape. The vegetation in this area appears to be treeless remnants of Valley Grassy Forest which transitions to Grassy Woodland to the east. There are a number of trees nearby, including some Candlebarks, Yellow Box and Snow Gums and some planted non-indigenous natives and Monterey Pines **Pinus radiata*. This indicates that the tree layer has likely been removed in the past. Additionally, there are no basalt soils in the area. As such, it is not considered that this area meets the diagnostic characteristics for Natural Temperate Grassland. This assessment was provided to the Department of the Environment, Ecological Communities Section who provided some further assessment advice which assisted with the determination (12 May 2017).

Left: Poong'ort Carex tereticaulis dominated wetland, synonymous with Plains Sedgy Wetland (Ecological Vegetation Class 647) behind motorbike track. Right: Aquatic Herbland (Ecological Vegetation Class 653) in a large wetland along Yam Holes Creek

Figure 9.4 Areas of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains

Figure 9.5 Area of EPBC Act listed White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland community

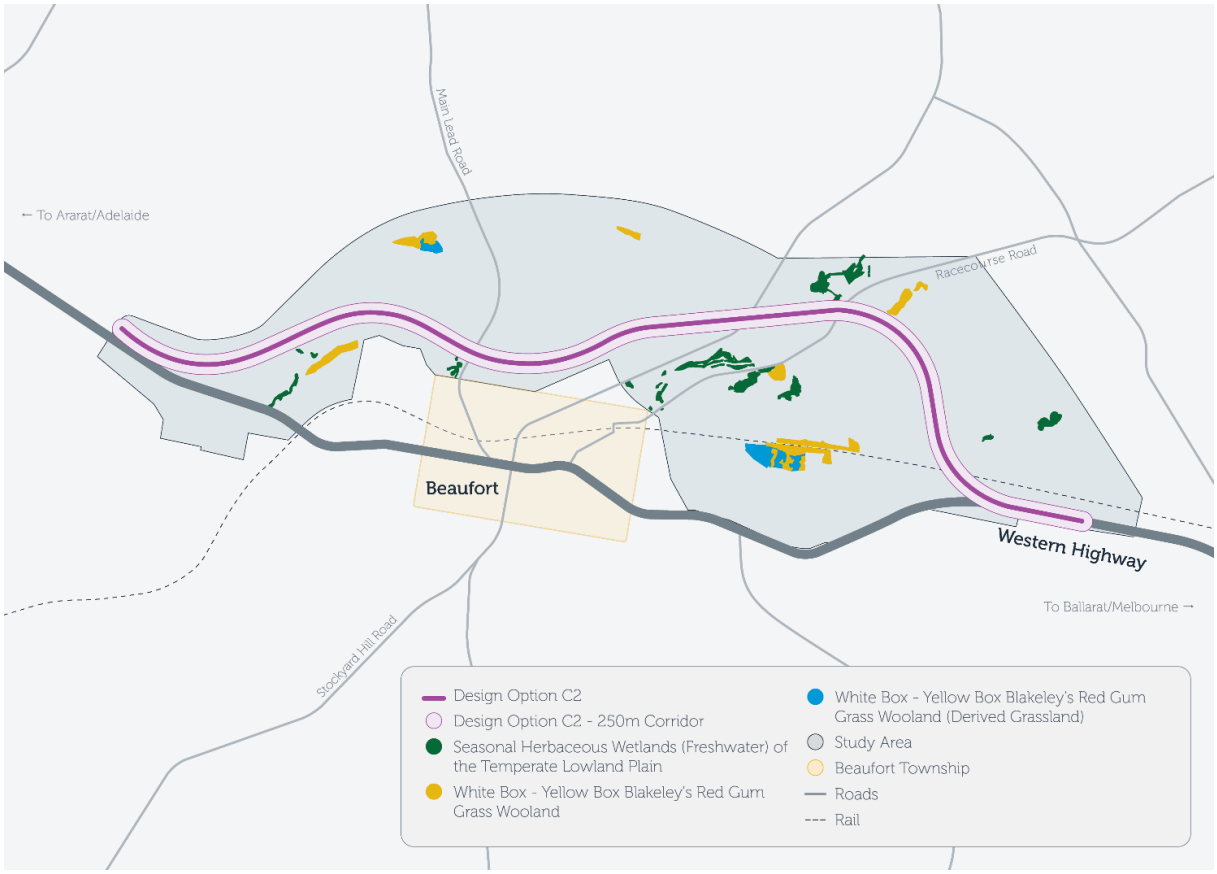

Figure 9.6 EPBC Act threatened ecological communities within the study area

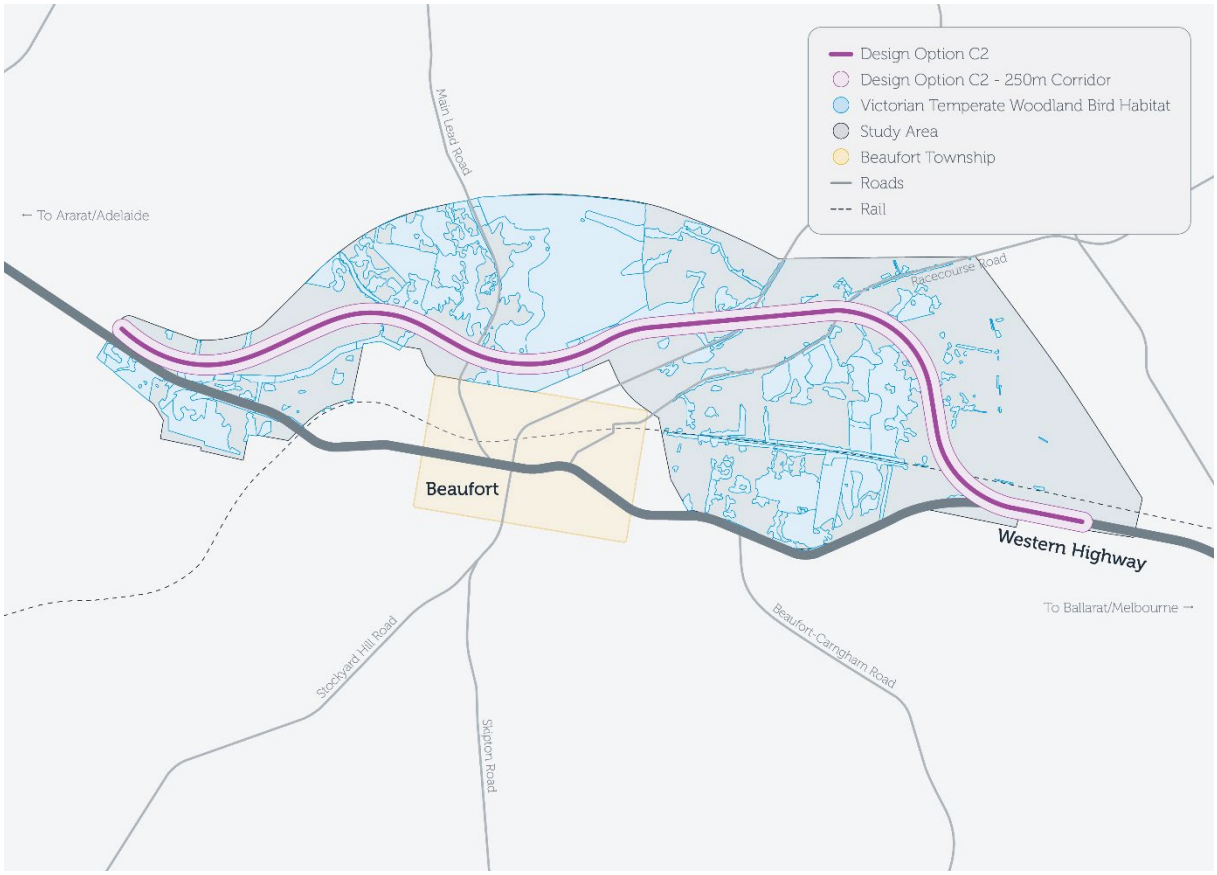

Figure 9.7 Victorian Temperate Woodland Bird Community habitat

Wetlands

Wetlands in the study area are seasonal wetlands (i.e. they are typically inundated by seasonal rainfall events in the cooler months and generally dry out by late summer). Inundation of seasonal wetlands are fed by rainfall as the main water source and are not dependent on connections to riverine systems.

For the flora and fauna impact assessment, all wetlands within the study area were categorised into high, moderate or low value based on the categories outlined in Table 9.8. The locations of these wetlands are shown in Figure 9.8 below.

Table 9.8 Wetland value categorisation

Wetland value	Degree of modification	Vegetation composition	Habitat attributes	Physical form
High value	Intact – low level of modification	Contains: • Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plain (critically endangered EPBC Act listed community) • areas mapped as wetland Ecological Vegetation Classes • areas mapped as 'Current Wetland' by DELWP.	Identified habitat for a range of wetland dependent flora and fauna including numerous threatened species such as: • Brolga (L, vu) • Brown Toadlet (L, en) • River Swamp Wallaby-grass (VU) • Growling Grass Frog (VU, L, en) • Little Galaxias (VU, L, en) • Floodplain Fireweed (r) • other wetland birds. Records of numerous threatened species. There are nine high value wetlands that meet the definition of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains located within the study area. A description of these wetlands is provided in Table 9.9 below.	Naturally occurring
Moderate value	Medium level of modification	Contains: • areas mapped as wetland Ecological Vegetation Classes • areas mapped as 'Current Wetland' by DELWP	Identified and potential habitat for a range of wetland dependent flora and fauna including numerous threatened species such as: • Brolga (L, vu) • Brown toadlet (L, en) • River Swamp Wallaby-grass (VU) • Growling Grass Frog (VU, L, en) • Little Galaxias (VU, L, en) • Floodplain Fireweed (r) • other wetland birds.	Naturally occurring and dams
Low value	Highly modified	Contains: • areas mapped as 'Current Wetland' by DELWP Mapped 'low value' wetlands do not contain areas mapped as wetland Ecological Vegetation Classes	Lesser areas of potential habitat for a range of wetland dependent flora and fauna. May provide some food resources for fauna and temporal values through longer periods of inundation.	Modified from natural form by artificial channels, dams and artificial waterbodies.

Key to threatened species listing:

- ***EPBC Act:*** *VU = vulnerable*
- ***FFG Act:*** *L = listed*
- ***Victorian Advisory List:*** *vu = vulnerable, en = endangered, r = rare*

The high value wetlands located within the study area all meet the definition of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains. A description of all wetlands in the study area in terms of the species habitat they provide and Ecological Vegetation Class composition is provided in Table 9.9 below.

Table 9.9 Description of the wetlands found within the study area

Wetland current ID	High value wetland number	Wetland description	Ecological values
35402	Wetland 1	Likely surface water fed, possibly fed from pivot irrigator nearby	• potential habitat for Brown Toadlet (mostly in high value wetland areas) and Eastern Ling-necked Turtle • potential habitat for Growling Grass Frog in high value wetland areas • wetland habitat for Little Galaxias • potential habitat for wetland birds including Brolga in the high value wetland areas • River Swamp Wallaby-grass present in high value wetland areas • contains wetland Ecological Vegetation Classes: Plains Grassy Wetland, Aquatic Sedgeland and Aquatic Herbland.
35403	–	Shallow wetland/floodplain along channelised part of Yam Holes Creek	• potential habitat for Eastern Long-necked Turtle and Brown Toadlet (mostly in high value wetland areas) • potential habitat for Growling Grass Frog and wetland birds, including Brolga, in the high value wetlands • stream habitat for Little Galaxias • marginal vegetation but meets definition of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains • contains wetland Ecological Vegetation Classes: Plains Sedgy Wetland and Creekline Grassy Woodland • large areas of low value wetland, which are dominated by pasture, grazed land and irrigated pasture.
35404	–	Seasonal wetland likely surface water fed. Not assessed in field as this is outside study area.	• potential habitat for wetland birds (including Brolga), Eastern Long-necked Turtle, Growling Grass Frog and Brown Toadlet • habitat for Little Galaxias unlikely as there is no defined creekline evident • extent of native wetland vegetation unknown.
35405	–	Seasonal wetland likely surface water fed. Not assessed in field as this is outside study area.	• potential habitat for wetland birds (including Brolga), Eastern Long-necked Turtle, Growling Grass Frog and Brown Toadlet • habitat for Little Galaxias unlikely as there is no defined creekline evident • extent of native wetland vegetation unknown.
35539	–	Seasonal wetland likely surface water fed	• potential but limited habitat for wetland birds and Growling Grass Frog in the moderate value wetland areas • potential habitat for Eastern Long-necked Turtle and Brown Toadlet (mostly in moderate value wetland areas) • no habitat for Little Galaxias • contains the following wetland Ecological Vegetation Classes: Plains Grassy Wetland and Aquatic Herbland.

Wetland current ID	High value wetland number	Wetland description	Ecological values
35540	Wetland 5	Seasonal wetland likely surface water fed	• potential habitat for Brown Toadlet (mostly in high value wetland areas) and Eastern Long-necked Turtle • potential habitat for Growling Grass Frog in high value wetland areas • potential habitat for wetland birds in the high value wetlands • limited to no habitat for Little Galaxias • River Swamp Wallaby-grass present in high value wetland areas • contains wetland Ecological Vegetation Classes: Aquatic Grassy Wetland and Aquatic Herbland.
35540	Wetland 9	Seasonal wetland likely surface water fed	• potential habitat for Brown Toadlet (mostly in high value wetland areas) and Eastern Long-necked Turtle • potential but limited habitat for Growling Grass Frog, mostly in high value wetland areas • limited to no habitat for Little Galaxias • potential but limited habitat for wetland birds in the high and moderate value wetland areas • River Swamp Wallaby-grass present in high value wetland areas • contains wetland Ecological Vegetation Classes: Plains Grassy Wetland and Aquatic Herbland.
35562	Wetland 3	Seasonal wetland likely surface water fed	• potential habitat for Brown Toadlet and Growling Grass Frog, in high value wetland areas, and Eastern Long-necked Turtle • wetland habitat for Little Galaxias • River Swamp Wallaby-grass and Floodplain Fireweed present in high value wetland areas • potential habitat for wetland birds including Brolga in high value wetland areas • contains wetland Ecological Vegetation Class: Plains Sedgy Wetland.
35563	–	Wastewater Treatment Plant was expanded across half of this wetland in 2014-15	• potential habitat for Eastern Long-necked Turtle and Brown Toadlet (mostly in moderate value wetland areas) • potential habitat for Growling Grass Frog in moderate value wetland areas • no habitat for Little Galaxias • limited habitat for wetland birds in the moderate value wetland areas • small area meets definition of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains • contains wetland Ecological Vegetation Classes: Plains Grassy Wetland/Brackish Herbland Complex, Tall Marsh and Aquatic Grassy Wetland.

Wetland current ID	High value wetland number	Wetland description	Ecological values
35564	–	Seasonal wetland likely surface water fed	• potential but limited habitat for wetland birds, constrained to the dam at the north of the wetland • limited habitat for Eastern Long-necked Turtle. • limited to no habitat for Growling Grass Frog or Brown Toadlet • no habitat for Little Galaxias • noes not contain native vegetation mapped as Ecological Vegetation Classes • low value wetland covers entire wetland area.
35566	–	Mostly a dry area rather than seasonal wetland, with damp areas constrained to the drainage line	• potential habitat for wetland birds, including Brolga, in the moderate value wetland areas • limited habitat for Eastern Long-necked Turtle • limited potential habitat for Growling Grass Frog (in moderate value wetland areas) • potential habitat for Brown Toadlet (mostly in moderate value wetland areas) • suboptimal stream habitat for Little Galaxias as there are few areas with in-stream aquatic plants, and channelised creeks with low shade which typically mostly dry out over summer • contains wetland Ecological Vegetation Class: Aquatic Herbland • large areas of low value wetland, which are dominated by pasture.
35595	–	Mostly a damp area rather than seasonal wetland	• limited potential habitat for Eastern Long-necked Turtle and Growling Grass Frog (mostly in moderate value wetland areas) • potential habitat for Brown Toadlet (mostly in moderate value wetland areas) • potential habitat for wetland birds, including Brolga, in the moderate value wetlands • suboptimal stream habitat for Little Galaxias as there are few areas with in-stream aquatic plants, and channelised creeks with low shade which typically mostly dry out over summer • contains treeless Ecological Vegetation Class: Creekline Grassy Woodland • large areas of low value wetland are dominated by cropped land and pasture.
35596	Wetland 8	Seasonal wetland likely surface water fed	• potential habitat for Eastern Long-necked Turtle, Brown Toadlet and Growling Grass Frog • potential habitat for wetland birds, including Brolga, in the high value wetlands • suboptimal stream habitat for Little Galaxias as there are few areas with in-stream aquatic plants, and creeks with low shade which typically mostly dry out over summer • contains wetland Ecological Vegetation Classes: Plains Grassy Wetland, Aquatic Herbland and Aquatic Sedgeland • areas of low value wetland are dominated by grazed pasture.

Wetland current ID	High value wetland number	Wetland description	Ecological values
35597	Wetland 7	Seasonal wetland likely surface water fed	• potential habitat for Eastern Long-necked Turtle, Growling Grass Frog (mostly in high value wetland areas) and Brown Toadlet (mostly in high and moderate value wetland areas) • potential habitat for wetland birds, including Brolga, in the high and moderate value wetlands • suboptimal stream habitat for Little Galaxias as there are few areas with in-stream aquatic plants, and channelised creeks with low shade which typically mostly dry out over summer • contains wetland Ecological Vegetation Classes: Brackish Herbland and Plains Grassy Wetland/Brackish Herbland Complex • large areas of low value wetland, which are dominated by cropped land, pasture or plantation previously affected by dryland salinity.
35649	Wetland 4	Shallow wetland/ floodplain along channelised part of Yam Holes Creek. Seasonal wetland likely surface water fed with overflow from creek in flood events and Wastewater Treatment Plant	• potential habitat for Growling Grass Frog and Brown Toadlet in high and moderate value wetlands • potential habitat for wetland birds including Brolga in the high value wetland areas • Stream habitat for Little Galaxias • contains wetland Ecological Vegetation Class: Plains Sedgy Wetland • large areas of low value wetland, which are dominated by pasture, grazed land and irrigated pasture.
35650	Wetland 2	Seasonal wetland likely surface water fed	• potential habitat for Brown Toadlet and Growling Grass Frog, in high value wetland areas, and Eastern Long-necked Turtle • potential habitat for wetland birds including Brolga in high value wetland areas • wetland habitat for Little Galaxias • contains wetland Ecological Vegetation Classes: Aquatic Sedgeland, Plains Grassy Wetland/Aquatic Herbland Complex and Aquatic Grassy Wetland.
35719	–	Created dam	• potential but limited habitat for wetland birds • limited habitat for Eastern Long-necked Turtle • limited to no habitat for Growling Grass Frog • potential habitat for Brown Toadlet around dam edges • no habitat for Little Galaxias • does not contain native vegetation mapped as Ecological Vegetation Classes. • dominated by large areas of low value wetland.
35735	–	Seasonal wetland likely surface water fed	• limited habitat for Eastern Long-necked Turtle • limited to no habitat for Growling Grass Frog or Brown Toadlet, constrained to the dam at the north of the wetland • suboptimal stream habitat for Little Galaxias • does not contain wetland Ecological Vegetation Classes. Vegetation is mapped as Alluvial Terraces Herb-rich Woodland and Grassy Dry Forest Ecological Vegetation Classes • low value wetland covers wetland area.

Wetland current ID	High value wetland number	Wetland description	Ecological values
–	Wetland 6	Complex of wetlands to the east of the former Beaufort Trotting Track	• potential habitat for Brown Toadlet (mostly in the moderate and high value wetland areas) and Growling Grass Frog (mostly in the high value wetland areas) • potential habitat for Eastern Long-necked Turtle • potential but limited habitat for wetland birds in the high and moderate value wetlands • suboptimal stream habitat for Little Galaxias as there are few areas with in-stream aquatic plants, and channelised creeks with low shade which typically mostly dry out over summer • River Swamp Wallaby-grass and Floodplain Fireweed present in high value wetland areas • contains wetland Ecological Vegetation Classes: Plains Grassy Wetland and Plains Sedgy Wetland.

Note: Table contains all current wetlands within the study area.

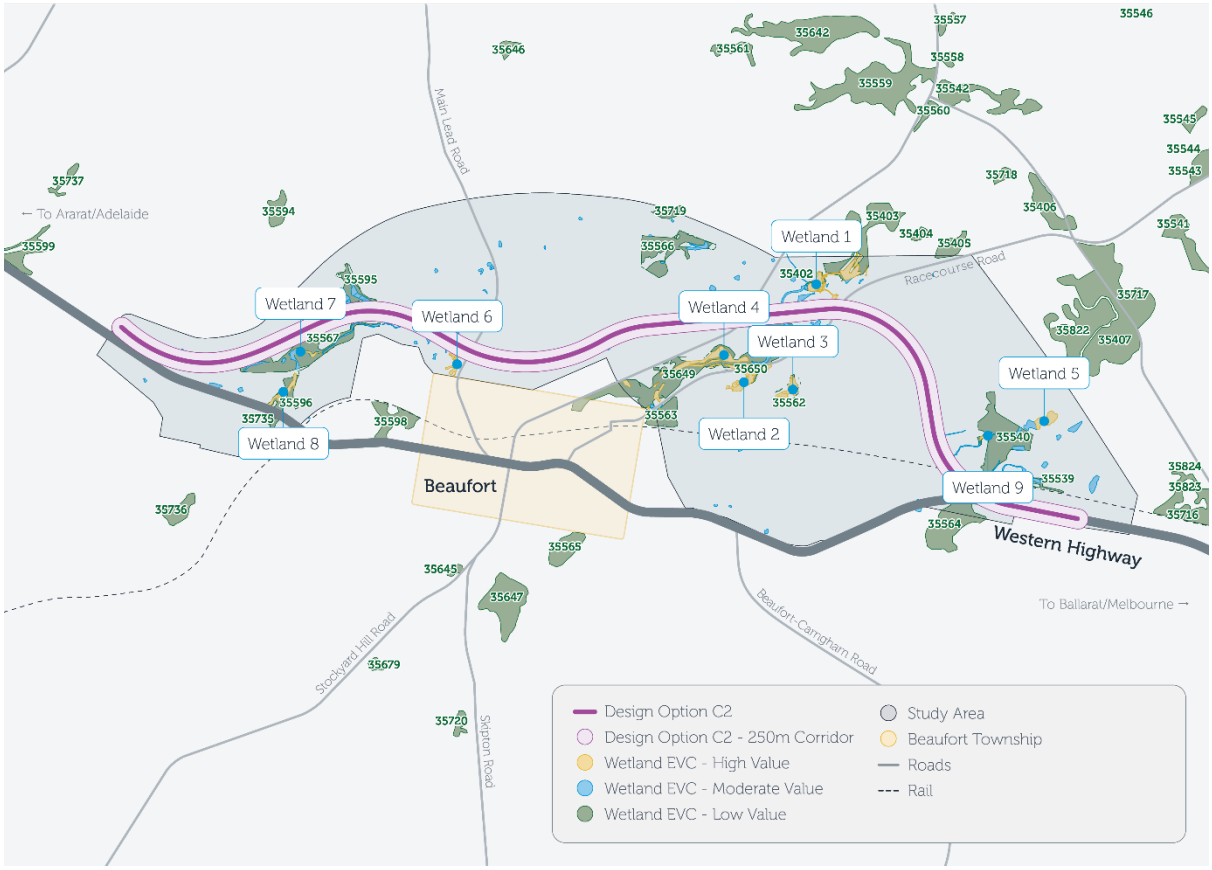

Figure 9.8 Wetlands within the study area

Individual trees

Trees were assessed in accordance with the *Guidelines for the removal, destruction or lopping of native vegetation*. A total of 2,036 trees, including large trees, small trees and dead trees, have been recorded within the study area. Thirteen eucalypt species were recorded in tree surveys, with dominant species being Candlebark, Messmate Stringybark, Scentbark and Yellow Box. Very few River Red-gum are found within the study area. The highest concentration of large trees is typically in remnants on roadsides (e.g. Racecourse Road), rail corridor, private land with patches and paddock trees, and to a lesser extent, public land in the Camp Hill State Forest.

Within the project area, 575 large trees in patches, 45 large scattered trees and 56 small scattered trees were recorded. Tree impacts resulting from the project are discussed in Section 9.7.1.

9.6.2 Flora

Flora species of State and/or National Significance

A total of 471 plant species were recorded in the study area, of which 350 (74%) were native and 121 (26%) introduced species.

Searches of the Department of Agriculture, Water and Environment's *Protected Matters Search Tool* and DELWP's *Victorian Biodiversity Atlas* identified species of State and/or National significance that have been recorded or are predicted to occur within 10 km of the study area. Analysis of the data by WSP ecologists identified that 34 species have a moderate or higher likelihood of occurring in the study area. The full list of flora species recorded in the study area is included in EES Appendix C: *Flora and fauna impact assessment*.

The targeted field surveys confirmed the presence of nine significant species and one further rated as highly likely to occur despite not being recorded during site assessments. These species are detailed in Table 9.10 and their habitat is further discussed below.

Table 9.10 Significant flora species recorded or with a moderate or higher likelihood to occur within the study area

Common name	Scientific name	Conservation status			Habitat	Likelihood of occurrence
		EPBC Act	FFG Act	Vic Advisory list		
Rough Wattle	*Acacia aspera subsp. Parviceps*	–	–	r	Restricted in Victoria, mainly known from sites west of Melbourne (Brisbane Ranges, Werribee Gorge area, Beaufort) with disjunct records from near Wedderburn. Plants grow in shallow soil in dry to moist open Eucalyptus forest.	MODERATE – one record from 1993 in Snow Gum Bushland Reserve from a defined area list. Not found during searches of the project alignments but further searches outside of alignments may find this species. There are a number of records from Trawalla State Forest.
River Swamp Wallaby-grass	*Amphibromus fluitans*	VU	–	–	Largely confined to permanent swamps, principally along the Murray River between Wodonga and Echuca, uncommon to rare in the south (e.g. Casterton, Moe, Yarram), probably due to historic drainage of wetlands.	RECORDED – new records for the area located during site assessments.
Ornate Pink Fingers	*Caladenia ornata*	VU	L	vu	In Victoria known only from the south-west in heathy forest on seasonally moist sandy loam. In some areas *Caladenia ornata* is intermixed with *Caladenia carnea* and some specimens are difficult to assign to one or the other.	RECORDED – multiple new records for the area were discovered during site assessments in Camp Hill Recreation Reserve.
Matted Flax-lily	*Dianella amoena*	EN	L	en	Occurs mainly in lowland grasslands, grassy woodlands, valley grassy forest and creeklines of herb-rich woodland.	RECORDED - several new records for area located in this study.
Yarra Gum	*Eucalyptus yarraensis*	–	*	r	Extending west from Glengarry (near Traralgon) to Melbourne and north-west to Daylesford and Ararat.	RECORDED – A number of new records found during surveys in 2015, 2016 and 2017.
Pale-flower Cranesbill	*Geranium sp. 3*	–	–	r	Usually found in open, grassy areas of dry woodland to forest.	RECORDED – new records for the area located during site assessments.

Common name	Scientific name	Conservation status			Habitat	Likelihood of occurrence
		EPBC Act	FFG Act	Vic Advisory list		
Ben Major Grevillea	*Grevillea floripendula*	VU	L	vu	Restricted to a small area north of Beaufort, from Waterloo to Ben Major Forest. Grows in dry open-forest, on shallow quartzitic soils.	RECORDED – Restricted to a small area north of Beaufort, from Waterloo to Ben Major Forest.
Rosemary Grevillea	*Grevillea rosmarinifolia*	–	–	r	In western Victoria on sandy soils in mallee or shrub associations, or occasionally on basaltic soils. Frequently planted species.	RECORDED – One recorded location appears to be non-planted.
Emerald-lip Greenhood	*Pterostylis smaragdyna*	–	–	r	Nearest records near Langi Ghiran State Park, east of Ararat. Located along the Western Highway near Packhams Lane and Camp Hill State Forest. Typically grows in drier forests and woodlands on well-drained shallow clay loam.	RECORDED - recorded during site surveys in September 2017.
Floodplain Fireweed	*Senecio campylocarpus*	–	–	r	Typically found throughout central Victoria and in the north-east and is usually found in seasonally inundated areas.	RECORDED – new records for the area located during site assessments.

Key to threatened species listing:

- ***EPBC Act:*** *VU = vulnerable, EN = endangered*
- ***FFG Act:*** *L = listed*
- ***Victorian Advisory List:*** *vu = vulnerable, en = endangered, r = rare*

**Rejected for listing as threatened; taxon ineligible*

Significant flora within study area

The results of the flora surveys, undertaken from 2015 to 2017 for the project study area, are summarised below.

Ben Major Grevillea

Ben Major Grevillea (*Grevillea floripendula*) is typically found on higher, north-facing ridges throughout the Camp Hill State Forest and Musical Gully State Forest. Targeted searches were conducted throughout intact Heathy Dry Forest, Grassy Dry Forest and related Ecological Vegetation Class complexes (mostly through Camp Hill State Forest and intact private land sites between Camp Hill State Forest and Musical Gully State Forest). During targeted searches, approximately 65 new locations supporting a number of individual Ben Major Grevillea plants were found in the Camp Hill State Forest which were not previously recorded in the Victorian Biodiversity Atlas.

Ben Major Grevillea locations (from Victorian Biodiversity Atlas records and survey identifications) and field-based habitat mapping and distribution modelling are shown in Figure 9.9.

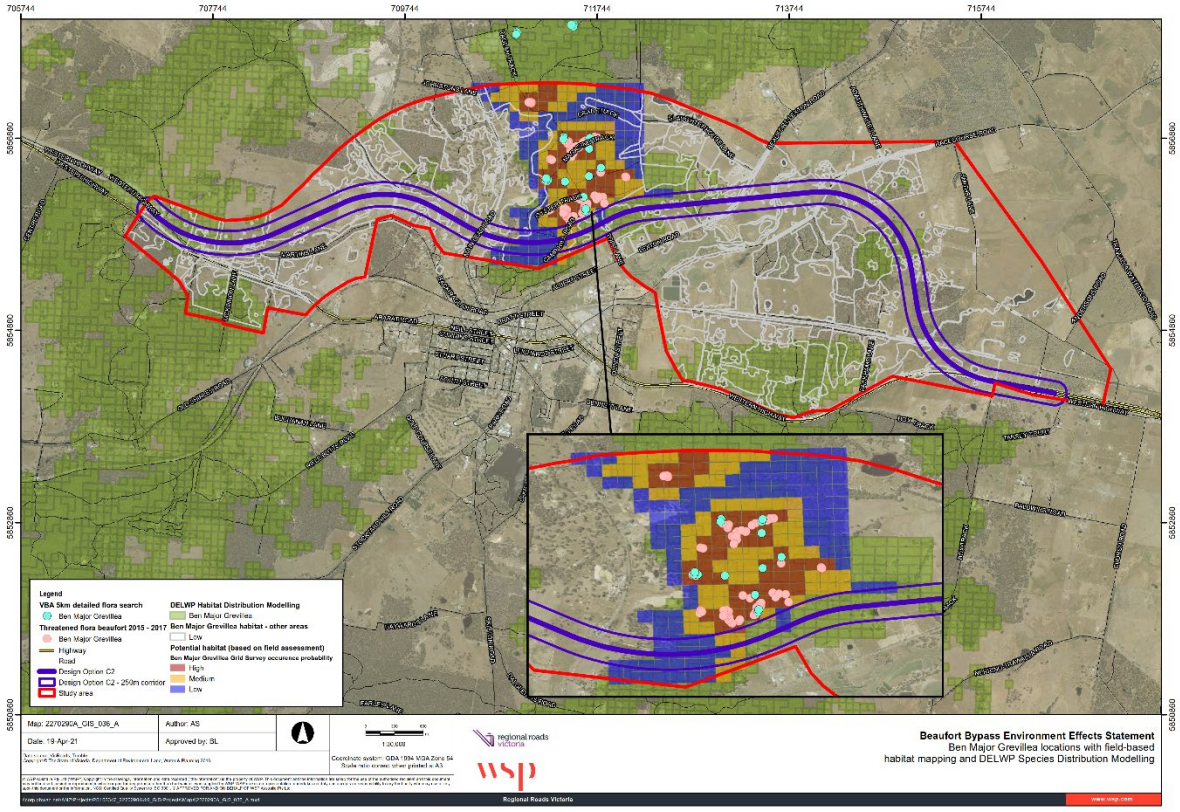

Figure 9.9 Ben Major Grevillea locations with field-based habitat mapping and DELWP Species Distribution Modelling

Emerald-lip Greenhood

A number of Emerald-lip Greenhood (*Pterostylis smaragdyna*) plants were recorded either side of the Western Highway between Beaufort-Carngham Road and Packhams Lane in a previous assessment of the area for the Western Highway upgrade works. Surveys undertaken in September 2017 for the project along Western Highway and in Camp Hill State Forest located several individuals. The location of these records, as well as modelled habitat, are shown in Figure 9.10.

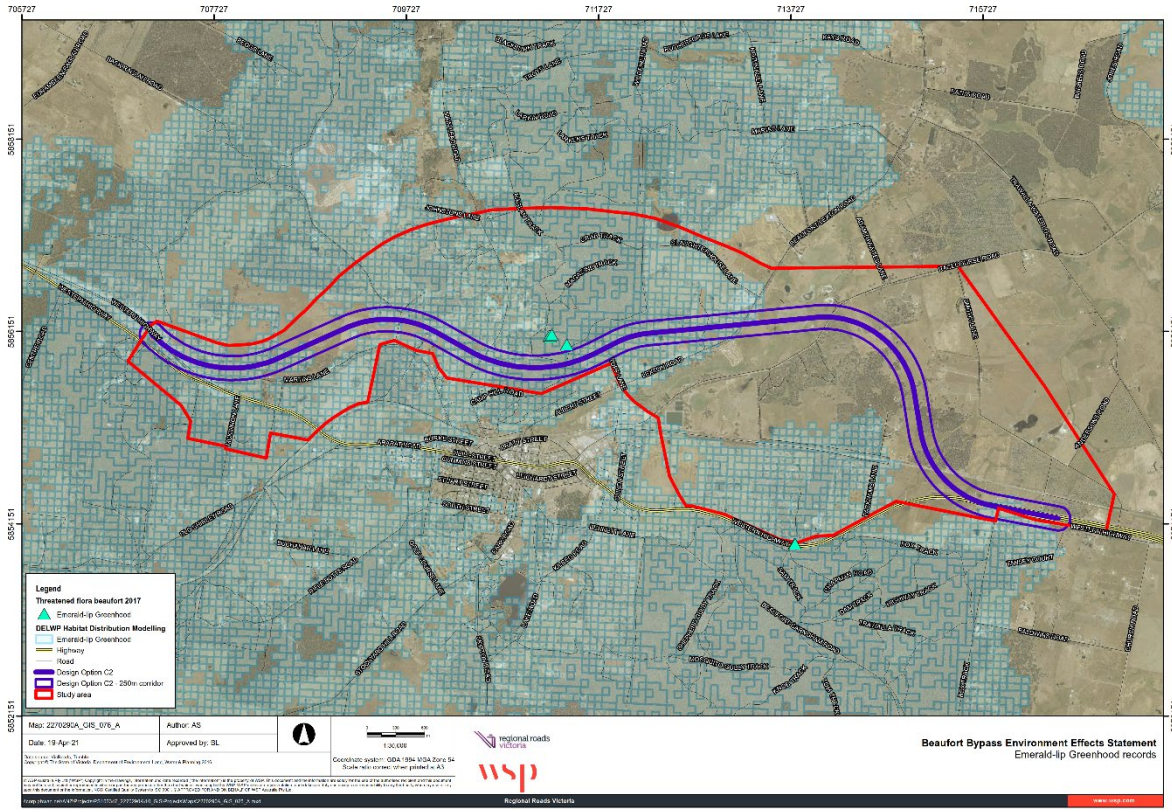

Figure 9.10 Emerald-lip Greenhood records and modelled habitat

Floodplain Fireweed

During field surveys, Floodplain Fireweed (*Senecio campylocarpus*) was mostly found in Plains Sedgy Wetland growing in the drawdown zone on wetland edges and drier parts of wetland dominated by Common Sedge (*Carex tereticaulis*), River Buttercup (*Ranunculus inundatus*) and Common Spikerush (*Eleocharis acuta*). This species was recorded in the Snow Gums Bushland Reserve (~50 plants), the disused Beaufort Trotting Track (~5–10 plants) and in the Melbourne-Ararat rail corridor (1 plant) (Figure 9.11).

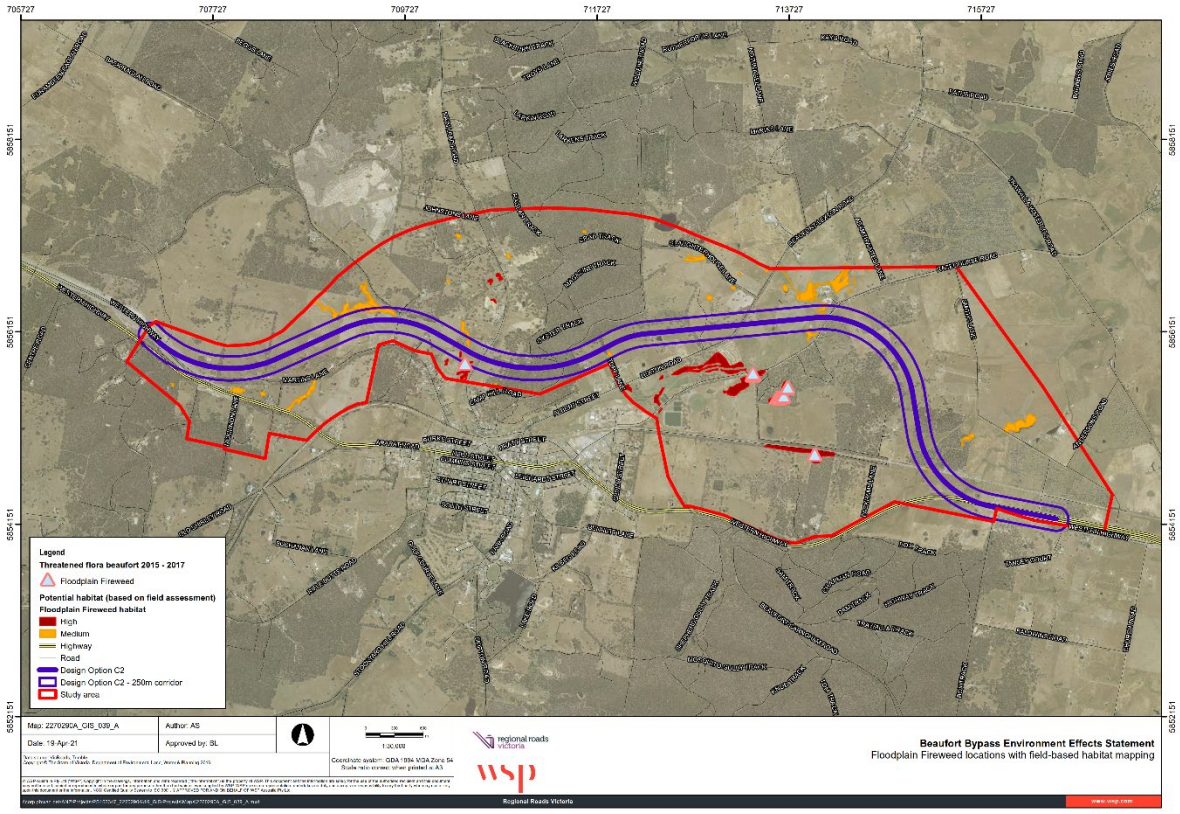

Figure 9.11 Floodplain Fireweed locations with field-based habitat mapping

Matted Flax-lily

Endemic to Victoria, Matted Flax-lily *Dianella amoena* is a small, perennial, tufted lily. Fifteen new occurrences of this species were recorded in the study area, comprising of population clusters in Snow Gum Bushland Reserve and private property on Racecourse Road, and along the Melbourne-Ararat rail corridor, Beaufort-Lexton Road and Back Raglan Road.

Matted Flax-lily locations identified through the project surveys, and habitat mapping and distribution modelling, are shown in Figure 9.12.

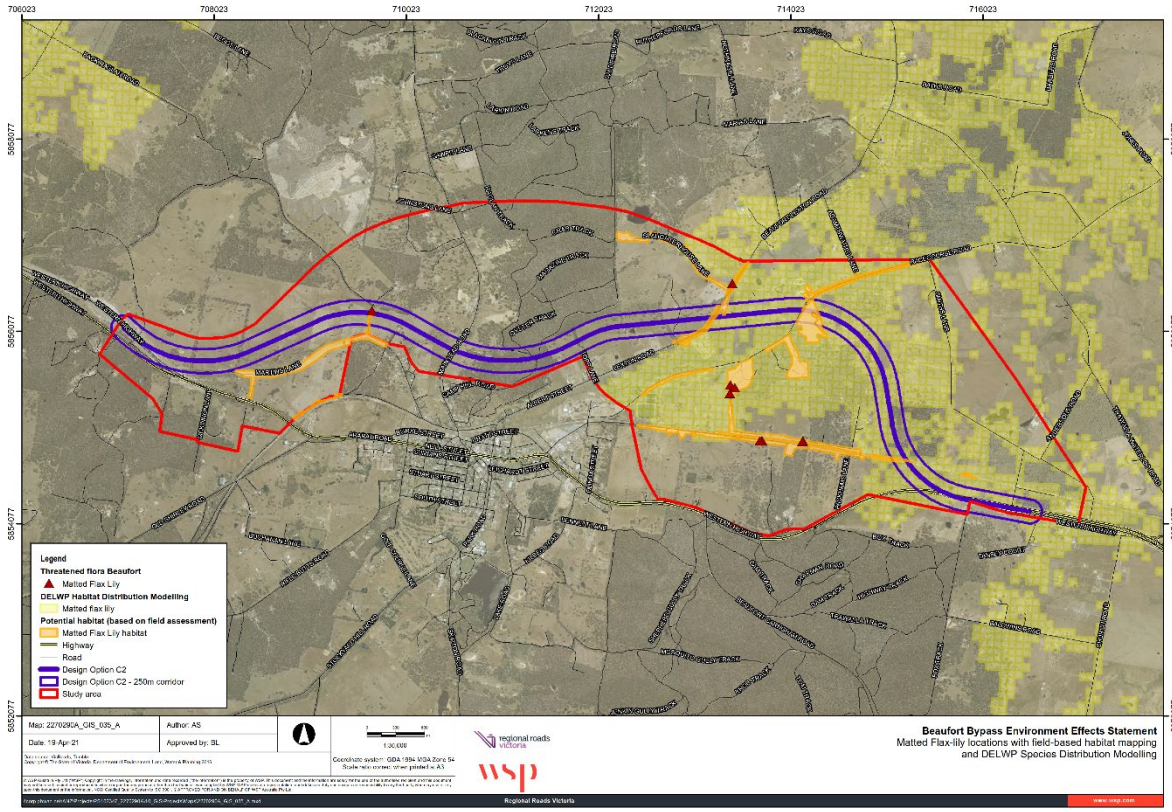

Figure 9.12 Matted Flax-lily locations with field-based habitat mapping and DELWP Species Distribution Modelling

Ornate Pink Fingers

One specimen of Ornate Pink Fingers *Caladenia ornata*, a terrestrial orchid, was recorded during the field surveys completed in 2016. More individuals were recorded in October 2017 through Camp Hill State Forest and on a private land block (Figure 9.13).

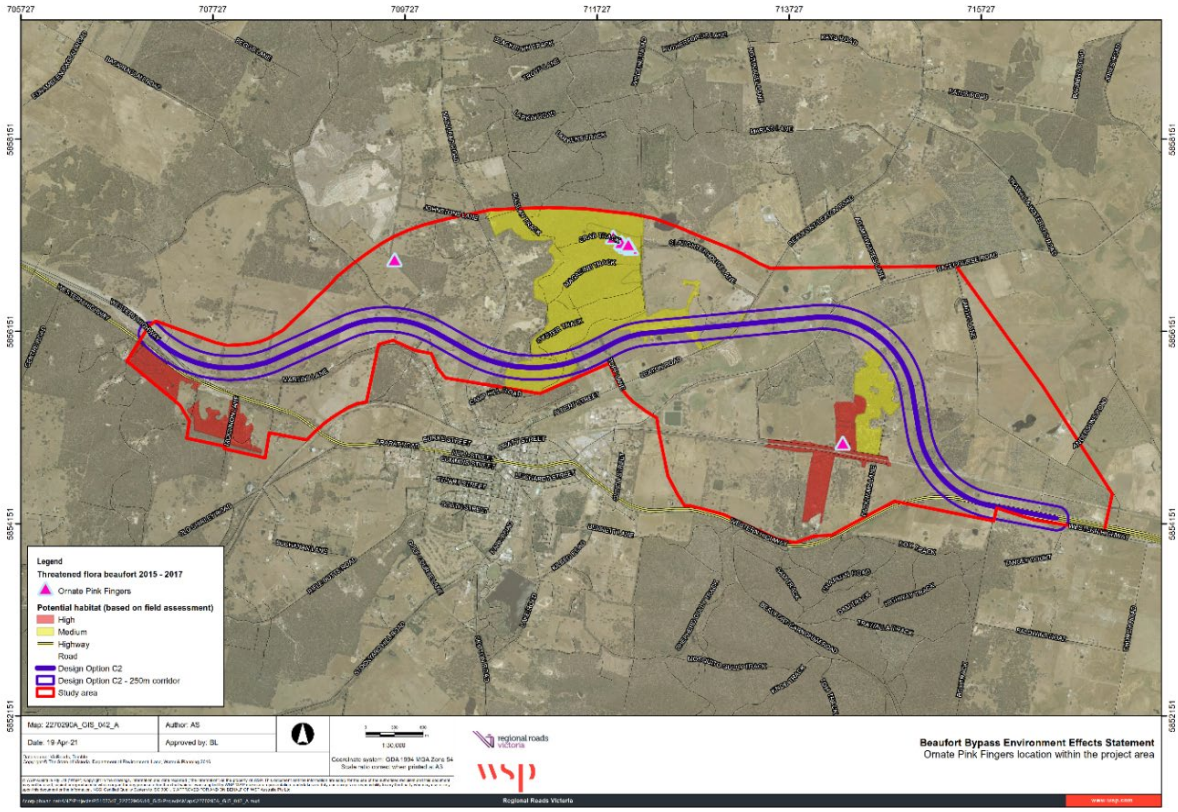

Figure 9.13 Ornate Pink Fingers locations with field-based habitat mapping

Pale-flower Cranesbill

In the study area, Pale-flower Cranesbill *Geranium sp. 3* was found in Grassy Dry Forest Ecological Vegetation Class within a mix of Radiata Pine and native grassy understorey along the rail corridor near Martins Lane, and within the Valley Grassy Forest Ecological Vegetation Class along the Melbourne-Ararat rail corridor.

Figure 9.14 shows the locations Pale-flower Cranesbill identified during the project surveys, as well as habitat mapping and distribution modelling results.

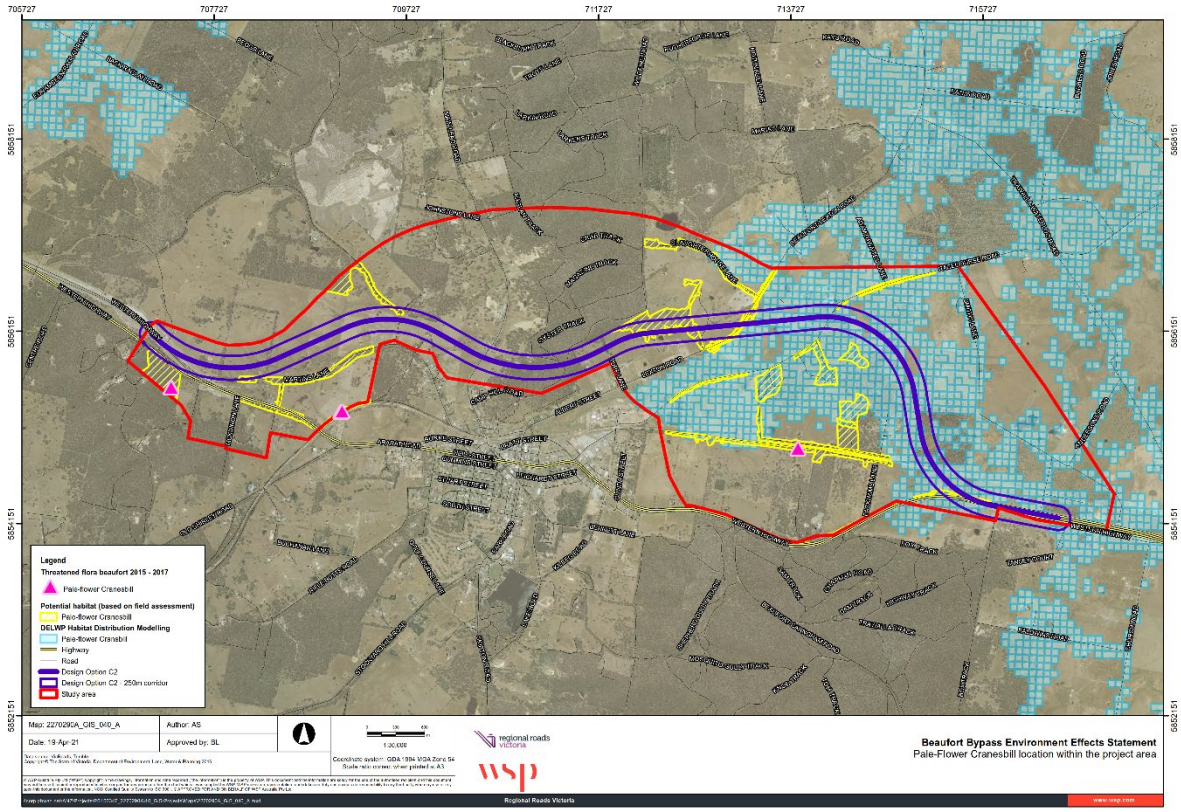

Figure 9.14 Pale-flower Cranesbill locations with field-based habitat mapping and DELWP Species Distribution Modelling

River Swamp Wallaby-grass

River Swamp Wallaby-grass *Amphibromus fluitans* plants have mostly been found in the Ecological Vegetation Classes Aquatic Grassy Wetland, Aquatic Herbland and Plains Grassy Wetland within the study area, growing in water 0.5–1.0 m deep, on wetland edges or on the floor of wetlands in drawdown phase.

An indicative coverage of River Swamp Wallaby-grass was mapped at each identified location, which covers approximately 9.24 ha within the study area (Figure 9.15).

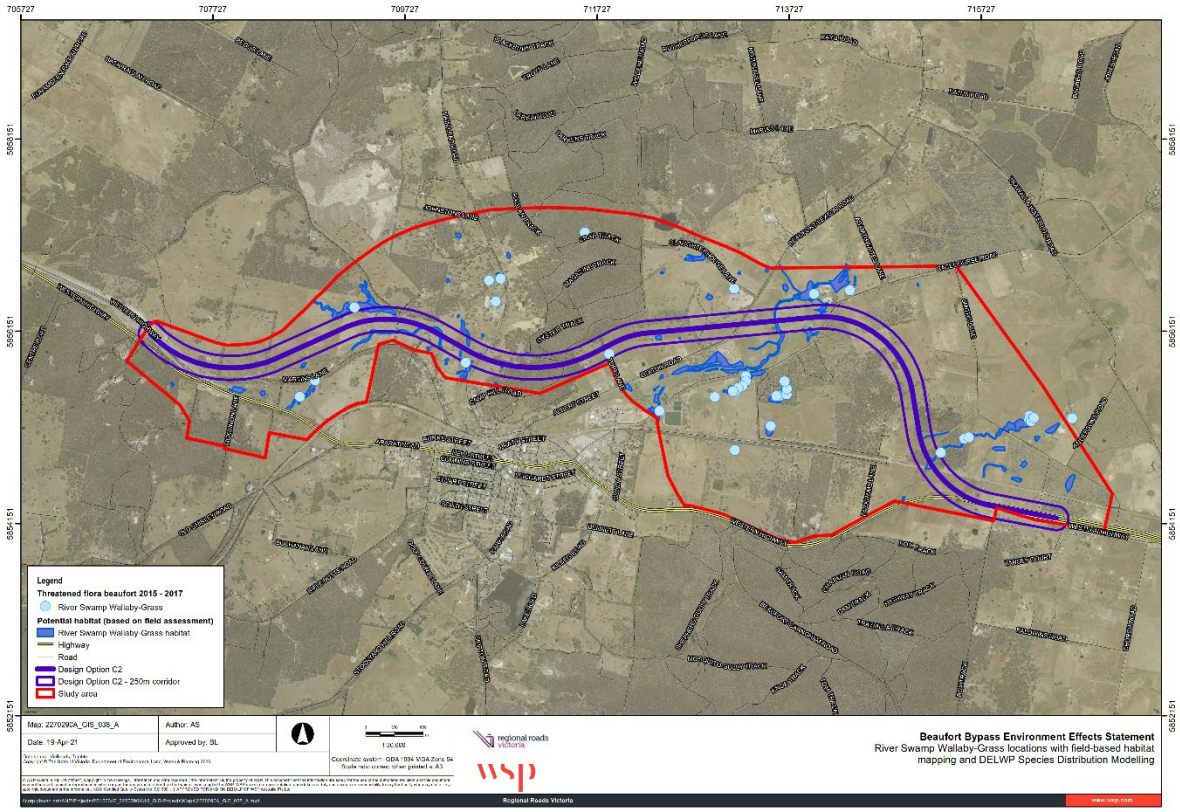

Figure 9.15 River Swamp wallaby-grass locations with field-based habitat mapping

Rosemary Grevillea

Approximately 30 Rosemary Grevillea *Grevillea rosmarinifolia subsp. rosmarinifolia* plants were recorded at an old mullock heap off Racecourse Road (Figure 9.16). It is uncertain if these plants are indigenous or naturalised, however they are within 26 km south from modelled habitat. Figure 9.16 also shows the habitat mapping results for this species within the study area.

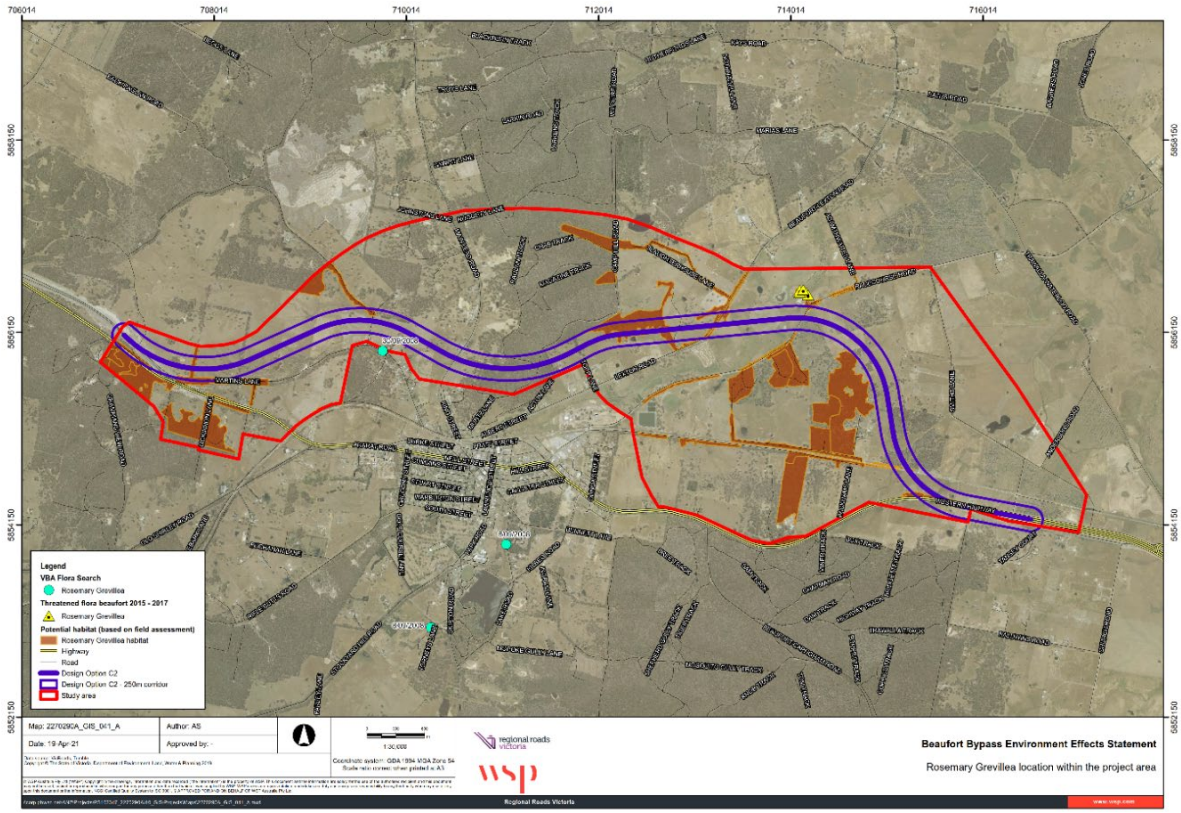

Figure 9.16 Rosemary Grevillea locations with field-based habitat mapping

Rough Wattle

Rough Wattle *Acacia aspera subsp. parviceps* has previously been recorded within the study area in the Snow Gums Bushland Reserve, and there are several records just south of the study area in Trawalla State Forest (Figure 9.17). Despite repeated searches through Snow Gums Bushland Reserve and other parts of the study area, it was not recorded during field surveys conducted in 2015–2017. Given the past records, it is still considered likely to be present within the study area.

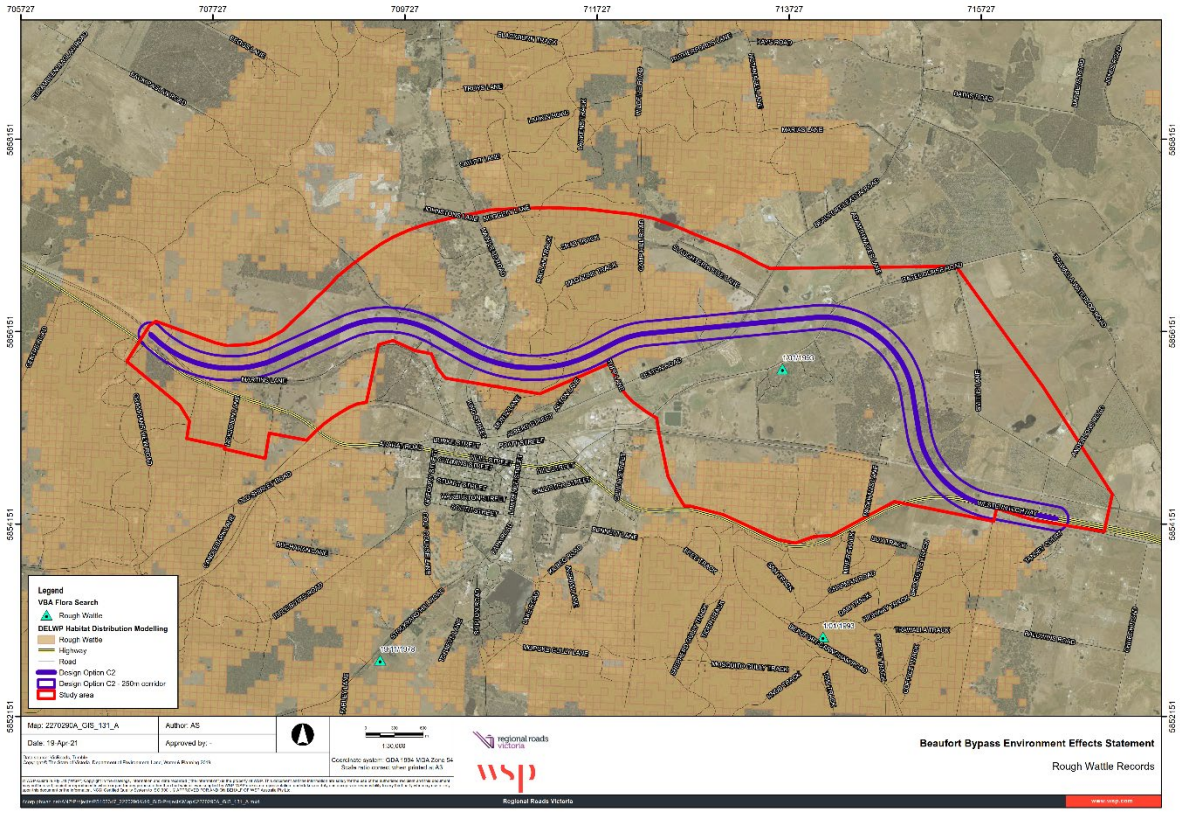

Figure 9.17 Rough Wattle Victorian Biodiversity Atlas records and DELWP Species Distribution Modelling

Yarra Gum

One Victorian Biodiversity Atlas record of Yarra Gum *Eucalyptus yarraensis* occurs in the study area, however this tree could not be relocated during field surveys conducted in 2015–2017. However, 31 new records of Yarra Gum were made during project surveys at Martins Lane, Smiths Lane, Racecourse Road and Johnsons Lane (just outside the study area), along the Melbourne-Ararat rail corridor and within Camp Hill State Forest (Figure 9.18).

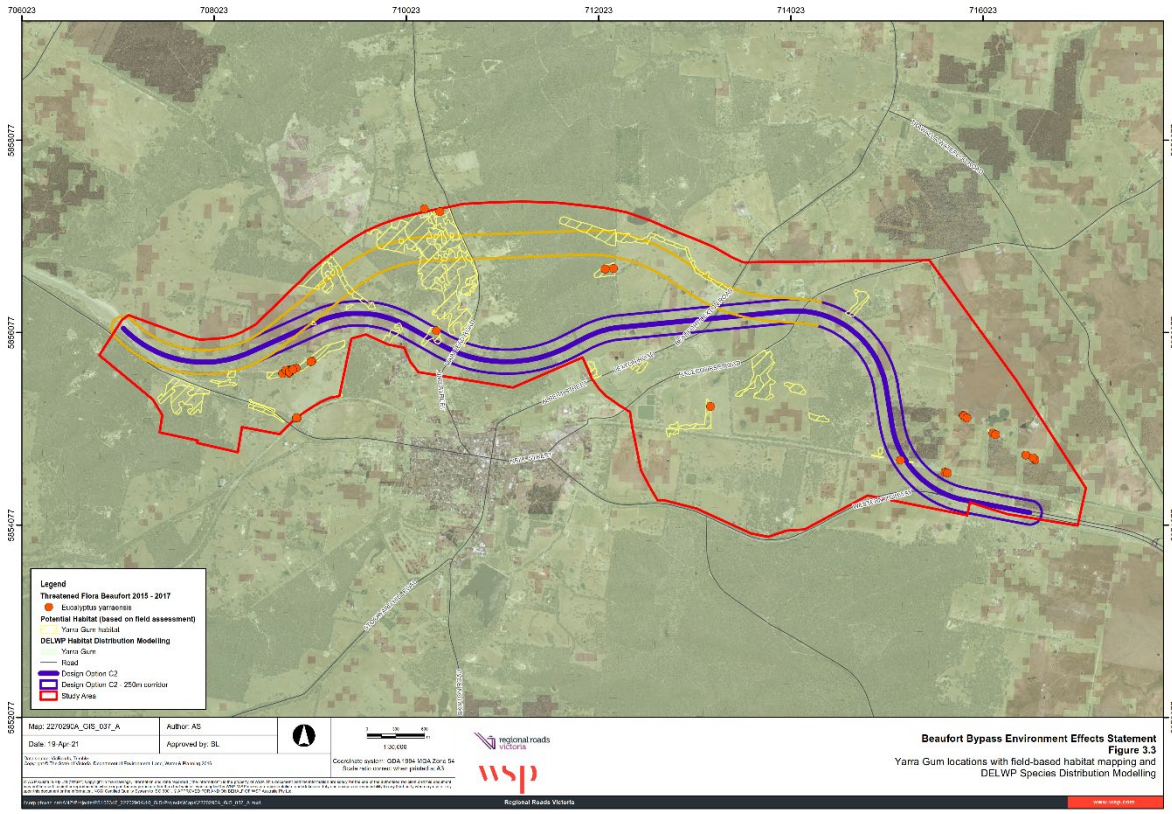

Figure 9.18 Yarra Gum locations with field-based habitat mapping and DELWP Species Distribution Modelling

Declared noxious weeds

The study area supports a number of weeds that are declared noxious under the *Catchment and Land Protection Act 1994*. Plants occurring on this list are known to or have the potential to result in detrimental environmental and/or economic impact.

The field surveys identified six regionally controlled and eight restricted weed species occurring within the study area as listed under the *Catchment and Land Protection Act 1994* (refer to Table 9.11). Six of these weed species are also listed as Weeds of National Significance by the Commonwealth Government.

Table 9.11 Declared noxious weeds occurring within the study area

Scientific name	Common name	*Catchment and Land Protection Act 1994* status	Weeds of National Significance listed
Allium triquetrum	Angled Onion	Restricted Weeds	–
Allium vineale	Crow Garlic	Restricted Weeds	–
Asparagus asparagoides	Bridal Creeper	Restricted Weeds	Yes
Asphodelus fistulosus	Onion Weed	Regionally Controlled Weeds	–
Chondrilla juncea	Skeleton Weed	Regionally Controlled Weeds	–
Cirsium vulgare	Spear Thistle	Restricted Weeds	–
Crataegus monogyna	Hawthorn	Restricted Weeds	–
Cytisus scoparius	English Broom	Restricted Weeds	Yes
Foeniculum vulgare	Fennel	Restricted Weeds	–
Genista monspessulana	Montpellier Broom	Restricted Weeds	Yes
Lycium ferocissimum	African Box-thorn	Regionally Controlled Weeds	Yes
Rosa rubiginosa	Sweet Briar	Regionally Controlled Weeds	–
Rubus fruticosus spp. agg.	Blackberry	Regionally Controlled Weeds	Yes
Ulex europaeus	Gorse	Regionally Controlled Weeds	Yes

9.6.3 Fauna

A total of 160 native fauna species were recorded in the study area across all surveys completed by WSP and GHD (2015), and including previous records from the Victorian Biodiversity Atlas. These records included:

- 127 bird species
- 9 frog species
- 9 native mammals
- 6 native reptiles
- 1 native invertebrate.

A full list of fauna species recorded in the study area can be found in EES Appendix C*: Flora and fauna impact assessment*.

Significant fauna

Of the above mentioned 160 native species, WSP ecologists identified 65 fauna species of State and/or National significance with the potential to occur within 10 km of the study area. This includes 49 birds, one fish, seven mammals, three amphibians, one invertebrate and four reptiles. Of these, 21 species were either recorded, or are considered moderately or highly likely to occur, within or nearby the study area on a permanent or intermittent basis.

Although not identified in database searches, one additional species, the Squirrel Glider (*Petaurus norfolcensis*), was recorded within the study area during targeted surveys conducted in 2015. All 22 species and their conservation statuses are detailed in Table 9.12 below.

Table 9.12 Significant fauna species recorded within the study area

Species (common and scientific name)	Conservation status			Habitat	Likelihood of occurrence
	EPBC Act	FFG Act	Vic Advisory list		
Amphibians					
Brown Toadlet *Pseudophryne bibronii*	–	L	en	Usually found singly under rocks and logs on slopes in grasslands or beside ditches. Found both in wet and dry sclerophyll forest. Breeding congregations usually occur in inundated grassy areas beside gutters, small creeks etc.	RECORDED – Recent records in the study area, with suitable habitat available.
Growling Grass Frog *Litoria raniformis*	VU	L	en	The Growling Grass Frog is usually found amongst emergent vegetation such as Typha, Phragmites and Eleocharis within or at the edges of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds, and farm dams. It also in occurs in irrigation channels and crops, lignum shrublands, black box and river red gum woodlands and at the periphery of rivers.	HIGH – Recent records in the study area, with suitable habitat available.
Birds					
Australasian Shoveler *Anas rhynchotis*	–	–	vu	Uses a wide variety of wetlands; prefers large permanent lakes or swamps that have abundant cover. A semi-nocturnal feeder; during the day floats with other ducks far out on open water. Usually breeds August - November or after rain in semi-arid interior.	MODERATE – A number of nearby records and suitable wetland habitat in the study area.
Baillon's Crake *Porzana pusilla*	–	L	vu	Baillon's Crakes inhabit vegetated wetlands, usually with fresh or brackish water, including swamps, billabongs, lakes and reservoirs and temporarily inundated areas. They often prefer wetlands with floating aquatic vegetation.	MODERATE – recent records, with suitable habitat present in the study area.
Blue-billed Duck *Oxyura australis*	–	L	en	Relatively sparse throughout species range. Found on temperate, fresh to saline, terrestrial wetlands, and occupies artificial wetlands. Prefers deep permanent open water, within or near dense vegetation. Nest in rushes, sedge, Lignum, *Muehlenbeckia cunninghami* and paperbark Melaleuca.	MODERATE – most recent Victorian Biodiversity Atlas record is from 2018.

Species (common and scientific name)	Conservation status			Habitat	Likelihood of occurrence
	EPBC Act	FFG Act	Vic Advisory list		
Brolga *Grus rubicunda*	–	L	vu	Occurs in well vegetated shallow freshwater wetlands, small isolated swamps in eucalypt forests, floodplains, grasslands, paddocks, ploughed fields, irrigated pastures, stubbles, crops, desert claypans, bore drains, tidal areas, mangroves, beach wastes. Roosts in shallow, bare swamps and nests on small islands in wetland or standing in shallow water, eggs are occasionally laid on bare ground.	RECORDED - Recorded during current survey.
Brown Treecreeper (south-eastern ssp.) *Climacteris picumnus victoriae*	–	N	nt	Found in eucalypt woodlands and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts. Nesting occurs in tree hollows.	RECORDED - Recorded during current survey.
Diamond Firetail *Stagonopleura guttata*	–	L	nt	Distributed through central and eastern NSW, extending north into southern and central Queensland and south through Victoria to the Eyre Peninsula, South Australia. Occurs in a range of eucalypt dominated communities with a grassy understorey including woodland, forest and Mallee. Firetails nest in trees and bushes, and forage on the ground, largely for grass seeds and other plant material, but also for insects.	HIGH - Based on landowner observation on their property.
Eastern Great Egret *Ardea alba modesta*	–	L	vu	Great Egrets are common throughout Australia, they prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. Great Egrets can be seen alone or in small flocks, often with other egret species, and roost at night in groups.	MODERATE – Most recent record is from 2019.

Species (common and scientific name)	Conservation status			Habitat	Likelihood of occurrence
	EPBC Act	FFG Act	Vic Advisory list		
Emu *Dromaius novaehollandiae*	–	–	nt	Widespread throughout Australia mainland in a variety of habitats from timbered areas to open country. Mostly found in flat undulating lands but also on timbered ridges, tablelands and moderately hilly terrain, also recorded on ocean beaches, wading in shallow estuarine inlets, mudflats, and saltmarshes. Other coastal habitats include sandplains, sand-dunes, heathlands and low foothills. Tends to nest in areas of extensive cover where disturbance is infrequent and tend to avoid areas frequently disturbed by human activity.	MODERATE – Potential habitat in the study area, however there are low number of records.
Hardhead *Aythya australis*	–	–	vu	On terrestrial wetlands and occasionally sheltered estuarine and inshore waters. Almost entirely aquatic, preferring large deep fresh waters with abundant aquatic vegetation; particularly deep swamps, lakes, creeks, billabongs and alluvial plains.	HIGH – Recorded by GHD in 2015.
Latham's Snipe	M	N	nt	Occurs in freshwater or brackish wetlands generally near protective vegetation cover. This species feeds on small invertebrates, seeds and vegetation. It migrates to the northern hemisphere to breed.	MODERATE – Most recent record is from 2017. Possibly occasional visitor to wetlands in the study area.
Musk Duck *Biziura lobata*	–	–	vu	Widespread in South east E and South West parts of continent, on terrestrial wetlands, estuarine habitats and sheltered inshore waters. Almost entirely aquatic; preferring deep water of large permanent swamps, lakes and estuaries, where conditions stable and aquatic flora abundant. Open water needed for feeding and display, but nesting birds secretive and remain within or beside vegetation. Wetlands with both dense marginal vegetation and large expanses of water suitable all year.	MODERATE – Last record is from 2018.
Painted Honeyeater *Grantiella picta*	VU	L	vu	Lives in dry forests and woodlands. Primary food is the mistletoes in the genus Amyema, though it will take some nectar and insects. Its breeding distribution is dictated by presence of mistletoes which are largely restricted to older trees. Less likely to be found in strips of remnant box-ironbark woodlands, such as occur along roadsides and in windbreaks, than in wider blocks.	HIGH - Based on landowner observation on their property.

Species (common and scientific name)	Conservation status			Habitat	Likelihood of occurrence
	EPBC Act	FFG Act	Vic Advisory list		
Pied Cormorant *Phalacrocorax varius*	–	–	nt	The Pied Cormorant is found in marine habitats including estuaries, harbours and bays. It is also found in mangroves and on large inland wetlands in eastern Australia.	MODERATE – Recent records for this species, with suitable habitat present in study area.
Powerful Owl *Ninox strenua*	–	L	vu	Powerful Owl are endemic to eastern and south-eastern Australia, predominately on the eastern side of the Great Dividing Range. They are typically found in open forests and woodlands, sheltered gullies in wet forests with dense understoreys along watercourses. Will sometimes be found in open areas near forests such as farmland, parks and suburban areas, as well as in remnant bushland patches. They need hollow bearing trees to nest.	HIGH - Suitable habitat available in the study area.
Speckled Warbler *Chthonicola sagittata (syn. Pyrrholaemus sagittatus)*	–	L	vu	Occurs in a wide range of eucalypt dominated vegetation with a grassy understorey and is often found on rocky ridges or in gullies. It feeds on seeds and insects and builds domed nests on the ground. The species has been shown to decrease in abundance as woodland area decreased, and it appears to be extinct in districts where no fragments larger than 100 ha remain. Isolation of Speckled Warbler populations in small remnants increases their vulnerability to local extinction as a result of stochastic events and decreases their genetic viability in the long term.	MODERATE – Potential habitat available in the study area.

Species (common and scientific name)	Conservation status			Habitat	Likelihood of occurrence
	EPBC Act	FFG Act	Vic Advisory list		
Mammals					
Brush-tailed Phascogale *Phascogale tapoatafa*	–	L	vu	Largely arboreal it occurs in a range of habitats which have reliable rainfall (500–2,000 mm) but has preference for open dry sclerophyll forest on ridges (up to 600 m alt) with little/sparse ground cover. It nests in tree hollows and feeds at dusk on arthropods and small vertebrates.	RECORDED – Recorded during 2015 surveys in the Camp Hill State Forest.
Squirrel Glider *Petaurus norfolcensis*	–	L	en	Predominantly inhabits dry sclerophyll forest environments, usually on inland slopes and near riverine corridors.	RECORDED – Recorded during targeted surveys conducted in 2015. Squirrel Gliders were not detected during 2021 surveys and is possible it was misidentified as a Sugar Glider in 2015 as the two species are similar.
Invertebrates					
Golden Sun Moth *Synemon plana*	CR	L	cr	This species occurs where wallaby grasses *Rytiosperma spp*. dominate the understory, such as grassy Box-Gum Woodlands or Natural Temperate Grasslands, as larvae feed exclusively on the roots of wallaby grass. Bare ground separating low tussocks of wallaby grass are key microhabitat features for the Golden Sun Moth, as courting behaviour occurs here.	RECORDED – Recorded during current surveys.

Species (common and scientific name)	Conservation status			Habitat	Likelihood of occurrence
	EPBC Act	FFG Act	Vic Advisory list		
Fish					
Dwarf Galaxias (Protected Matters Search Tool) *Galaxiella pusilla* (Protected Matters Search Tool) Little Galaxias (Victorian Biodiversity Atlas) *Galaxiella toourtkoourt* (Victorian Biodiversity Atlas)	VU	L	en	Occurs in low flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains, and the backwaters of streams and creeks.	HIGH – Species has been recorded in Yam Holes Creek in 2011 immediately downstream of the study area. There is suitable habitat in the study area in Yam Holes Creek and its associated wetland areas, however, subsequent surveys failed to detect this species.
Reptiles					
Eastern Snake-necked Tortoise *Chelodina longicollis*	–	–	dd	Widespread through Coastal and inland waterways, typically inhabiting swamps, lagoons and slow-moving rivers and creeks, but often seen wandering overland far from any apparent water.	RECORDED – shell found in the study area in 2018.

Key to threatened species listing:

- ***EPBC Act:*** *VU = vulnerable, EN = endangered, CR = critically endangered, M = migratory*
- ***FFG Act:*** *L = listed, N = nominated*
- ***Victorian Advisory List:*** *vu = vulnerable, en = endangered, cr = critically endangered, nt = near threatened, dd = data deficient*

Significant fauna and habitat within study area

The results of the fauna and habitat surveys undertaken for the project study area are summarised below.

Australasian Shoveler

There are three previous Australasian Shoveler (*Anas rhynchotis*) Victorian Biodiversity Atlas records in the study area. While this species was not recorded during 2016–2017 field surveys undertake by WSP for the project, it was recorded during previous surveys conducted in 2015.

Blue-billed Duck

The Blue-billed Duck (*Oxyura australis*) was not recorded during the surveys undertaken for the project, however potential wetland habitat is present within the study area. Previous Victorian Biodiversity Atlas records, as recent as 2018, occur approximately 1.3 km south of the study area and one record is located within the study area.

Brolga

The primary habitat for Brolga (*Grus rubicunda*) during the breeding period (July – December) is freshwater meadows or shallow freshwater marshes. This form of habitat is located adjacent to the project construction footprint, which is likely to be used on a seasonal basis for foraging and possibly for breeding. During field surveys, a pair of Brolga was seen at two wetlands within the study area.

Brown Toadlet

Brown Toadlet (*Pseudophryne bibroni*) habitat is typically dry forest, woodland, shrubland and grassland where they shelter in moist depressions and soaks such as drainage lines and small dams. Habitat for Brown Toadlet has been mapped in the study area and the species has been recorded during previous surveys conducted in 2015. No Brown Toadlet were recorded (seen or heard) during the surveys conducted in 2016–2017, however they are still considered to be present in the study area.

Brown Treecreeper

The Brown Treecreeper (*Climacteris picumnus victoriae*), one of the 24 species that makes up the FFG Act listed Victorian Temperate Woodland Bird Community, mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts and nests in tree hollows. This habitat community has been mapped within the study area.

Brush-tailed phascogale

Potential habitat for Brush-tailed phascogale *Phascogale tapoatafa* is present within the project area where it intersects areas of mature native vegetation such as within Camp Hill State Forest. Both Brush-tailed Phascogale and Squirrel Glider were recorded during the 2015 surveys within the study area. Surveys undertaken in 2021 recorded multiple Brush-tailed Phascogales, however no Squirrel Gliders were detected (Figure 9.19).

Diamond Firetail

The Diamond Firetail (*Stagonopleura guttata*), one of the 24 species that makes up the FFG Act listed Victorian Temperate Woodland Bird Community, occurs in a range of eucalypt dominated communities with a grassy understorey. This habitat community has been mapped within the study area, however this species has not been recorded during project surveys.

Eastern Great Egret

No Eastern Great Egrets (*Ardea alba modesta*) were recorded during surveys conducted for the project. However, potential wetland habitat is present within the study area and records indicate the species has been previously located approximately 1.3 km south of the study area.

Eastern Long-necked Turtle

Surveys undertaken in 2015, 2016, 2017 and 2018 throughout wetlands across the study area did not record Eastern Long-necked Turtle (*Chelodina longicollis*). Therefore, it is likely that the species occurs in low numbers in the study area.

Emu

The Emu (*Dromaius novaehollandiae*) has an extensive distribution across mainland Australia, mostly found in flat undulating lands. Given the wide distribution for this species, habitat within the study area was not mapped. While not recorded during project surveys, there are two previous records to the south of the study area and suitable habitat is located within the study area.

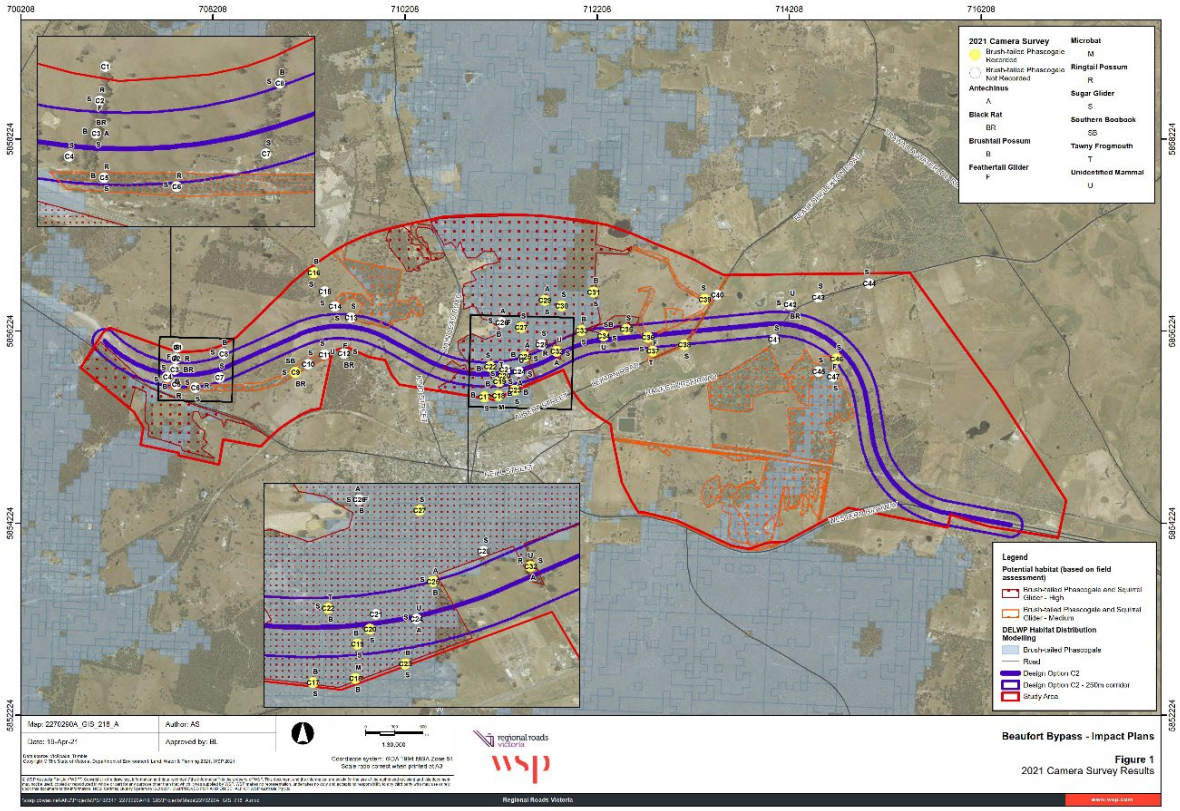

Figure 9.19 Brush-tailed Phascogale potential habitat and 2021 survey results

Golden Sun Moth

The Golden Sun Moth (*Synemon plana*) habitat includes areas which have, or once had, native grasslands or grassy woodlands, including degraded grasslands dominated by introduced Chilean Needlegrass *Nassella neesiana*.

Surveys for Golden Sun Moth within the study area observed the following:

- species first identified in the Beaufort region in 2015
- not observed in surveys conducted in 2017 and 2018 at the properties where they were observed in 2015. However, a population was recorded at three new locations along Racecourse Road
- observed in grassland habitats that exhibited the specific characteristics described above during surveys conducted for the flora and fauna impact assessment
- recorded during incidental surveys on 7 and 12 December 2018 in previous and new locations.

Golden Sun Moth survey records, field-based habitat mapping and distribution modelling results are shown in Figure 9.20.

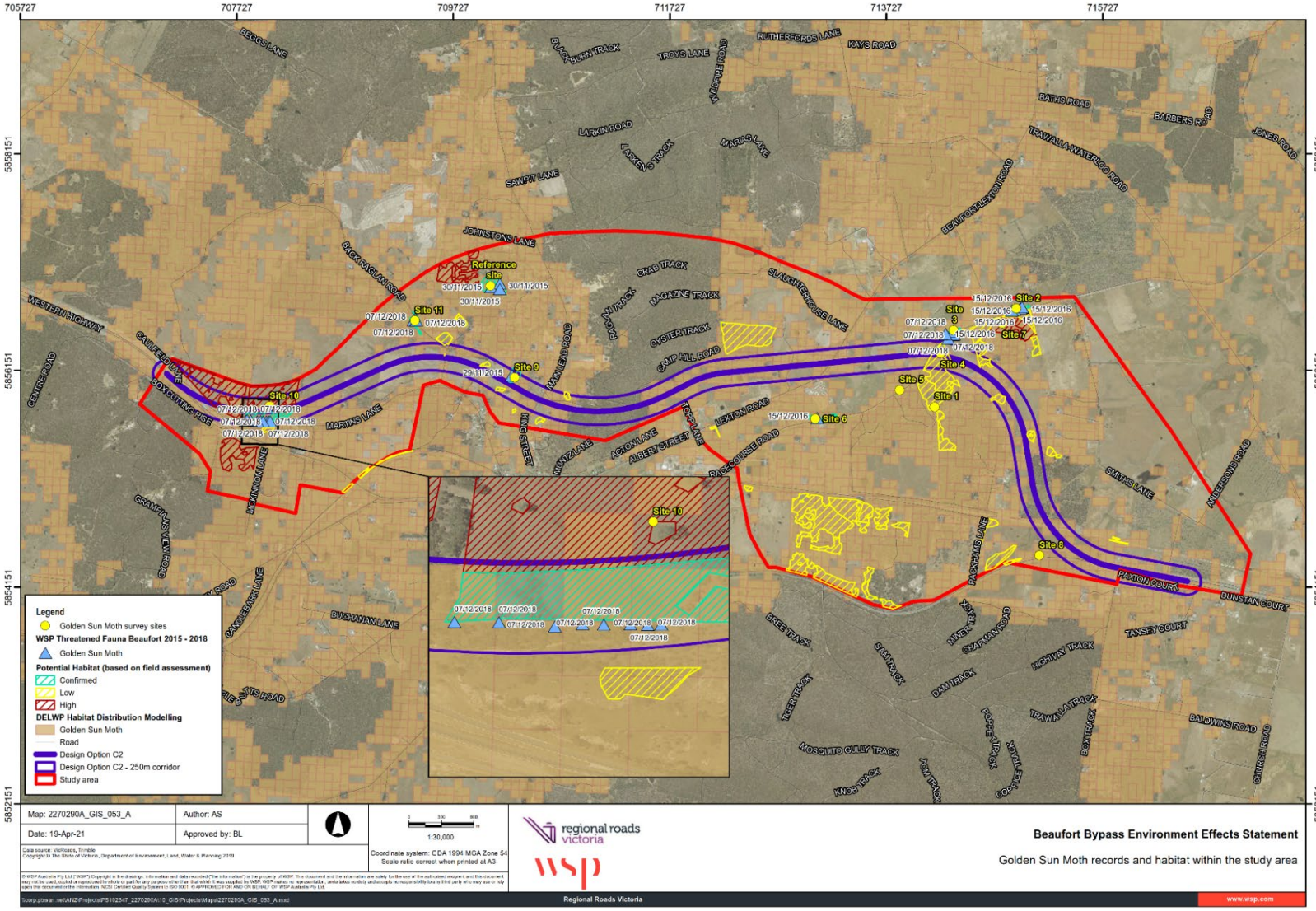

Figure 9.20 Golden Sun Moth records and survey sites with field-based habitat mapping and DELWP Species Distribution Modelling

Growling Grass Frog

The ideal habitat characteristics for Growling Grass Frog (*Litoria raniformis*) are large and relatively permanent waterbodies, with a high proportion of emergent vegetation cover and/or off-stream wetlands, which contain water at least periodically. Many of the wetlands and waterbodies within or adjacent to the project area provide these habitat characteristics (Figure 9.21).

There are a number of Growling Grass Frog records in the Victorian Biodiversity Atlas within or in close proximity to the study area, mostly recorded between 2000 and 2011, with a concentration of records in the Yam Holes Creek floodplain between Racecourse Road and Beaufort-Lexton Road. There are also a cluster of records in the complex of wetlands near Trawalla Road in the Mount Emu Creek and Yam Holes Creek floodplain area.

No Growling Grass Frogs were recorded in 2015 during fauna surveys, possibly due to seasonally very dry conditions. Additionally, no Growling Grass Frogs were recorded during targeted surveys undertaken in 2016/2017 after wetlands had been filled from heavy rainfall. There have been a number of sightings of Growling Grass Frog in the Beaufort area by a local ecologist, which have been considered in the mapping of Growling Grass Frog habitat.

Surveys conducted in 2020 did not identify Growling Grass Frogs within the study area. Given the habitat values and previous records, although not detected during surveys, it is possible that Growling Grass Frog are still present within the study area.

High quality potential aquatic habitat includes many areas considered ‘high quality’ wetlands, as discussed in Section 9.6.1, many of which are the EPBC Act-listed community Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plain. Moderate quality potential aquatic habitat cover the remainder of wetlands, dams and creeks which occur throughout the Yam Holes Creek valley and tributaries.

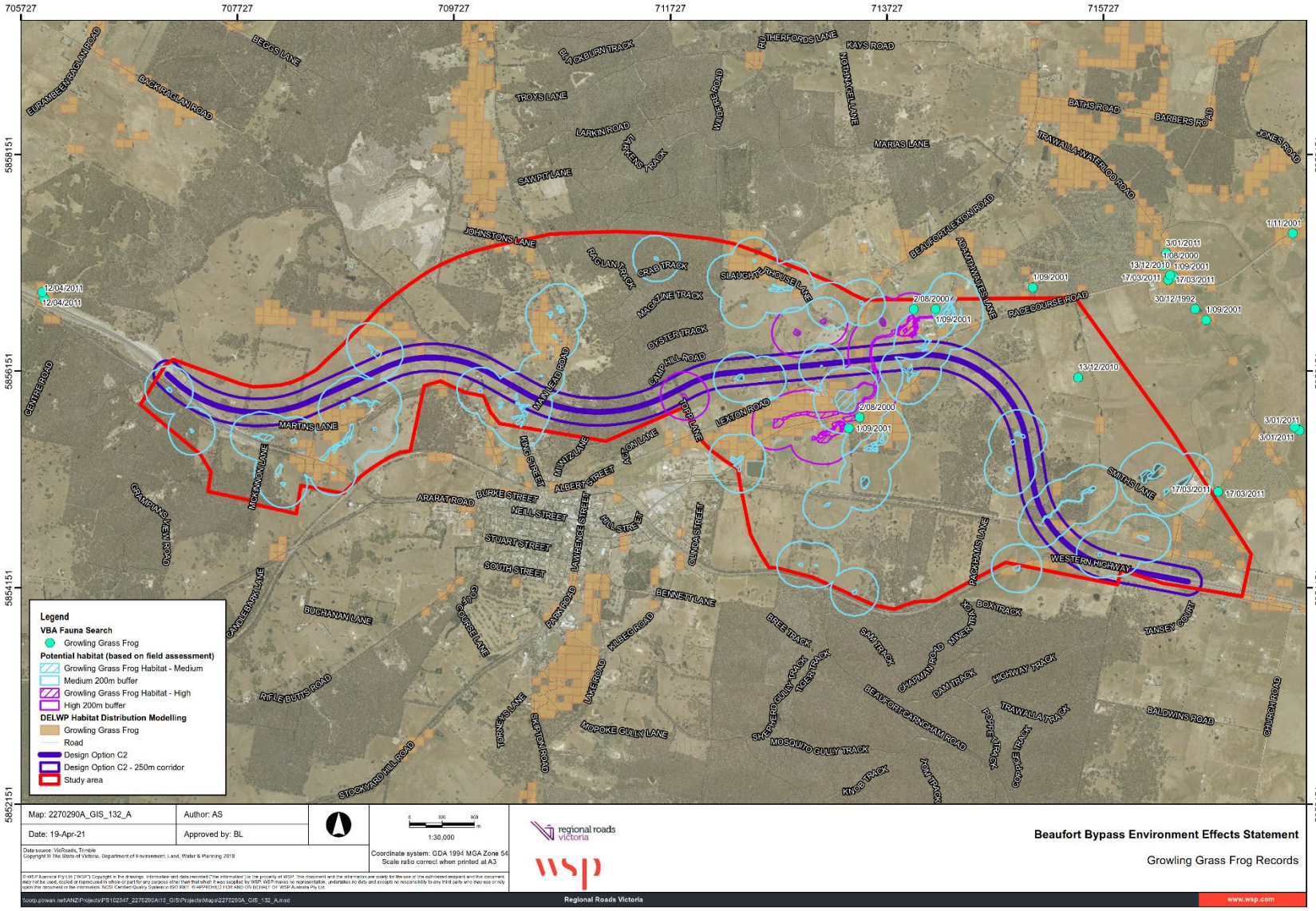

Figure 9.21 Growling Grass Frog Victorian Biodiversity Atlas records with field-based potential habitat mapping and DELWP Species Distribution Modelling

Hardhead

A medium sized duck, the Hardhead (*Aythya australis*) prefers large, deep freshwater habitats with abundant aquatic vegetation. Potential wetland habitat is present within the study area and the species was recorded during surveys in 2015.

Latham's Snipe

The Latham's Snipe (*Gallinago hardwickii*) is a wading bird that inhabits a variety of freshwater permanent and ephemeral wetland habitats that support low, dense vegetation. The species has not been recorded during project surveys, however there are recent records in the Victorian Biodiversity Atlas located less than 2 km south of the study area.

Little Galaxias

Little Galaxias (*Galaxiella toourtkoourt*) (formerly described as the Dwarf Galaxias (*Galaxiella pusilla*) occurs in waters which have an array of native aquatic vegetation, typically preferring swampy floodplain environments. Little Galaxias was recorded in 2011 in Yam Holes Creek. Despite previous records, Little Galaxias was not recorded in the 2016 survey and is not expected to currently exist within the study area. The absence of recent records from the study area suggests that Yam Holes Creek and the other waterways sampled are not primary habitat for this species, however it is considered to have a high likelihood of occurrence.

Records of Little Galaxias in the Victorian Biodiversity Atlas, field-based habitat mapping and distribution modelling results are shown in Figure 9.22.

Musk Duck

The Musk Duck (*Biziura lobata*) prefers large, deep, permanent expanses of water such as lakes and wetlands. Potential wetland habitat of varying quality is present within the study area. While not recorded in recent surveys, Musk Duck was recorded during the 2015 surveys.

Painted Honeyeater

Painted Honeyeater (*Grantiella picta*) live in dry forest and woodland habitats, While the species has not been formally recorded during project surveys, may occur in patches of larger vegetation such as Camp Hill State Forest. This species is one of the 24 species that makes up the FFG Act listed Victorian Temperate Woodland Bird Community

Pied Cormorant

The Pied Cormorant (*Phalacrocorax varius*) is found in marine habitats including estuaries, harbours and bays. Within the study area, potential habitat consists of large expanses of water with dense marginal vegetation. The species was not recorded during project surveys, however two recent records within the Victorian Biodiversity Atlas indicates the presence of the species nearby.

Powerful Owl

The Powerful Owl (*Ninox strenua*) typically inhabits open forests, open woodlands and sheltered gullies in wet forests with dense understoreys along watercourses. Suitable habitat for the Powerful Owl is present within the study area, with Camp Hill State Forest supporting many large hollow-bearing trees. This species has not been recorded during surveys for this project, however it is considered likely to occur at least periodically.

Speckled Warbler

The Speckled Warbler (*Chthonicola sagittate*), one of the 24 species that makes up the FFG Act listed Victorian Temperate Woodland Bird Community, is a small woodland bird that inhabits a wide range of eucalypt dominated vegetation with a grassy understorey. This habitat community has been mapped within the study area, however Speckled Warbler has not been recorded during project surveys.

Striped Legless Lizard

No Striped Legless Lizards (*Delma impar*) were observed during the tile surveys. The flora and fauna impact assessment determined that there is very little suitable habitat for Striped Legless Lizard based on the lack of Plains Grassland vegetation and basalt-derived geology. This species is considered to have a low likelihood of occurrence within the study area.

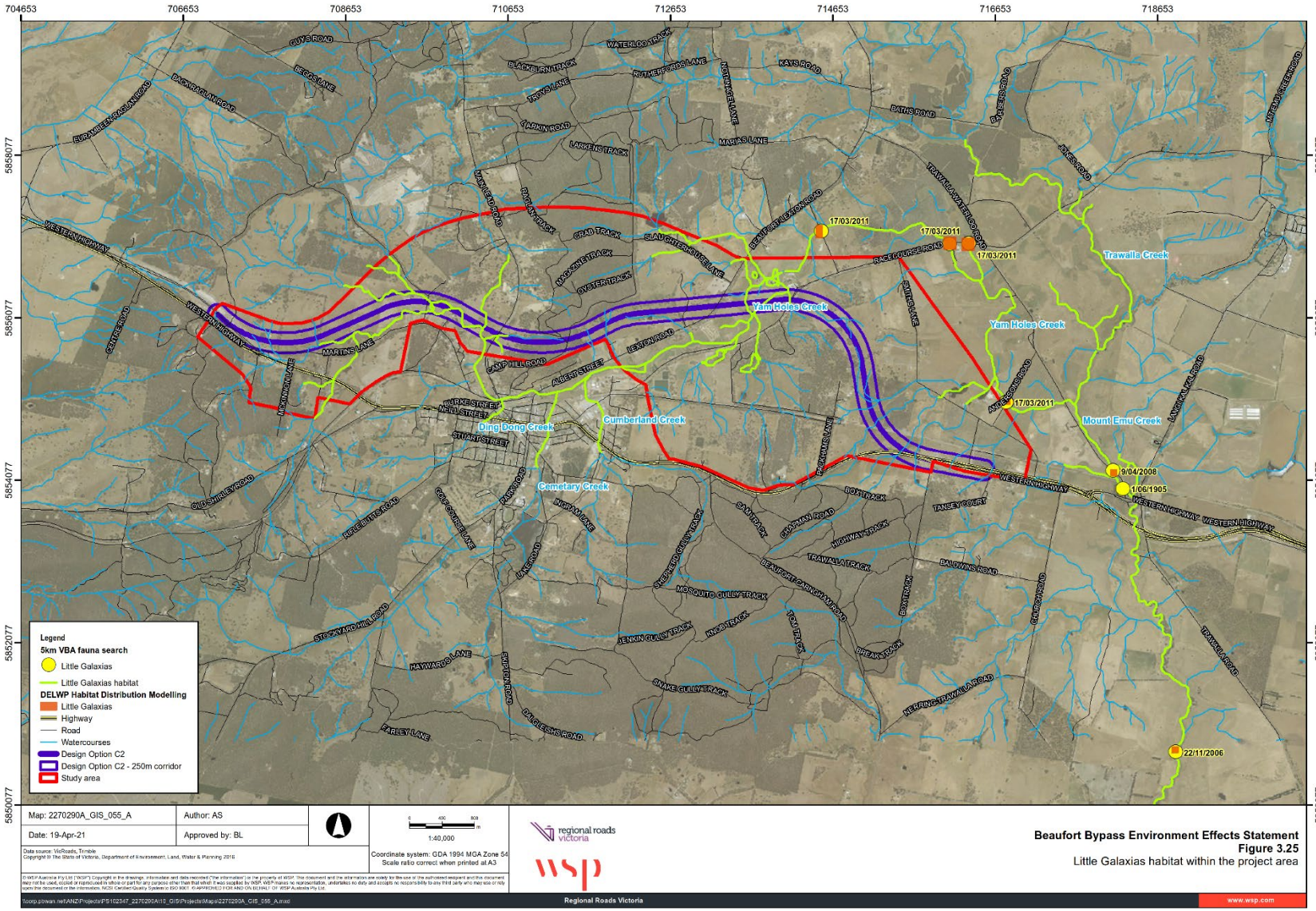

Figure 9.22 Little Galaxias Victorian Biodiversity Atlas records with field-based habitat mapping and DELWP Species Distribution Modelling

Victorian Temperate Woodland Bird Community

The Victorian Temperate Woodland Bird Community is listed under the FFG Act and is defined as a suite of bird species which has declined significantly, mainly associated with drier woodlands on the slopes and plains north of the Great Dividing Range.

Of the 24 species which make up this community, two species, the Brown Treecreeper and the Fuscous Honeyeater, were observed in the study area in 2015. There are unconfirmed (although reasonably reliable) records of Painted Honeyeater and Diamond Firetail by a local landowner on their property on Johnstons Lane. There are also records of several other species in this community in the Victorian Biodiversity Atlas from within or near the study area.

Given the above, the majority of the woodland and forest Ecological Vegetation Classes within the study area have been mapped as Victorian Temperate Woodland Bird Community. The extent of Victorian Temperate Woodland Bird Community mapped within the study area is shown in Figure 9.7 above, and amounts to 31.56 ha within the project construction footprint.

Habitat connectivity existing conditions

The Wildlife Connectivity Impact and Mitigation Assessment (which forms part of the flora and fauna impact assessment) identified for a species with a short dispersal range, such as the Golden Sun Moth, preferred habitat within the study area is highly fragmented, with large distances between suitable habitat. In comparison, habitat for the Growling Grass Frog, also a short-range species, was slightly less fragmented due to the well-connected patches of habitat that extend from the centre to the east of the study area via the Yam Holes Creek system.

For wider ranging species such as woodland bird species, the large patches of habitat in Camp Hill State Forest and Musical Gully, to the north of the study area, are currently isolated from patches of habitat in Trawalla and Andrews State Forest, which are located in the south. This is largely due to the existing roads and built up area of Beaufort as some species of woodland birds will not fly over large areas of open spaces, such as the Western Highway.

In contrast, for the Echidna and Brush-tailed Phascogale, which are longer-distance dispersers, the landscape is relatively unfragmented due to the presence of scattered trees and woody vegetation along minor roads that enable these species to move throughout most of the study area.

9.7 Impact assessment

The future construction and operation of the project is likely to affect the local ecology in a number of ways. Impacts may be temporary, predominantly occurring during the construction phase, or ongoing for the operational phase of the bypass. The impacts can be classified as ‘direct’ impacts, for example the loss of vegetation through clearing for the road, or ‘indirect’ impacts, such as increased noise and light from the new road. The broad types of impacts likely to be associated with the project, and the potential nature of the impacts without specific mitigation measures, are discussed in the following sections.

9.7.1 Construction

Loss of vegetation and habitat

Loss of habitat, together with habitat degradation and fragmentation, is one of the most critical impacts to native flora and fauna in Australia. For fauna, these processes reduce the ability of the land to provide necessary resources (including foraging, roosting and breeding resources), and increase competition between species. Fragmentation of native vegetation can lead to increased ‘edge effects’, which is where habitat at the edge of the vegetation patch suffers more impacts from dust, noise, light and weed invasion than the middle of a single larger patch. Fragmentation can also split a population of a species and cause a barrier to dispersal, which can lead to smaller population sizes, inbreeding depression, greater susceptibility to environmental variation, and local extinction.

Ecological vegetation classes

The project will require clearing of approximately 47.95 ha of mapped vegetation and habitat within the construction footprint to construct the project. The extent of direct vegetation/habitat loss and the impacts upon significant biodiversity values are detailed below.

The total amount of vegetation removal expected for the construction of the project, based on the current design, is detailed in Table 9.13 below, separated into each Ecological Vegetation Class.

Table 9.13 Breakdown of impacts on Ecological Vegetation Classes in the construction footprint

Ecological Vegetation Class number	Ecological Vegetation Class name	Ecological Vegetation Class conservation status	Hectares (ha)
20	Heathy Dry Forest	Least Concern	14.432
22	Grassy Dry Forest	Depleted	20.532
47	Valley Grassy Forest	Vulnerable	7.185
67	Alluvial Terraces Herb-rich Woodland	Endangered	1.325
125	Plains Grassy Wetland	Endangered	0.510
136	Sedge Wetland^	Vulnerable	0.350
175	Grassy Woodland	Endangered	0.764
647	Plains Sedgy Wetland	Endangered	0.030
653	Aquatic Herbland	Endangered	0.944
		Total (ha) mapped in patches	**46.072**
n/a	Current Wetland (WET_0000)	Unclassified	1.878
		Total (ha) mapped in patches, including DELWP modelled wetland	**47.950**
		EnSym output total*	**50.714**

^ Sedge Wetland used as closest Ecological Vegetation Class to Aquatic Sedgeland

** total areas from the EnSym outputs are slightly different to totals to include canopies of trees on the edges of patches as required as per the 'Guidelines for the removal, destruction or lopping of native vegetation' (DELWP 2017)*

Several Ecological Vegetation Classes are also consistent with two threatened vegetation communities under the EPBC Act. The breakdown of areas of threatened vegetation communities within the proposed construction footprint for the project is provided in the Table 9.14 below. The White box – Yellow Box – Blakely's Red Gum Grassy Woodland vegetation community mapped within the study area is not impacted by the project area or construction footprint.

Table 9.14 Area of threatened vegetation communities within the proposed construction footprint

Community name	Status	Hectares (ha) in proposed Construction Footprint	Assessment of impacts	Severity rating of impact (without mitigation)
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered under EPBC Act	0.312	Direct impacts to the Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains within the project construction footprint near Yam Holes Creek. Other impacts during construction may include impacts resulting from dust and the introduction of weeds. Additionally, any significant changes in surface water hydrology, including water levels and water quality, may have flow on effects for this community.	**Moderate**

Community name	Status	Hectares (ha) in proposed Construction Footprint	Assessment of impacts	Severity rating of impact (without mitigation)
Victorian Woodland Bird Community	Threatened under FFG Act	32.800	Direct impacts to the Victorian Woodland Bird Community within the project construction footprint. Other impacts may also occur outside of the construction footprint without mitigation through unapproved clearing, dust and weeds.	**High**

Trees

It is important to consider potential impacts to large trees in the assessment of impacts to biodiversity and habitat and in the sourcing of vegetation offsets, as defined under the *Guidelines for the removal, destruction or lopping of native vegetation* (DELWP 2017). Up to 348 large canopy trees (both in patches and scattered) have the potential to be impacted by construction of the bypass. Large trees typically contain hollows that provide habitat. Loss of these trees will impact hollow-dependent species.

A breakdown of preliminary losses of trees (large trees and small scattered trees only) is provided in Table 9.15. This includes those trees which occur outside the construction footprint, but which would have greater than 10% impact upon their Tree Protection Zone, resulting in a likely loss of the tree.

Table 9.15 Summary of proposed tree loss for the construction footprint

	Number impacted	
Tree type	**Large trees**	**Small trees**
Scattered tree	21	7
Trees in patches	327	Not counted (assessed through Ecological Vegetation Class patches)
Totals	348	7

Note that this assessment does not include impacts on small trees in patches. While the future construction of the project will result in the loss of a considerable number of small trees in patches, these are accounted for through Ecological Vegetation Class impacts. The total number of trees lost will be confirmed during the detailed design phase through an arborist assessment.

Flora

Some habitat loss for significant terrestrial and wetland flora species may occur as a consequence of the construction of the project. Four threatened flora species were recorded within the project construction footprint. These are listed in Table 9.16 with an assessment of the likely impact without mitigation.

Table 9.16 Threatened flora species impacted by proposed construction footprint

Common name	Scientific name	EPBC listed	FFG Act listed	Advisory list	Direct clearing impacts
Matted Flax-lily	*Dianella amoena*	Endangered	Listed	Endangered	Two records within construction footprint. One record located within the construction footprint and will be impacted, while the other is located outside the construction footprint. Impacts on the species from construction may occur without mitigation, particularly from dust, weeds, or inadvertent clearing.
Ben Major Grevillea	*Grevillea floripendula*	Vulnerable	Listed	Vulnerable	Construction footprint avoids all records but does pass through potential habitat. Impacts on the species from construction may occur without mitigation, particularly from dust, weeds, or unapproved clearing.
Yarra Gum	*Eucalyptus yarraensis*	–	–	Rare	Two records within construction footprint: • one large Yarra Gum was recorded along the rail corridor where the construction footprint crosses the corridor to the east. It is likely to impacted • a second Yarra Gum was recorded north of the Trotting Track between the proposed road alignment and an exit to Main-Lead Road. Impacts on the species from construction may occur without mitigation, particularly from dust, weeds, or inadvertent clearing. Any significant changes in surface water hydrology or changes to creek realignment to the west of the individual Yarra Gum north of the racecourse, may have flow on effects for this species.
River Swamp Wallaby-grass	*Amphibromus fluitans*	Vulnerable	–	–	Two records within construction footprint. Species was recorded in a dam off Topp Lane, current construction footprint intersects the dam it was recorded in. The current construction footprint avoids another record of this species by approx. 70 m east of Main Lead Road. Impacts on the species from construction may occur without mitigation, particularly from dust, weeds, or inadvertent clearing. Any significant changes in surface water hydrology, including water levels and water quality, may have flow on effects for this species.

Fauna habitat

Some habitat loss for threatened fauna species listed as threatened under the EPBC Act, FFG Act and/or the Victorian Advisory List will occur as a consequence of the project.

Fourteen significant fauna species were considered to have a moderate to high likelihood of occurrence in the study area. The amount (ha) of habitat loss for each species within the construction footprint is outlined in Table 9.17.

Key for Conservation Status

Listing under the EPBC Act: CR = Critically Endangered, EN = Endangered, VU = Vulnerable, M = Migratory

Listing under the FFG Act: L = listed as threatened, N = Nominated for listing as threatened

Listed on the Victorian Advisory List of threatened species: cr = Critically Endangered, en = Endangered, vu = Vulnerable, nt = near threatened, dd = Data Deficient

Table 9.17 Breakdown of potential impact areas of mapped fauna species habitat

Habitat type	Construction footprint impacts	Assessment of impacts	Severity rating of impact (without mitigation)
Wetland bird habitat Threatened species (and their conservation status) include: • Australasian Shoveler (vu) • Baillon's Crake (L, vu) • Blue-billed Duck (L, en) • Brolga (L, vu) • Eastern Great Egret (L, vu) • Hardhead (vu) • Latham's Snipe (M, N, nt) • Musk Duck (vu) • Pied Cormorant (nt)	• 1.520 ha of moderate quality habitat	Two migratory species, Curlew Sandpiper *Calidris ferrunginea* and Latham's Snipe *Gallingo hardwickii* have been recorded within the 10 km search area. However, the potential impact on these two species as a result of the project is likely to be **low**. Wetland habitat within the study area consists mainly of seasonal wetlands, farm dams and drainage lines. A number of wetland-dependent birds such as Brolga *Grus rubicunda* and Blue-billed Duck *Oxyura australis* may have habitat which is affected by the project. It is not expected that the project will have a significant impact on habitat for these species.	Eastern Great Egret and Pied Cormorant – **Low** Other wetland bird species – **Moderate**

Habitat type	Construction footprint impacts	Assessment of impacts	Severity rating of impact (without mitigation)
Woodland bird habitat Threatened species (and their conservation status) include: • Brown Treecreeper (N, nt) • Diamond Firetail (L, nt) • Painted Honeyeater (VU, L, vu) • Powerful Owl (L, vu) • Speckled Warbler (L, vu)	• 32.800 ha	The largest impact woodland bird species will result from the removal of Victorian Temperate Woodland Bird Community habitat at Camp Hill State Forest and, to a lesser extent, roadside reserves and private property within and adjacent to the construction footprint. Other potential impacts include fragmentation of habitat, loss of connectivity, increased noise disturbance and ecological light pollution.	Painted Honeyeater – **Low**, with a low likelihood of a significant impact without mitigation Powerful Owl – **High** Other woodland bird species – **Moderate**
Growling Grass Frog habitat (status: VU, L, en)	• 0.281 ha high quality potential aquatic habitat • 1.132 ha moderate quality potential aquatic habitat • 17.285 ha high quality potential terrestrial habitat • 68.179 ha moderate quality potential terrestrial habitat	Growling Grass Frogs were not detected during surveys, however, previous records and habitat exist for them in the study area. For the purposes of the assessment, it is assumed Growling Grass Frogs are present in the study area. Most of the impacts on potential habitat for this species are expected to occur at Yam Holes Creek floodplain between Racecourse Road and Beaufort-Lexton Road. The project will result in the removal and fragmentation of some potential terrestrial habitat and lead to a decrease in available potential aquatic habitat for this species. Other likely impacts include barriers to movement, injury and mortality from the construction and operation phase of the project spread of chytrid fungus, hydrological changes, and decreased water quality of Yam Holes Creek as a result of erosion, sedimentation and pollution.	A **moderate** impact severity rating has been applied, largely due to the potential for reduction of connectivity for this species in the landscape, rather than the direct clearance of potential habitat

Habitat type	Construction footprint impacts	Assessment of impacts	Severity rating of impact (without mitigation)
Brown Toadlet habitat (status: L, en)	• 1.680 ha potential habitat	Despite not being recorded during the 2016–2017 targeted surveys, the Brown Toadlet was recorded during surveys conducted in 2015. Given the prior records and potential habitat mapped along Yam Holes Creek, draining lines and small dams within the study area, the species is likely to be present. The future construction of the project will result in some removal and fragmentation of potential habitat for this species along Yam Holes Creek. Other potential impacts include physical barriers to movement and increased risk of injury and mortality from the construction and operation phase of the project. Any significant changes in surface water hydrology, including water levels and water quality, may have flow on effects for this species.	**Moderate**
Arboreal mammal habitat: • Brush-tailed Phascogale (L, vu)	• 15.598 ha high quality potential habitat • 6.985 ha moderate quality potential habitat	Potential habitat for the Brush-tailed Phascogale is present within the project construction footprint. Construction of the project will result in the loss of 15.598 ha of high quality potential arboreal mammal habitat. This species is most at risk of impacts associated with habitat fragmentation and changes to wildlife movement. It is also at risk of injury and mortality from the construction phase of the project.	**High**
Golden Sun Moth habitat (status: CR, L, cr)	• 1.672 ha confirmed habitat • 9.431 higher quality potential habitat • 2.822 ha lower quality potential habitat	Surveys within the study area detected Golden Sun Moth in multiple locations. The project will require the removal of 1.672 ha of confirmed habitat and 9.431 ha of high potential habitat. The project is likely to lead to an increase in habitat fragmentation and present a barrier to dispersal.	**High**
Little Galaxias habitat (status: VU, L, en)	• 7 creek crossings	Despite previous records as recent as 2011, the Little Galaxias was not recorded in the 2016 survey and is not currently known to have a self-sustaining population within any of the seven creek crossings that intercept the project construction footprint. There is potential for the species to be dispersed into Yam Holes Creek during flood events.	**Moderate**

Fauna injury and mortality

Mortality of wildlife during construction may occur during clearing, or during instances when wildlife strays into the construction footprint. The potential for injury and mortality of wildlife from the project is summarised in Table 9.18 below.

The impact severity rating of mortality during construction is considered to be high without mitigation.

Table 9.18 Summary of potential for increased injury and mortality from construction phase

Activity with potential to cause mortality	Native animals with potential to be affected	Nature and magnitude of the impact of the project
Vegetation/habitat removal during construction: Removal of mature trees with hollows and dead standing trees	• hollow-dependent bats • hollow-nesting and canopy-nesting birds • arboreal mammals • arboreal reptiles • arboreal frogs • invertebrates.	A large number of potentially hollow bearing large old trees are likely to be removed for the proposed road.
Removal of understorey, groundcover, topsoil and debris (wood, rocks, rubbish etc.)	• small woodland birds • ground-dwelling reptiles • frogs • invertebrates.	Mortality of species of native (non-threatened) reptiles and frogs is likely to occur in higher numbers from vegetation (groundcover) clearance.
Machinery/plant and vehicle collisions with fauna during construction	• terrestrial, semi-aquatic and arboreal reptiles, frogs and mammals • birds, especially waterbirds.	Occasional mortality of native animals may occur during vehicle movements within the construction footprint. This is unlikely to be a substantial risk as construction speed limits would be low.
Other caused of mortality (trenches etc)	• terrestrial, semi-aquatic and arboreal reptiles, frogs and mammals.	Without sufficient controls, mortality may result from fauna falling into trenches or sheltering in materials.

Noise and vibration

The noise from road construction and then operational traffic can be stressful, with some animals temporarily or permanently moving away from the noise. This is particularly evident for frogs, birds, bats and other species that rely on acoustic signals.

Given the short-term nature of any high noise-generating activities, the impacts of construction noise on wildlife are expected to be minor. Nevertheless, minimisation of noisy and high vibration work near sensitive habitats from July-October inclusive is recommended where possible.

Vibration is predominantly expected to be short term during the construction phase which involves piling works and vibratory compaction of ground surfaces. Vibration is generally considered unlikely to impact fauna, as it will be short term and has only local impacts (i.e. near the site of the machinery). However, even short-term impacts during the breeding season for threatened fauna should be avoided, where possible.

Light

Light pollution from the project has the potential to impact fauna during construction of the project through use of artificial lighting for night work (if required). Artificial light affects species in different ways, but can affect foraging, reproduction, communication and other critical behaviours.

With regards to construction lighting, night works are unlikely to be required on a regular basis. Nightworks will only be carried out in the event where the works cannot be safely carried out during daytime hours. Any night works scheduled would be short-term only. An impact rating of moderate has been attributed to construction light impacts, without mitigation.

Further discussion on the effects of construction lighting on the visual amenity of surrounding land uses is included within EES Chapter 15: *Landscape and visual amenity*.

Physical habitat disturbance and modification

Weed invasion and disease

Without proper management practices during construction, weed and disease introduction or spread may lead to the degradation and/or loss of threatened ecological communities and a reduction in the value of habitat for threatened species.

A rating of moderate has been applied to this impact.

Rubbish

The construction phase of the project is expected to result in an increase in rubbish in terrestrial and aquatic habitats. Without the implementation of suitable mitigation measures, rubbish may impact wildlife through fauna mortality and by reducing habitat quality in close proximity to the construction footprint.

A rating of low-moderate has been applied to this impact.

Erosion, sedimentation and water pollutants

Bare ground after clearing, stockpiling, earthworks, or driving vehicles and plant off-road is susceptible to erosion. Similarly, there is the potential for an increase in water pollutants in wetlands at or near the study area as a result of road construction through spills or run-off.

The risk of erosion, sedimentation, and water pollution is highest in the Yam Holes Creek valley. Lack of appropriate erosion, sediment and pollution control may lead to the deterioration of aquatic flora and fauna, and resulting impacts to foraging wetland birds, amphibians and degradation of the relevant Ecological Vegetation Classes.

A rating of moderate has been applied to this impact.

The potential impacts of erosion and sedimentation during project construction and operation are further discussed in EES Chapter 16: *Soils, geology and contaminated land*.

Changes in groundwater and surface hydrology

Both aquatic and terrestrial Groundwater Dependant Ecosystems are present within the construction footprint including Yam Holes Creek and its tributaries and unnamed wetlands, and the following Ecological Vegetation Classes: Alluvial Terraces Herb-rich Woodland, Heathy Dry Forest, Valley Grassy Forest and Plains Grassy Wetland.

Potential impacts to groundwater levels and quality that may impact biodiversity and habitat during construction include:

- reduction in groundwater levels affecting existing users/sensitive receptors – such as registered and unregistered groundwater bores (water users), Groundwater Dependant Ecosystems and surface waters systems
- spill events during construction resulting in contaminants entering groundwater
- disturbance of existing soils with elevated levels of contamination during construction resulting in mobilisation of contaminants into groundwater
- excavation of cuttings resulting in groundwater inflows during construction, leading to groundwater drawdown and changes to groundwater flow paths
- inflow of contaminated groundwater presenting ongoing environmental compliance issues
- construction works impacting water quality in watercourses, Groundwater Dependant Ecosystem environments, and wetlands (as applicable).

Potential surface water impacts relevant to biodiversity and habitat during construction include:

- changes to flooding conditions and water levels in sensitive wetlands caused by clearing of vegetation along the route alignment and cut and fill works to achieve proposed alignment design levels
- vegetation clearing, soils compaction and floodplain storage removal resulting in increased runoff rates and subsequent impacts to significant habitat both nearby the study area and further downstream
- alterations to catchment hydrology from temporary construction works such as watercourse realignment, modifications to drainage networks and pumping of surface water
- reduced water quality caused by sediment runoff during the construction phase. This has the potential to increase turbidity which, depending on the severity, may impact flora, fauna, and ecological communities that are dependent on the aquatic ecosystem.

A rating of moderate has been applied to this impact.

Potential surface water and groundwater impacts resulting from the project are discussed further in EES Chapter 11: *Catchment values and hydrology*.

Air quality and dust

Without mitigation, dust and particulates during construction may have a temporary effect on flora and fauna and result in increased nutrients and turbidity in waterways.

Air quality and dust impacts are attributed an impact rating of moderate, largely due to the potential for dust during construction.

A further discussion of air quality and dust impacts on nearby sensitive receptors is contained within EES Chapter 14: *Amenity*.

9.7.2 Operation

Wetland habitat

The nine high priority wetlands identified within the study area could be impacted by changes to surface water resulting from the project.

Table 9.19 outlines the impacts on each wetland. The most useful flood event to determine the potential effects on seasonal wetlands and dependent fauna species is likely to be the 1 Exceedance per Year event, as the seasonal flooding and drying cycles are most affected by proposed roads and catchments. Of these wetlands, only Wetlands 1 (35402) and 4 (35649) will experience changes in their surface water flooding regime, however these changes are expected to be minimal and mainly occur at the higher order events (Table 9.20). As such, the impact to these wetlands is considered to be low. For more information on surface water impacts, refer to EES Appendix L: *Surface water impact assessment*.

Overall, the project will directly impact a total of 3.65 ha of wetlands, which includes:

- 0.19 ha of high value wetlands
- 1.45 ha of moderate value wetlands
- 2.00 ha of low value wetlands.

Potential impacts of the project operation on wetland flood regime (including flood levels, velocities and duration) and water quality due to surface water runoff from the road drainage system are further discussed in EES Chapter 11: *Catchment values and hydrology*.

Table 9.19 Summary of surface water impacts to wetlands within the study area

Wetland current ID	High value wetland number	Impacts from the project
35402	Wetland 1	• Minor increases in flood level of less than 20 mm over distances of up to 100 m downstream of Yam Holes Creek bridges. • No significant velocity changes. • Areas of High potential habitat for Growling Grass Frog in this wetland are unlikely to be affected as the aquatic habitat is expected to be largely unchanged. There may be some areas of slightly increased flooding (less than 20 mm) close to the culvert and bridges which are within the terrestrial buffer area for Growling Grass Frog. • Changes in the High value wetland area are unlikely to be different from current levels, the impact of the freeway on other ecological values including Brown Toadlet, Little Galaxias and Seasonal Herbaceous Wetlands is unlikely to be significant. Potential sedimentation could be discharged during construction and post works. • Potential to increase run-off from new road surface (operation) into wetlands and downstream areas.
35403	–	• No surface water impacts.

Wetland current ID	High value wetland number	Impacts from the project
35404	–	• No surface water impacts.
35405	–	• No surface water impacts.
35539	–	• No surface water impacts.
35540	Wetland 5	• No change to flood regime.
35540	Wetland 9	• No change to flood regime.
35562	Wetland 3	• No change to flood regime.
35563	–	• No surface water impacts.
35564	–	• No surface water impacts.
35566	–	• No surface water impacts. • Unlikely to have impacts on any threatened flora and fauna and threatened ecological communities.
35595	–	• No change to flood regime. • Unlikely to have impacts on any threatened flora and fauna and threatened ecological communities.
35596	Wetland 8	• No surface water impacts.
35597	Wetland 7	• No change to flood regime.
35649	Wetland 4	• Increases in flood level of less than 300 mm upstream of the Yam Holes Creek bridge with lesser increases extending up to 200 m upstream of Yam Hole Creek bridges where high value wetlands occur. • Wetland 4 area is approximately 550 m upstream from Yam Holes Creek bridge. • Localised velocity changes within the project area. • Impacts to wetland bird habitat including Brolga are unlikely to be different from current levels (+/- 100 mm changes), therefore the impact on wetland bird habitat is not considered to be significant. • Areas of High potential habitat for Growling Grass Frog along Yam Holes Creek may be affected by approximately 50–100 mm increases. Larger areas of Moderate and High potential habitat for Growling Grass Frog within this wetland are mostly located 200–300 m away which at this distance, is unlikely to be different from current levels, therefore the potential impact on Growling Grass Frog habitat is not considered to be significant. • Increases on flood levels are unlikely to significantly impact on other ecological values including Brown Toadlet, Little Galaxias and Seasonal Herbaceous Wetlands. • Potential to impact on water quality and pollutants in wetlands and downstream areas. • Potential sedimentation could be discharged during construction and post works. • Potential to increase run-off from new road surface (operation) into wetlands and downstream areas.
35650	Wetland 2	• No surface water impacts – outside project area of influence.

Wetland current ID	High value wetland number	Impacts from the project
35719	–	• No surface water impacts. • Unlikely to have impacts on any threatened flora and fauna and threatened ecological communities.
35735	–	• No surface water impacts.
–	Wetland 6	• No surface water impacts – outside project area of influence.

Note: Table contains all current wetlands within the study area.

Fauna injury and mortality

Many species are vulnerable to injury and mortality from roads, with the impacts on populations differing between species. The impacts will differ for different species depending on their ability to move out of the way of moving vehicles, the extent to which the species is attracted to the road, and (if a bird or bat) the height at which the species flies.

All roads have potential to result in the mortality (roadkill) of native animals. The risk of roadkill is higher where the road:

- bisects areas of substantial animal habitat, including wildlife corridors – within the project alignment this includes the areas around the southern extent of the Camp Hill Reserve, as well as open cleared areas which support high numbers of Eastern Grey Kangaroos
- is located in close proximity to natural or artificial water bodies – within the project alignment this includes where the alignment crosses Yam Holes Creek
- supports food sources (e.g. mown grass verges, nectar-producing shrubs) which attract animals to the road edge – this may apply along much of the project alignment
- has a high speed limit – this will apply along the entire project
- provides poor visibility of wildlife (e.g. due to bends, crests and poor lighting) – is largely considered unlikely to apply to the project based on the current design.

Fauna likely to be most at risk of roadkill without mitigation are terrestrial mammals, arboreal mammals, reptiles and frogs. Birds may also be at some risk, although are generally capable of flying between or above vehicles. Larger and heavier birds such as some wetland birds and birds of prey may be at higher risk as they are less able to avoid vehicles and are slower to ascend to a safe height. Birds of prey are also at risk of collision when scavenging other dead animals on the road.

The impact of introduced carnivores, specifically cats and foxes, is considered unlikely to be noticeably increased by the proposed works. Feral cats and foxes are already present in the study area.

Mortality from the operation of the road is expected to be highest:

- near wetlands
- where the road is at grade or above
- in cleared farmland areas where there are Eastern Grey Kangaroos
- through Camp Hill State Forest where there are Black Wallabies, Brush-tailed Phascogales and possums.

Overall, the impact severity rating of fauna injury and mortality during operation is considered to be high without mitigation.

Loss of connectivity

A new road can fragment a population of a species and cause a barrier to dispersal which can lead to smaller population sizes, inbreeding depression, greater susceptibility to environmental variation, and local extinction. Roads form a barrier or filter to the movement for certain species, particularly those that are sensitive to the noise, are slow moving (and suffer high mortality as discussed above) or require protective cover to move around.

The fauna habitat in the study area is already fragmented to some degree, particularly through roads and historical clearing for agriculture. Nevertheless, the connectivity which currently exists among the remaining patches of native vegetation will be affected by the proposed road.

The current project would impact connectivity in the following ways:

- the project passes through the southern extent of the Camp Hill Recreation Reserve and will result in the fragmentation of part of this reserve. The road will be a substantial connectivity barrier between the two fragmented sections of the reserve, likely to stop movement of all but the most mobile of fauna (i.e. birds and bats)
- within highly modified landscapes, narrow roadside remnants provide important connectivity between larger patches of remnant vegetation, including for species such as Brush-tailed Phascogale and small woodland birds. The project will result in the loss of vegetation along linear reserves such as Beaufort-Lexton Road. It will also bisect some narrow remnants which are likely to function as movement corridors for some species
- without mitigation, the road will also lead to a substantial reduction in connectivity across the landscape for fauna which utilise open grassy areas and paddocks such as Eastern Grey Kangaroo, and potentially Emu
- the current construction footprint is likely to reduce connectivity for wetland fauna which move between ponds, particularly frogs and turtles, and may also affect fish movement at Yam Holes Creek (without mitigation).

Arboreal mammals such as Brush-tailed Phascogale, and small or less mobile fauna such as reptiles, frogs and Golden Sun Moth are particularly susceptible to loss of connectivity. Small woodland birds that use roadside remnant vegetation are also at risk from loss of connectivity in areas where the proposed project intersects smaller existing roads. For these species, fragmentation of habitat through construction of the project may result in increased 'edge effects', barriers to species dispersal and reduction of connectivity in the landscape.

Overall, an impact rating of 'high' is attributed to loss of connectivity without mitigation.

Noise and vibration

The main impacts on wildlife associated with noise are behavioural. Vehicle noise has been shown, particularly in some species of birds and frogs, to interfere with communication essential for reproduction and can also impact a species' ability to maintain territories, cause withdrawal from favourable habitat, and reduce foraging area, particularly in species with low-frequency signals as they are likely to experience the most interference with traffic noise.

Noise modelling for the project indicates that unmitigated maximum noise levels at sensitive receptor locations along the project will vary between 54 and 72 $dBL_{10,18hr}$. These results were used to determine potential level of impact to areas of ecological sensitivity and value, including:

- wetlands, dams and waterway crossings, which provide potential habitat or known habitat for wetland dependent species (e.g. waterbirds and frogs)
- Victorian Temperate Woodland Bird Community habitat, including Camp Hill State Forest, and other smaller patches of forest/woodland habitat.

Based on a large body of evidence (as detailed in EES Appendix C: *Flora and fauna impact assessment*) it is recommended that traffic noise should be kept below 60 dBA to avoid significant impacts to fauna species along the project. While in most areas the impact was not deemed to be significant, potential for impact through Camp Hill State Forest was considered likely to be substantial due to increase in noise over the current baseline and the higher population of fauna in the area. The use of noise-reducing structures, surfaces and other measures, such as planted mounds/embankments and other noise attenuating structures, has been considered for sensitive human receptors. Where these may not be adequate to address the risk to fauna species, additional mitigation is proposed (refer to Section 9.8.1).

Light

Once the project is operational, the project area and surrounds are likely to be affected by a low level of light pollution. The ecological values most at risk of impact from artificial lighting and headlights are:

- fauna occurring at the waterway crossings through the Yam Holes Creek valley between Racecourse Road and Beaufort-Lexton Road, including wetland birds
- fauna occurring at the waterway crossing through the Yam Holes Creek upper catchment near Main Lead Road
- fauna occurring in proximity to the crossing through Camp Hill State Forest, although some light may be reduced in cuttings, and vegetation will provide shielding
- fauna occurring in the vicinity of Back Raglan Road and areas near Martins Lane
- fauna occurring in the vicinity of the remnant habitats near the railway and Packhams Lane.

The sensitive receptors for light impacts are likely to be largely located around high value wetlands. Spread of light across wetlands is expected to be a greater impact than light spread into woodland habitats. Mitigation options are available to minimise the anticipated impacts and will need to be incorporated into the landscape plan and into lighting design for the project. Street lighting will likely be kept to a minimum, with lighting required at interchanges to maintain the safety of the road, but not along the entire highway itself.

An impact rating of moderate has been attributed to project operation light impacts, without mitigation.

Visual impacts

The impacts of the presence of artificial structures and car movement (as separate from noise, light and mortality impacts) are poorly known, however it is understood that certain species, including wetland birds such as Brolga, may be affected. This may lead to decreased use of habitat nearby to the structure.

An impact rating of low-moderate has been attributed to visual impacts.

Physical habitat disturbance and modification

Weed invasion and disease

Fragmentation of patches of vegetation will create additional edges from which weeds and disease incursion may occur. Where the project intersects Camp Hill State Forest, the vegetation currently supports a low cover of weeds. This relatively intact patch of vegetation will be at increased risk from weed and disease from road operation.

Without proper management practices post construction, weed and disease introduction or spread may lead to the degradation and/or loss of threatened ecological communities and a reduction in the value of habitat for threatened species.

An impact rating of moderate has been attributed to weed invasion and disease, largely due to ongoing risk from road operation and maintenance.

Rubbish

As with the construction phase, the operational phase of the project is also expected to result in an increase in rubbish in terrestrial and aquatic habitats. Without the implantation of suitable mitigation measures, rubbish may impact wildlife through fauna mortality and by reducing habitat quality in close proximity to the project area.

A rating of low-moderate has been applied to this impact.

Erosion, sedimentation and water pollutants

Wetlands connected to/adjacent to the study area may be impacted should adequate controls not be in place. Some residual risk of water pollution from spills on the road is likely to be unavoidable.

A rating of moderate has been applied to this impact.

Changes in groundwater and surface hydrology

Potential impacts to groundwater levels and quality were all considered low or negligible without mitigation due to the limited interaction with groundwater and the project.

Potential surface water impacts relevant to biodiversity and habitat during operation include:

- alterations to catchment hydrology from permanent features (roads, bridges and culverts). Including an increase in duration of peak flood event from 8 to 10.4 hours. This may lead to changes in the natural seasonal filling and drying cycles of wetlands in the study area
- reduced water quality caused by road runoff, accidental oil/fuel spillages and pollutant runoff generated from maintenance activities. Untreated and undiluted, these pollutants (typically consisting of sediments, hydrocarbons, nutrients and metals) may result in a deterioration of water quality in the receiving water environment and in aquatic systems further downstream.

Potential surface water and groundwater impacts resulting from the project are discussed further in EES Chapter 11: *Catchment values and hydrology*.

9.7.3 Cumulative impacts

The results of the cumulative impact assessment indicated that the combined impact of the Beaufort Bypass, together with the four projects within the cumulative impact assessment area were unlikely to result in a significant cumulative impact on any of the species or communities included in the assessment. However, unmitigated, the impacts of the four projects combined with impacts associated with the Beaufort Bypass could potentially result in a minor cumulative impact on native vegetation, Victorian Temperate Woodland Bird Community and on some species, particularly those which may be impacted by the Beaufort Bypass including Yarra Gum, Brolga, Brown Toadlet and Golden Sun Moth.

No significant cumulative impacts are likely for native vegetation, Yarra Gum, Brolga, Brown Toadlet and Golden Sun Moth as the anticipated cumulative impact for these species and native vegetation comprises less than 1% of its distribution modelled to occur within the cumulative impact assessment area. Given the small loss of Brolga habitat as a result of the project and the large home range of the species, it appears unlikely that a significant cumulative impact on Brolga will occur as a result of impacts associated with the other projects.

A cumulative impact assessment for River Swamp Wallaby-grass was not recommended as this species was not found in previous assessments completed for Stage 1 or Stage 2A duplication projects. As this species is not on DELWP's advisory list, there is no modelled data available.

Further details of the cumulative impact assessment process and outcomes are provided in EES Appendix C: *Flora and fauna impact assessment*.

9.8 Mitigation

This section provides strategies to avoid, minimise, and mitigate ecological impacts on significant ecological values at the planning, design stage and during project construction and operation. These mitigations described in this section are RRV's commitment to minimising the residual impacts and will be incorporated into the Environmental Management Framework.

The project will be undertaken in accordance with the below listed relevant RRV processes and standard specifications including, but not limited to:

- VicRoads (2011) *Roadside Management Strategy*.
- VicRoads (2012) *Fauna Sensitive Road Design Guidelines*.
- VicRoads *Contract Specifications Section 201 – Site Clearing.*
- VicRoads *Contract Specifications Section 720 – Landscape Works,* including*:*
  - revegetation auditing to ensure contractors meets specified revegetation targets within the defects liability period. Trees not meeting the growth performance requirements will be replaced annually by the contractor to achieve the specified planting numbers.
- VicRoads *Contract Specifications Section 750.D – Roadside Maintenance Requirements,* including:
  - maintaining ground cover under single trees or shrubs and in unmulched plantations
  - maintain mulched or matted tree and shrub plantations in a weed free state
  - removing existing tree guards when the plant height exceeds 1.5 times the height of the tree guard.
- VicRoads *Contract Specifications Section 177.I – Flora and Fauna*, where the contractor must:
  - avoid, minimise and offset (where appropriate) the removal of native vegetation during construction
  - avoid injury to fauna or damage to protected vegetation or habitat
  - obtain permits from relevant authorities prior to disturbance of flora/fauna sites or relocation of native fauna affected by project works, and comply with all permits and approvals and associated conditions
  - confirm and clearly identify and mark trees, vegetation or habitat to be removed, consistent with the Contract drawings and any relevant permits and shall fence and sign all sites nominated as no-go zones.

These standards set out how RRV projects will comply with relevant legislation and how biodiversity and habitat impacts will be managed during construction and operation of the project. The mitigations proposed to manage potential impacts to biodiversity and habitat are summarised below.

The Environmental Management Framework is prepared prior to any construction works being undertaken for the project. The contractor is required to prepare, implement and maintain an Environmental Management Plan that will meet the requirements of the Contract Specification and RRV's Environmental Management Framework. During and after construction, the mitigation process is typically managed through a Construction Environmental Management Plan. A Construction Environmental Management Plan typically outlines all practicable measures to minimise and mitigate impacts on biodiversity from the construction and operational phase to the management and maintenance phases.

9.8.1 General mitigation measures

The measures provided in this section have been developed to mitigate impacts on biodiversity, including Matters of National Environmental Significance, State-significant species and communities and wildlife protected under the *Wildlife Act 1975* and FFG Act. These measures include standard controls provided in VicRoads Contract Specifications Section 177.

Monitoring the effectiveness of these mitigation measures on listed ecological values is required to determine whether additional measures are required after construction to further mitigate impacts (such as additional planting, weed control, fences etc).

Table 9.20 Mitigation measures for biodiversity and habitat impacts

Impacts	Mitigation measures	Mitigation number
Design		
Loss of vegetation and habitat	Detailed refinement of design/construction footprint to avoid and minimise vegetation to be removed and further development of no-go zones. Incentives to contractors to further minimise vegetation and habitat loss.	BH01
Loss of connectivity	The use of structures designed to improve connectivity should be used to facilitate safe passage across the road and discourage fauna from crossing the road at grade. The six broad types of mitigation are: • land bridge • modified drainage structure to include wildlife movement and drainage (e.g. open span bridge) • canopy rope bridge • extended bridge underpass • dedicated wildlife culvert • strategic revegetation • fencing to prevent wildlife from accessing the roadway and to funnel them towards the crossing structures • bridges and culverts designed to the *Growling Grass Frog Crossing Design Standards* (DELWP 2017). The detailed design of features to mitigate loss of connectivity should be developed in consultation with ecologists, with consideration of the ecology of the relevant species most requiring mitigation. Assessment of proposed types and locations of crossing structures for wildlife is contained within EES Appendix C: *Flora and fauna impact assessment*. The above listed connectivity measures will be implemented at a minimum in the approximate locations proposed in Figure 9.23. The precise locations are to be determined during the detailed design in consideration with the habitat connectivity assessment completed as part of the flora and fauna impact assessment.	BH02
Noise and vibration	Measures to reduce the effects of noise areas of ecological sensitivity and value will be designed in the detailed design phase and include: • extending the proposed Camp Hill State Forest noise barrier approximately 150 m east to include a larger area of Camp Hill State Forest, shielding additional habitat not currently protected from the proposed noise barrier • screening of wetland habitat and installing multi-function fauna barriers to attenuate noise effects close to high value Wetland 1.	BH03

Impacts	Mitigation measures	Mitigation number
Light	Design principles for lighting, in accordance with *Interim Guidance: Artificial lighting and wildlife - Recommendations to help minimise the impact of artificial lighting* (Bat Conservation Trust), VicRoads (2012) *Fauna sensitive road design guidelines*, Florida Fish and Wildlife Conservation Commission – *Wildlife Lighting Criteria*, International Dark-sky Association and *National Light Pollution Guidelines for Wildlife* (Department of Environment and Energy 2020), include: • **siting of lights:** site away from sites of ecological value to the extent possible, consider lower mounting height for lights, ensure lighting does not shine onto any fauna crossing structures • **fixtures:** shielded lights or fixtures to direct light down and minimise light spill • **wavelengths:** use narrow-spectrum light sources, avoid white or blue wavelengths • **barriers and/or plantings:** low walls and/or plantings should be used where required to prevent headlight and streetlight spill across habitat/sites of ecological value (to be incorporated into the landscape plan, using ecological appropriate species and local native species) • **temporary fencing:** should vegetation be utilised as an ongoing screening measure, install temporary fencing with screening until vegetation is sufficiently mature. The final detailed lighting design for the project should be developed by a professional lighting designer with experience in minimising impacts on ecological values.	BH04
Pre-construction/construction		
Physical habitat disturbance and modification	A Construction Environmental Management Plan will be developed and implemented to address the range of environmental risks and impacts, and proposed management measures identified in the EES. Related to biodiversity and habitat, the Construction Environmental Management Plan will include measures to address: • water quality • air quality • erosion and sediment control • contaminated soils and materials • waste • fuels and chemicals • no-go zones • tree protection • fauna fencing • fauna relocation • weed and pathogen controls • monitoring and reporting.	BH05

Impacts	Mitigation measures	Mitigation number
Fauna injury and mortality	All construction personnel must attend a project-specific induction prior to commencing site work. The inductions will include relevant information about the ecological sensitivities of the site and appropriate management measures. Suitably qualified and experienced fauna rescue and welfare contractors will be engaged to salvage and release fauna displaced during construction, including: bats, birds and possums from hollows, lizards, snakes, turtles, and echidnas, and any fish, frogs or aquatic fauna within wetland areas. Suitably qualified, experienced and licensed ecologist will be engaged to identify tree hollows that are likely to support native fauna, to inspect these prior to tree removal, and to supervise removal. A protocol for staged tree clearing and management and relocation of fauna during tree clearing should be developed in consultation with the arborist and a suitably qualified and licenced wildlife handler. Provision of replacement hollows in nearby/retained native vegetation to be retained for use by any displaced fauna will be provided, during two staged clearing	BH06
Noise and vibration	A Construction Noise and Vibration Management Plan will be developed by the construction contractor in accordance with Environment Protection Authority Victoria Guidelines to ensure that the impacts of construction noise are minimised as far as practicable. The Construction Noise and Vibration Management Plan will be approved by MRPV and relevant stakeholders, and will include: • establishment of project-specific noise targets for construction • a prediction of noise from each construction scenario • an assessment of each scenario to the established targets • mitigation measures to be implemented to control noise levels • requirements for a noise monitoring regime whereby noise levels are measured and recorded • highlight potential unavoidable evening and night works for seeking prior approval from relevant stakeholders including RRV and the Environment Protection Authority Victoria.	BH07
Light spill	Light shielding will be installed for any nightworks.	BH08
Loss of vegetation and habitat	Penalties for contractors that impact no-go zones or any vegetation/habitat outside of the project area will be incorporated into the contract.	BH09
Air quality and dust	Measures to address air quality and dust impacts during construction will include: • mitigations outlined in BH05.	–
Cumulative impacts	Measures to address cumulative impacts during construction will include: • mitigations outlined in BH05.	–
Operation		
Physical habitat disturbance and modification	Post-construction, MRPV will maintain the road for two years, prior to handing the road management back to RRV. During this time MRPV must adhere to defect liability periods to ensure the establishment of controls in the Environmental Management Framework. In accordance with VicRoads *Contract Specifications Section 163 – Maintenance General, Part F - Environmental Management Plans*, maintenance contractors will be required to develop and implement an Operational Environmental Management Plan, which documents operational controls relating to environmental impacts including water quality and management, and flora and fauna (including weed management). The Operational Environmental Management Plan must include details of approvals, licences and permits necessary to meet statutory requirements.	BH10

Impacts	Mitigation measures	Mitigation number
Visual impacts	Ecological restoration will be undertaken in accordance with a landscape plan, which: • focuses on ecological appropriate species and local native species • includes planting of trees and vegetation to screen the bypass from key viewpoints in the landscape • includes strategies for integration of habitat corridors and culverts into the detailed design to reduce impacts on flora and fauna habitat connections. RRV will manage and monitor effectiveness of landscape works through their performance requirements within VicRoads standard specifications, *Section 720 – Landscape Works*, which includes regular auditing to ensure contractors meet specified revegetation targets within the defects liability period. Trees not meeting the growth performance requirements will be replaced to achieve the specified planting numbers.	BH11

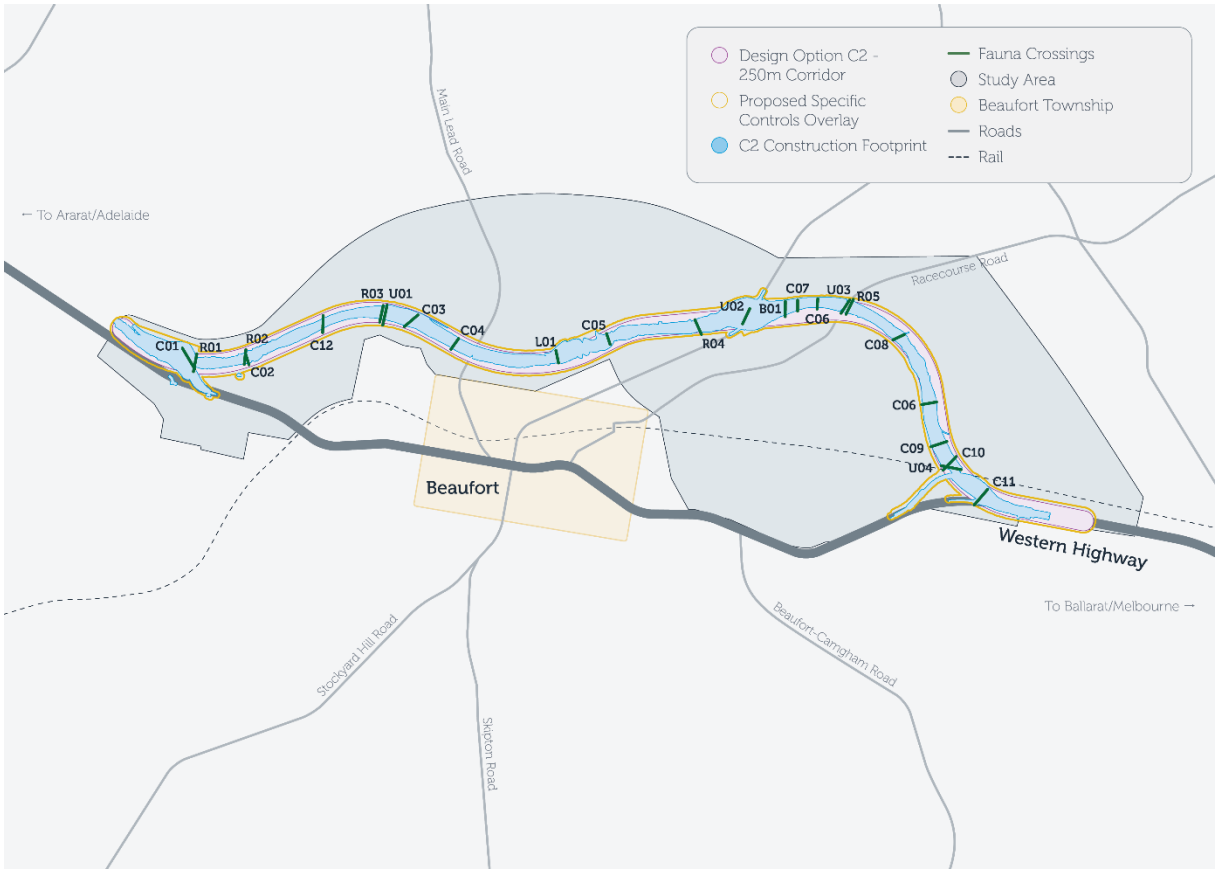

Figure 9.23 Proposed wildlife crossing locations

9.8.2 Measures to avoid and minimise impacts

Measures to avoid and minimise impacts to biodiversity and habitat that were incorporated into the project design are outlined in Section 9.9.1 (refer to Table 9.23). Further refinement during the detailed design phase of the project will likely allow for further avoidance and minimisation of impacts to biodiversity and habitat.

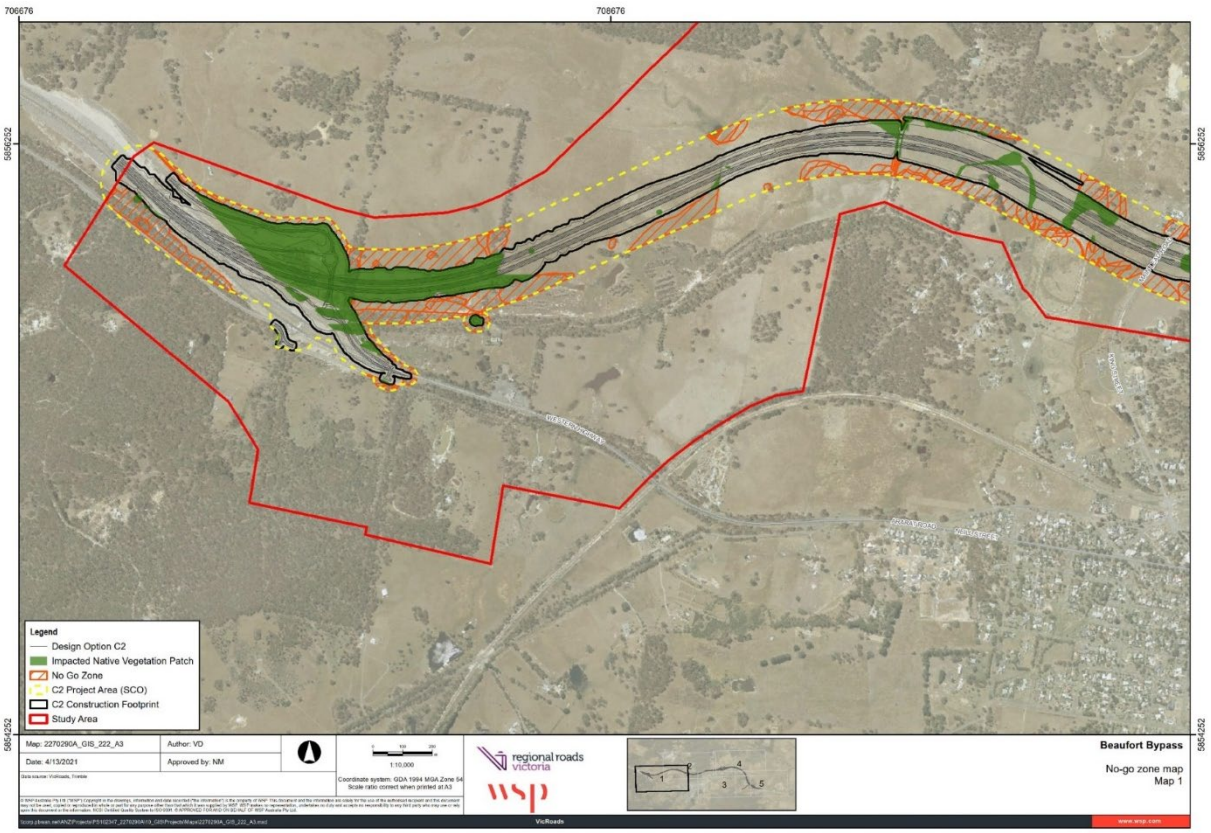

Figure 9.24a No-go zone mapping – map 1

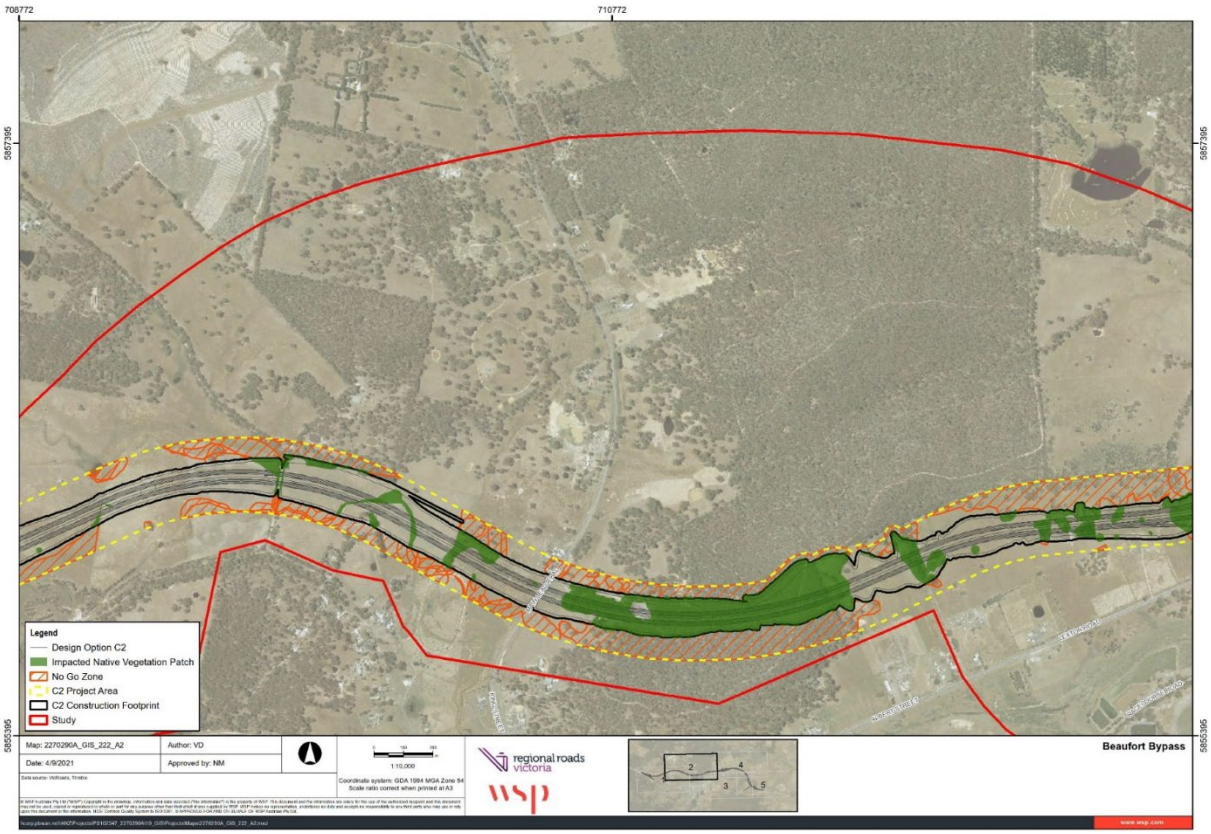

Figure 9.24b No-go zone mapping – map 2

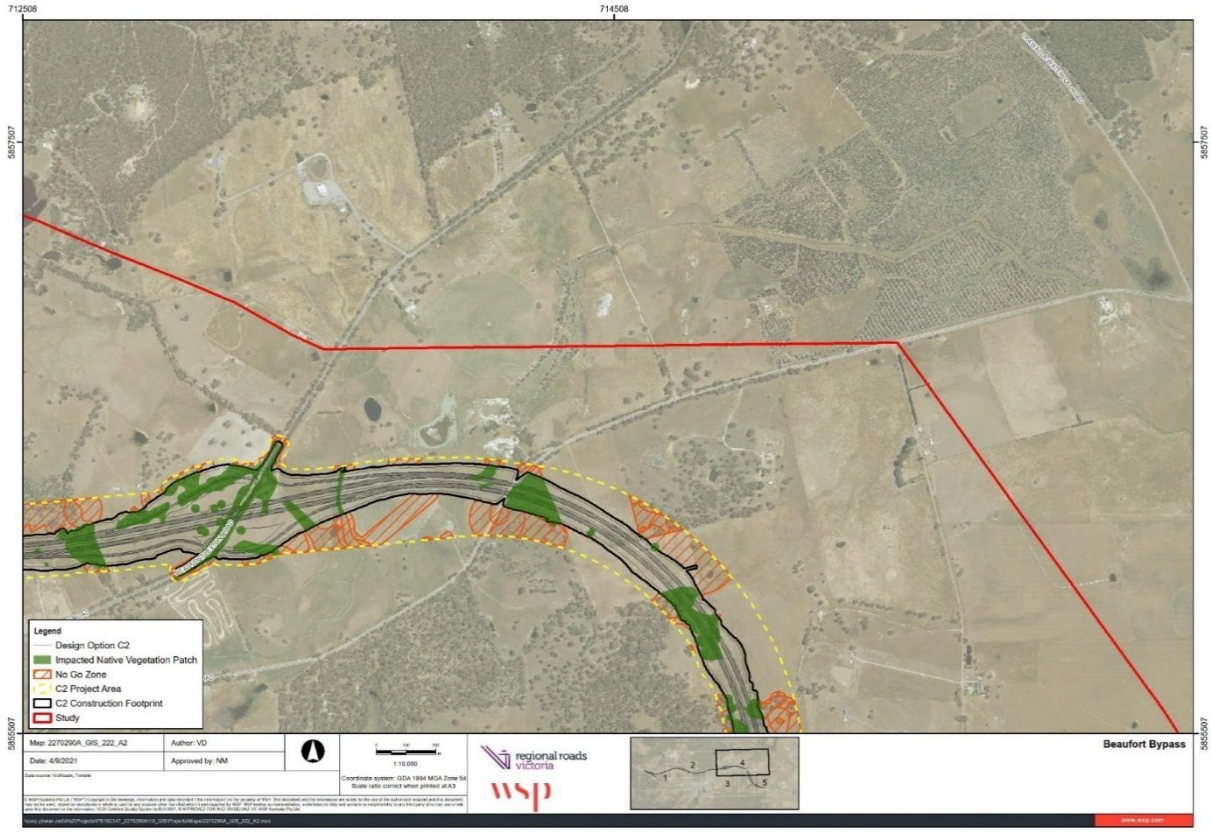

Figure 9.24c No-go zone mapping – map 3

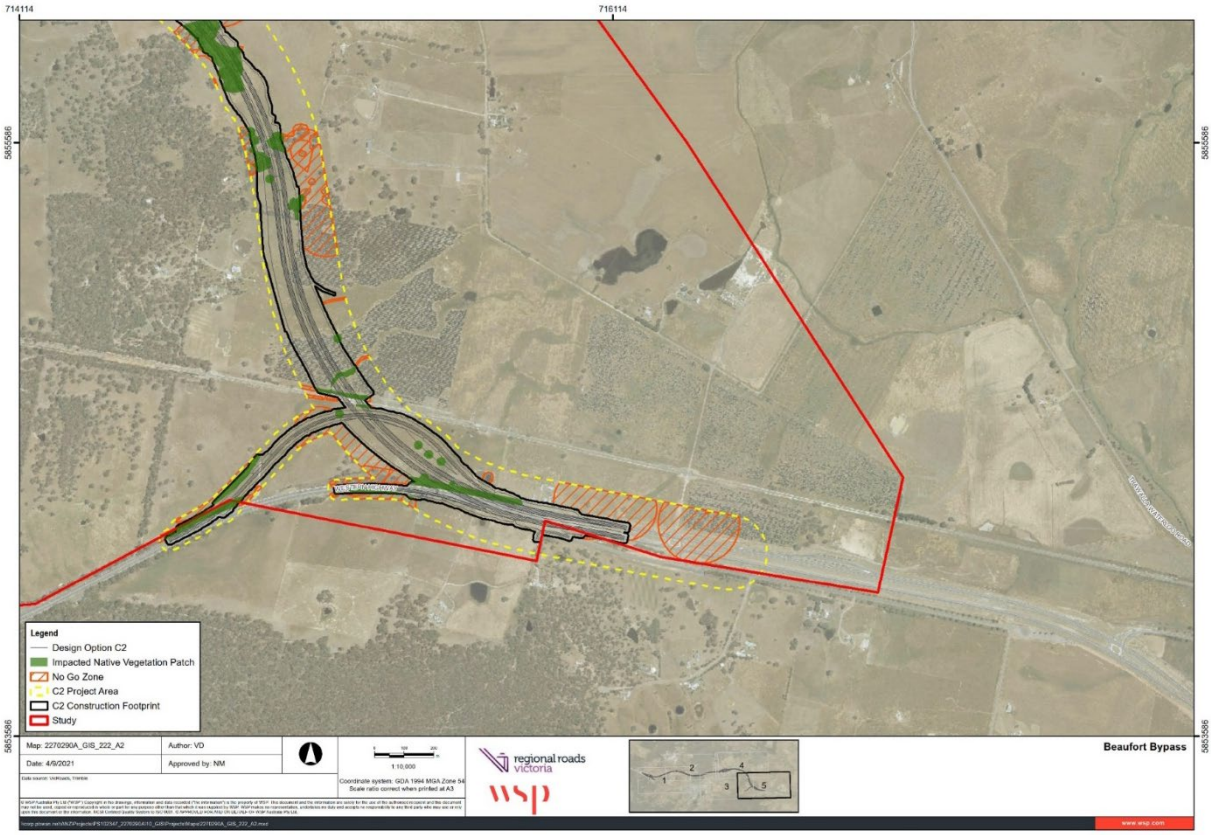

Figure 9.24d No-go zone mapping – map 4

9.8.3 Species- and community-specific mitigation measures

A Threatened Species Management Plan (a sub-plan of the Construction Environmental Management Plan) will be prepared for the following threatened species outlined in Table 9.21, which will include detail on mitigation measures as detailed in this table. These species-specific mitigation measures for native threatened species and communities are to be implemented in conjunction with the mitigation measures outlined in Section 9.8.1.

The majority of threatened plants have been avoided through the design phase of the project. It is possible, despite extensive targeted surveys, that more plants may be encountered during construction and the mitigation measures outlined here should be applied if these plants are not able to be avoided.

Table 9.21 Threatened Species Management Plan -specific mitigation measures for the

	Species/community											Mitigation number
Mitigation measures	**Matted Flax-Lily *(EN, L, en)***	**Ben Major Grevillea *(VU, L, vu)***	**River Swamp Wallaby-Grass *(VU)***	**Growling Grass Frog *(VU, L, en)***	**Golden Sun Moth *(CR, L, cr)***	**Little Galaxias *(VU, L, en)***	**Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains *(CR)***	**White Box – Yellow Box – Blakelys Red Gum Grassy Woodland *(CR)***	**Brolga (L, vu)**	**Brush-tailed Phascogale (L, vu)**	**Brown Toadlet (L, en)**	
Threatened Species Management Plan	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	BH12
Design												
Water sensitive road design elements to minimise surface water changes (further discussed in EES Chapter 11: *Catchment values and hydrology*.			Y		Y	Y	Y		Y		Y	BH13
Design measures to maintain the connectivity for the species through crossings and strategic habitat creation, including at culvert entrances				Y		Y				Y	Y	BH14

Mitigation measures	Species/community											Mitigation number
	Matted Flax-Lily *(EN, L, en)*	Ben Major Grevillea *(VU, L, vu)*	River Swamp Wallaby-Grass *(VU)*	Growling Grass Frog *(VU, L, en)*	Golden Sun Moth *(CR, L, cr)*	Little Galaxias *(VU, L, en)*	Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains *(CR)*	White Box – Yellow Box – Blakelys Red Gum Grassy Woodland *(CR)*	Brolga (L, vu)	Brush-tailed Phascogale (L, vu)	Brown Toadlet (L, en)	
Pre-construction/construction												
No-go zone identification/ mapping, fencing and signage to protect retained native vegetation, habitat and threatened species (to be included in landscape plan)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	BH15
Pre-clearing survey for threatened flora	Y	Y	Y							Y		BH16
Translocation and/or restoration plan for any plants which cannot be avoided	Y		Y									BH17
Seed collection			Y									BH18
Weed and disease controls	Y	Y			Y		Y	Y			Y	BH19
Dust controls	Y	Y	Y		Y		Y	Y				BH20
Measures to prevent rubbish from entering habitat	Y		Y	Y	Y	Y	Y	Y	Y		Y	BH21
Erosion and sedimentation controls to protect wetland habitat			Y	Y		Y	Y		Y		Y	BH22

Mitigation measures	Species/community											Mitigation number
	Matted Flax-Lily *(EN, L, en)*	Ben Major Grevillea *(VU, L, vu)*	River Swamp Wallaby-Grass *(VU)*	Growling Grass Frog *(VU, L, en)*	Golden Sun Moth *(CR, L, cr)*	Little Galaxias *(VU, L, en)*	Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains *(CR)*	White Box – Yellow Box – Blakelys Red Gum Grassy Woodland *(CR)*	Brolga (L, vu)	Brush-tailed Phascogale (L, vu)	Brown Toadlet (L, en)	
Maintaining connectivity for the species through crossings and strategic habitat creation, including at culvert entrances				Y		Y				Y	Y	BH23
Salvage from impacted ponds if required				Y							Y	BH24
Appropriate disease controls to minimise spread of the waterborne pathogen Chytrid fungus which affects frogs				Y							Y	BH25
Construction using techniques which minimise impacts on wetlands which are partially within the construction footprint to avoid impacts on the retained potential habitat				Y								BH26
Flow connectivity should be maintained and unimpeded along Yam Holes Creek at all times that water is present and/or during flooding events						Y						BH27
Store fuel and chemicals outside of flood zones						Y	Y					BH28

Mitigation measures	Species/community											Mitigation number
	Matted Flax-Lily *(EN, L, en)*	Ben Major Grevillea *(VU, L, vu)*	River Swamp Wallaby-Grass *(VU)*	Growling Grass Frog *(VU, L, en)*	Golden Sun Moth *(CR, L, cr)*	Little Galaxias *(VU, L, en)*	Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains *(CR)*	White Box – Yellow Box – Blakelys Red Gum Grassy Woodland *(CR)*	Brolga (L, vu)	Brush-tailed Phascogale (L, vu)	Brown Toadlet (L, en)	
Operation												
Revegetation and habitat creation to be included in landscape plan				Y	Y							BH29
Reinstatement of temporary impacts to habitat which may support overwintering or movement				Y								BH30
Habitat restoration or creation of habitat around culverts where new crossings are proposed to include wetland vegetation			Y				Y					BH31
Monitoring program to report on the success and failure of plant translocation and recommend management interventions, as needed	Y		Y									BH32

Key to threatened species listing:

- *EPBC Act: VU = vulnerable, EN = endangered, CR = critically endangered, M = migratory*
- *FFG Act: L = listed, N = nominated*
- *Victorian Advisory List: vu = vulnerable, en = endangered, cr = critically endangered, nt = near threatened, dd = data deficient*

9.9 Residual impacts

Following incorporation of mitigations outlined in Section 9.8, the following residual impacts will apply for the project.

Table 9.22 Biodiversity and habitat residual impacts

Impact	Residual impacts	Rating
Loss of vegetation and habitat	With mitigation, loss of vegetation and habitat is still given a high impact rating as clearing of the assessed amount of native vegetation and flora and fauna habitat is unavoidable. However, mitigation is critical to ensure no impacts occur outside of the construction footprint.	High
Fauna injury and mortality	With mitigation, fauna injury and mortality during construction is given a low-moderate severity rating. Some residual injury or mortality during construction is likely although the recommended measures are expected to substantially reduce these impacts. The recommended mitigation is likely to substantially reduce injury and mortality of fauna during operation of the road. However, in some locations, wildlife-vehicle collisions are likely to still occur.	Low-moderate
Light	With the recommended mitigation, impacts of ecological light pollution on ecological values are considered to be low. Shielding and revegetation is expected to protect the habitats most sensitive to light, particularly wetlands.	Low
Noise and vibration	With the recommended mitigation, impacts of noise and vibration on ecological values are considered likely to be low.	Low
Physical habitat disturbance and modification	With the proposed mitigation, an impact rating of low-moderate has been attributed to weed invasion and disease, largely due to ongoing risk from road operation and maintenance that is difficult to fully mitigate.	Low-moderate
	With best practice erosion controls during construction and use of water sensitive road design in the detailed design of the road, the residual impact of sedimentation and polluted run-off entering waterways and/or impacting habitat is considered to be low. However, this will depend on the type of water sensitive road design used and the ability of the design to stop any spills entering wetlands or waterways. Some residual risk associated with spills is likely to remain. The residual impact of changes in surface water hydrology on vegetation and habitat is likely to be low. The specific water sensitive road design elements are yet to be designed – this should be undertaken during detailed design.	Low
Visual impacts	Design of measures to shield sensitive habitat should occur during detailed design.	Low-moderate
Loss of connectivity	With the recommended mitigation BH02 in line with Figure 9.23, loss of connectivity is given a moderate impact rating.	Moderate

9.9.1 Offset strategy

Native vegetation (*Guidelines for the Removal, Destruction or Lopping of Native Vegetation* – DELWP 2017)

The offset requirements for the project (based on the construction footprint) have been estimated using DELWP's EnSym tool. The project was assessed against the application requirements outlined in Table 9.23 below. All permit applications to remove native vegetation are required to include this assessment.

Table 9.23 Assessment of the project against the application requirements of the *Guidelines for the Removal, Destruction or Lopping of Native Vegetation* (DELWP 2017) for a permit to remove native vegetation

Application requirement		Project assessment
1. Information about the vegetation to be removed	a. the assessment pathway and reason for the assessment pathway.	Detailed Assessment Pathway, Location Category 2 50.714 ha proposed to be removed
	b. a description of the native vegetation to be removed accounted for	Refer to maps provided within Appendix K of EES Appendix C: *Flora and fauna impact assessment*, which show the location of impacted native vegetation (patches and trees)
	c. the offset requirement	**General offset amount:** • 2.041 general habitat units **Species offset amount:** • 27.002 specific units of habitat for Ben Major Grevillea, *Grevillea floripendula* • 32.250 specific units of habitat for Emerald-lip Greenhood, *Pterostylis smaragdyna* • 28.002 specific units of habitat for Rough Wattle, *Acacia aspera subsp. parviceps*
2. Topographic and land information relating to the native vegetation to be removed		Provided within EES Appendix C: *Flora and fauna impact assessment*
3. Recent, dated photographs of the native vegetation to be removed.		Provided within EES Appendix C: *Flora and fauna impact assessment*
4. Details of any other native vegetation approved to be removed, or that was removed without the required approvals within 5 years of the permit application.		Not applicable

Application requirement	Project assessment
5. An avoid and minimise statement	A summary of measures taken to avoid and minimise impacts to native vegetation for the options analysis phase included: • road corridor analysis to consider a range of feasible alternatives by incorporating engineering design principles with constraints and environmentally sensitive areas • consideration of alignment alternatives to minimise impacts through areas such as Camp Hill State Forest • modification of project alignment to avoid known occurrences of Ben Major Grevillea • modification of project alignment to avoid a number of wetlands, threatened ecological communities and threatened species habitat • micro-alignment of the project design to avoid and minimise impacts to isolated paddock trees (or scattered trees) • the preferred alignment selected for the project (C2) has the lowest impacts to native vegetation of the proposed alignment alternatives. Following the selection of the preferred alignment (C2) was chosen, a detailed exploration of measures to avoid and minimise impacts on native vegetation included the following: • design modifications to reduce impacts on specific trees or areas of habitat • citing of laydown areas, site offices, temporary access tracks and relocation of utility services within the construction footprint or outside of native vegetation and habitat • development of no-go zones to ensure native vegetation and fauna habitat outside the construction footprint is not impacted during construction • use of bridges instead of culverts to avoid and minimise in-stream impacts. Further refinement during detailed design will likely allow for further avoidance and minimisation of impacts to native vegetation.
6. A copy of any Property Vegetation Plan contained within an agreement made pursuant to section 69 of the *Conservation, Forests and Lands Act 1987* that applies to the native vegetation to be removed.	Not applicable
7. Where the removal of native vegetation is to create defendable space, a written statement explaining why the removal of native vegetation is necessary.	Not applicable
8. If the application is under Clause 52.16, a statement that explains how the proposal responds to the Native Vegetation Precinct Plan considerations.	Not applicable

Application requirement	Project assessment
9. An offset statement providing evidence that an offset that meets the offset requirements for the native vegetation to be removed has been identified, and can be secured in accordance with the Guidelines	State offsets will be required for native vegetation and habitat under the *Guidelines for the Removal, Destruction or Lopping of Native Vegetation* (DELWP 2017). The feasibility to secure all state offsets are considered likely given the confirmed availability through offset brokers and extent of modelled habitat coverage. Offsets need to be secured prior to commencement of construction.

An alternative offset arrangement request has been endorsed by DELWP for Wimmera Scentbark species units triggered in the initial native vegetation removal report. Habitat requirements of the species are inconsistent with habitat characteristics of the native vegetation at the site, and the species offset obligations will not be required.

EPBC Act environmental offsets

The EPBC Act referral determination was that the project is likely to have a significant impact on, but not limited to, Golden Sun Moth. As significant impacts on protected matters are considered likely and the project is a 'controlled action', the *EPBC Act Environmental Offsets Policy* (Department of Sustainability, Environment, Water, Population and Communities 2012) will apply as residual impacts on Golden Sun Moth remain significant, even after mitigation.

The impact on Golden Sun Moth habitat is estimated to be 13.925 ha. The final EPBC Act offset requirements will be determined when a suitable site/s is identified. Details of any EPBC Act offset requirements and offset site options will be provided in a Site Offset Management Plan. A third-party offset site would need to be approved to the satisfaction of the Commonwealth Department of Agriculture, Water and the Environment and secured with an appropriate offset covenant in accordance with the *EPBC Act Environmental Offsets Policy* prior to the commencement of works.

9.10 Matters of National Environmental Significance

The project was referred to the Commonwealth Minister for Environment under the EPBC Act, who determined the action to be 'controlled' due to potential significant impacts to listed threatened species and communities including Golden Sun Moth. The project is to be assessed under an accredited process (i.e. through the EES process). Presented within this section is an assessment of significant impacts against the nominated species, in line with *Matters of National Environmental Significance: Significant impact guidelines 1.1* (Department of the Environment 2013).

9.10.1 Growling Grass Frog

Permanent removal or degradation of terrestrial habitat

The anticipated loss of potential terrestrial habitat associated with high quality potential aquatic habitat is 17.285 ha and the anticipated loss of potential terrestrial habitat associated with moderate quality potential aquatic habitat is 68.179 ha (excluding any overlap with high quality (total = 85.464 ha). This is calculated conservatively using a 200 m buffer from waterbodies as per the *Significant impact guidelines for the vulnerable growling grass frog (Litoria raniformis)* (Department of the Environment, Water, Heritage and the Arts 2009).

The potential terrestrial habitat is unlikely to currently be utilised by the species, which was not recorded in the study area. Furthermore, a large proportion of this terrestrial habitat would be unlikely to be used by the species, as it does not occur between waterbodies, is utilised for high-intensity grazing or cropping, or does not support features preferred by the species for overwintering or foraging (rocks, tussock grasses etc.). The potential terrestrial habitat largely comprises modified grazed or cropped paddocks. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Alteration of aquatic vegetation diversity or structure that leads to a decrease in habitat quality

Erosion, sedimentation and dust from construction impacting the aquatic vegetation in retained habitat is possible. Similarly, pollution and rubbish from operation of the road may also enter waterways and ponds and degrade habitat quality. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Alteration to wetland hydrology, diversity and structure that leads to a decrease in habitat quality

Water sensitive road design elements and cross drainage structures are proposed to ensure that changes to drainage which may affect this species do not occur.

Specifically, where there are connected wetlands such as those along Yam Holes Creek, overland seasonal flows will be maintained or not significantly altered. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Introduction of predatory fish and/or disease agents

Works are unlikely to result in the introduction of any predatory fish, however, may spread the waterborne fungal pathogen *Batrachochytrium dendrobatidis* which causes the disease chytridiomycosis (chytrid fungus). With the incorporation of appropriate chytrid hygiene practices during construction using the threat abatement plan (Commonwealth of Australia 2016), the likelihood of significant impacts is low.

Net reduction in the number and/or diversity of water bodies available to an important population

The project will result in impacts to or loss of eleven waterbodies available to this species, totalling 0.281 ha of high quality aquatic potential habitat (two waterbodies) and 1.132 ha of moderate quality aquatic potential habitat (total 1.413 ha). These ponds are unlikely to currently support the species based on survey results (i.e. are unlikely to currently support an important population). The waterbodies are largely isolated from other potential habitat ponds. Strategic habitat creation to include planted ponds which may support this species are proposed to enhance habitat for potential future populations. The likelihood of significant impacts is low.

Removal or alteration of available terrestrial or aquatic habitat corridors

The project will alter both terrestrial and aquatic habitat corridors, with the potential to remove these corridors altogether without mitigation. The alignment passes between potential habitat wetlands and crosses Yam Holes Creek.

The design will maintain connectivity for the species through crossings and strategic habitat creation. Four crossing points for Growling Grass Frog are currently proposed, to include bridges and culverts designed to the *Growling Grass Frog Crossing Design Standards* (DELWP 2017).

Water sensitive road design elements to ensure that changes to drainage which may affect this species do not occur. Specifically, where there are connected wetlands such as those along Yam Holes Creek, overland seasonal flows will be maintained or not significantly altered. The likelihood of significant impacts is low.

Construction of physical barriers to movement between water bodies, such as roads or buildings.

The project will maintain connectivity for the species through crossings and strategic habitat creation. Four crossing points for Growling Grass Frog are currently proposed, to include bridges and culverts designed to the *Growling Grass Frog Crossing Design Standards* (DELWP 2017). The likelihood of significant impacts is low.

Overall likelihood of a significant impact

Although direct impacts on aquatic potential habitat are low, the project is likely to increase fragmentation and may result in degradation of retained habitat without mitigation. With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is low.

9.10.2 Golden Sun Moth

Large or contiguous habitat area (greater than 10 ha)

Across the study area, there is 8.014 ha of confirmed habitat, 41.214 ha of higher quality potential habitat and 72.601 ha of lower quality potential habitat. Although the roadway will be less than 200 m wide, the project will introduce a barrier to dispersal between confirmed and high-quality potential habitat.

The project will impact 1.672 ha of confirmed Golden Sun Moth habitat. In addition, 9.431 ha of higher quality potential habitat and 2.822 ha of lower quality potential habitat occurs within the current construction footprint. Based on the amount of habitat, particularly confirmed and higher quality potential habitat mapped in the study area, it is likely that the study area would be considered a 'large or contiguous habitat area'. This may impact the species locally but it unlikely to have a substantial impact on the species as a whole. With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is moderate.

Habitat connectivity

Although the current construction footprint does not bisect any patches of confirmed habitat, it does fragment a patch which is partly confirmed habitat and partly high quality potential habitat north of Martin's Lane. Although the roadway will be less than 200 m wide, the project will introduce a barrier to dispersal between this confirmed and high-quality potential habitat. The construction footprint also bisects an area of lower quality potential habitat south of Racecourse Road and will increase fragmentation between a patch of confirmed and a small patch of low-quality potential habitat west of Main lead Road (north of the Beaufort Trotting Track). The remaining patches of confirmed and potential habitat area are either a distant from the construction footprint or already fragmented by >200 m.

This is likely to locally impact the species, although is considered unlikely to substantially impact the species as a whole. With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is high.

Overall likelihood of significant impact

Habitat loss and fragmentation is likely to impact the species locally. As there is confirmed and potential habitat remaining and the species is locally common and protected elsewhere in Victoria, this may not significantly impact the species as a whole. However, based on the significant impact criteria assessment, a significant impact should be assumed unless otherwise determined by the Department of Agriculture, Water and Environment. With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is moderate to high.

9.10.3 Little Galaxias

Lead to a long-term decrease in the size of an important population of a species

Whilst the Little Galaxias is not currently known to have a self-sustaining population within any of the seven creek crossings sections that intercept this alignment, it may be dispersed into Yam Holes Creek and tributaries during flood events. If this were to occur, construction and operation may impact on water quality and habitat, which could lead to a long-term decrease in the size of an important Little Galaxias population. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Reduce the area of occupancy of an important population

Apart from a small amount of intrusion into waterways, there will be limited impact to areas that can be occupied by the Little Galaxias. Creek realignments should mean little change to the overall availability of potential habitat. The likelihood of significant impacts is low.

Fragment an existing important population into two or more populations

Fragmentation could occur should culverts be used which do not permit easy movement of the species. Although, this would not currently split an important population (as one is not currently present). It could reduce potential future connectivity for an important population. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of a species

Construction will not be in reaches that are critical habitat for the Little Galaxias. The Little Galaxias has a wider natural distribution than the Beaufort area, so proposed road works will not impact on the survival of the species. The likelihood of significant impacts is low.

Disrupt the breeding cycle of an important population

The works are to take place in areas which currently do not support Little Galaxias populations. The project is unlikely to impact upon the breeding cycle of an important population of Little Galaxias. The likelihood of significant impacts is low.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The Little Galaxias has a natural range through the study area. Therefore, the project could result in modification, destruction, removal or isolation or decrease the availability or quality of habitat to the extent that the species is likely to decline at a local scale. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The project is unlikely to result in invasive fish, as no waterways will be linked by the road works. The likelihood of significant impacts is low.

Introduce disease that may cause the species to decline

The construction activities are unlikely to introduce disease that may cause the Little Galaxias to decline. The likelihood of significant impacts is low.

Interfere with the recovery of the species

The project has potential to interfere with the species' recovery through disruption to habitat connectivity. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Overall likelihood of a significant impact

With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is low.

9.10.4 Painted Honeyeater

Lead to a long-term decrease in the size of an important population of a species

Important population is unlikely to be present based on the low number of records from the Beaufort area. The likelihood of significant impacts is low.

Reduce the area of occupancy of an important population

Important population unlikely to be present. The likelihood of significant impacts is low.

Fragment an existing important population into two or more populations

Important population unlikely to be present. The likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of a species

Based on the low number of records around Beaufort, it is unlikely that this habitat is of particularly high significance to the Painted Honeyeater and the survival of the species. The likelihood of significant impacts is low.

Disrupt the breeding cycle of an important population

Important population unlikely to be present. The likelihood of significant impacts is low.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Based on the low number of records around Beaufort, it is unlikely that loss of some potential habitat in this area would cause decline of the species. The likelihood of significant impacts is low.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The project is unlikely to result in invasive species which could affect habitat quality for this species. The likelihood of significant impacts is low.

Introduce disease that may cause the species to decline

The project is unlikely to introduce disease that may cause the species to decline. The likelihood of significant impacts is low.

Interfere with the recovery of the species

The project is unlikely to interfere with the species' recovery. Based on the paucity of records, the habitat is unlikely to be of substantial value to the species. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

The overall likelihood of significant impacts is low.

9.10.5 Migratory species: Latham's Snipe

The significant impact criteria for migratory species are detailed below.

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

Criterion 1. *substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

Criterion 2. *result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or*

Criterion 3. *seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

Source: *Matters of National Environmental Significance: Significant Impact Guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999* (Department of the Environment 2013)

Latham's Snipe would not be significantly impacted by the project based on the potential habitat present not meeting the definition of 'important habitat' in the significant impact criteria and the lack of an 'ecologically significant proportion' of the population utilising the area. No mitigation is required for this species.

9.10.6 Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains

Reduce the extent of an ecological community

The project would clear up to 0.312 ha of this community. This amount represents a small area on the edge of a larger wetland complex and a small proportion of the 18.981 ha of this community which was mapped in the broader EES study area.

This minor reduction in the extent of lower quality part of this community is unlikely to constitute a significant impact although impacts during construction on retained areas of this community are possible without controls. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The extent of the community within the construction footprint is small and on the edge of the wetland complex. Loss of this area will not fragment the community. The likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of an ecological community

The project will adversely affect only a small area of wetland and is unlikely to impact the survival of the remaining wetland complex or the community as a whole. The likelihood of significant impacts is low.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

Without controls, the construction of the road has the potential to modify abiotic factors which could impact the remaining areas of the community. This includes potential changes to surface water hydrology, increased pollution, and spills.

Flood modelling, catchment calculations and water quality modelling was undertaken in EES Appendix L: *Surface water impact assessment*. For impacts on flooding regimes, only Wetlands 35649 (which includes high value Wetland 4) and 35402 (which includes high value Wetland 1) will experience changes in their flooding regimes but these changes are expected to be minimal and mainly occur at the high order events, with most significant impacts occurring within the project boundary. The impacts on the wetlands are therefore considered to be minor.

Groundwater in the study area has been shown to be deep and not connected to the wetlands. As such, no groundwater impacts are anticipated (refer to EES Appendix D: *Groundwater impact assessment*). With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

Surface water changes and introduction and spread of weeds in the community could lead to changes in species composition.

Changes to flooding conditions and water levels in sensitive wetlands caused by clearing of vegetation along the route alignment and cut and fill works to achieve proposed alignment design levels. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:– assisting invasive species, that are harmful to the listed ecological community, to become established, or– causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

The footprint removes part of a larger wetland complex. The road could result in an increase in weed spread or contaminated run off into the remaining wetland without controls. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Interfere with the recovery of an ecological community

The small area of impact is unlikely to interfere with the recovery of the ecological community. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

Although the area of clearance is relatively small, without controls, other impacts during construction and operation such as hydrological changes may affect the community outside of the construction footprint. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

9.10.7 White box – Yellow Box – Blakely's Red Gum Grassy Woodland

Reduce the extent of an ecological community

The works would not reduce the extent of this community. Works are occurring approximately 80 m from the nearest patch of this community such that material impacts on retained patches of this community are unlikely. The project will not fragment the community. The likelihood of significant impacts is low.

Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines

The project will not adversely affect habitat critical to the community's survival. The likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of an ecological community

The project is unlikely to affect drainage or other factors which may impact this community as the works are occurring approximately 80 metres from the edge of the closest patch of Box Gum Woodland. The likelihood of significant impacts is low.

Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns

Species composition could be affected by dust, rubbish and weeds introduced during construction or operation of the road. However, as works are occurring approximately 80 m from the community, impacts are likely to be negligible. The likelihood of significant impacts is low.

Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting

Given the distance of the construction footprint from the community (approximately 80 m), works are unlikely to cause a substantial reduction in the quality or integrity the ecological community. The likelihood of significant impacts is low.

Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:– assisting invasive species, that are harmful to the listed ecological community, to become established, or– causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community

The project is unlikely to interfere with the recovery of the ecological community. The likelihood of significant impacts is low.

Interfere with the recovery of an ecological community

The project is unlikely to interfere with the recovery of the ecological community. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

Although none of this community is proposed to be cleared, other impacts during construction and operation may affect the community outside of the construction footprint. The likelihood of significant impacts is low.

9.10.8 River Swamp Wallaby-grass

Lead to a long-term decrease in the size of an important population of a species

River Swamp Wallaby-grass was recorded within the construction footprint in a dam off Topp Lane which will be impacted as a result of the proposed works. As the site of impact is small (approx. 300 m^2/0.03 ha) the removal is unlikely to have a material impact on the size of the important population as a whole.

Other records are located outside the construction footprint, with the closest being approximately 55 m from the construction footprint. Based on the distance of the works from this record (and other more distant records within the study area), indirect impacts on these occurrences are unlikely. The likelihood of significant impacts is low.

Reduce the area of occupancy of an important population

The site to be impacted covers an area of approximately 300 m^2 (0.03 ha). While this alignment will reduce the area of occupancy the species is likely to be able to spread and colonise other dams and waterways in the area.

Indirect impacts of the project could also impact area of occupancy for this species outside of the construction footprint. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Fragment an existing important population into two or more populations

Populations of River Swamp Wallaby-grass in the study area are already spread across the study area and seeds and propagules are likely spread by wind, water and via waterbirds.

The project will not further contribute to fragmentation of the population. The likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of a species

The habitat along this alignment is unlikely to be critical to this species survival as there are many other similar dams and drainage lines in the area. The likelihood of significant impacts is low.

Disrupt the breeding cycle of an important population

The project will not disrupt the breeding cycle of the species which reproduces by rhizomes (asexual spreading) and sexually (abiotic pollination which would not be affected by the project). The likelihood of significant impacts is low.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The habitat along this alignment is unlikely to be critical to this species' survival as there are many other similar dams and drainage lines in the area. Loss of these sites is unlikely to cause a decline in species. The likelihood of significant impacts is low.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Roads can contribute to weed spread both during construction and ongoing from cars and construction vehicles bringing seeds into the area. Vegetation clearing also leaves vacant land along road verges that fast colonising species can take advantage of. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Introduce disease that may cause the species to decline

There are no known disease risks for this species. The likelihood of significant impacts is low.

Interfere with the recovery of the species

There is no recovery plan for this species, however the project is unlikely to affect the recovery of this species. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

In addition to the mitigation measures outlined in Section 9.8, collecting of seed from the population to be impacted and propagating to introduce to water sensitive road design ponds should also be considered. With the implementation of these mitigations, the overall likelihood of significant impacts is low.

9.10.9 Matted Flax-lily

Lead to a long-term decrease in the size of an important population of a species

One record of the species is currently proposed to be impacted. This is unlikely to result in a material long-term decrease in the size of a population. Precautionary mitigation measures are recommended due to the high conservation significance of the species. The likelihood of significant impacts is low.

Reduce the area of occupancy of an important population

The works may reduce the area of occupancy of the species through the direct loss of potential habitat, although this habitat is currently only known to support one plant. Measures to minimise the potential for indirect impacts from construction and operation on retained habitat and potential future habitat are recommended. With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is low.

Fragment an existing important population into two or more populations

Records for this species are scattered around the Beaufort area. The habitat and population is already fragmented. The road may further contribute to this and potentially reduce gene flow and movement of pollinators (native bees) and seed dispersers (frugivorous birds) however this is considered unlikely to result in complete fragmentation of the local population. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of a species

The habitat in this alignment is unlikely to be critical to the survival of the species based on the low density of records. The likelihood of significant impacts is low.

Disrupt the breeding cycle of an important population

The project would not disrupt the breeding cycle of a population. The likelihood of significant impacts is low.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

The loss of some habitat (supporting only one known individual) is unlikely to cause the species to decline. The likelihood of significant impacts is low.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Weed invasion is identified as a key current threat in the *National Recovery Plan for the Matted Flax-lily Dianella amoena* (Carter 2010).

It is likely that construction and ground disturbance may increase weed incursion in the area. However, it is unlikely to have a significant impact on the species. This is evident from the fact that the recorded populations of this species located in/near this alignment already occur in a highly modified environment with a high density of weeds. The likelihood of significant impacts is low.

Introduce disease that may cause the species to decline

There are no known disease risks for this species. The likelihood of significant impacts is low.

Interfere with the recovery of the species

'Manage threats to populations' is identified in the *National Recovery Plan for the Matted Flax-lily Dianella amoena* (Carter 2010). This project may threaten small populations of the species, however, this is unlikely to interfere with the recovery of the species as a whole. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

For any plants which cannot be avoided (currently only one plant/clump likely to be impacted), a translocation plan is recommended to be prepared. Plants should be translocated to a suitable recipient site within secure conservation reserves (either on or off site).

With the implementation of mitigations outlined in Section 9.8 and translocation (if impacts cannot be avoided), the overall likelihood of significant impacts is low.

9.10.10 Ben Major Grevillea

Lead to a long-term decrease in the size of an important population of a species

Alignment avoids all individuals recorded during surveys, however, the current construction footprint passes in close proximity to the species where a fire track is proposed to be constructed.

Impacts on the species from construction may occur without mitigation, particularly from dust, weeds, or inadvertent clearing. Despite this, any minor impacts are unlikely to lead to a long-term decrease in the size of an important population of Ben Major Grevillea. The likelihood of significant impacts is low.

Reduce the area of occupancy of an important population

The project would not impact known habitat, however, potential habitat adjacent to known records is proposed to be cleared. This is unlikely to reduce the area of occupancy of the population. The likelihood of significant impacts is low.

Fragment an existing important population into two or more populations

Alignment will not fragment existing populations. The likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of a species

Alignment avoids the critical (occupied) habitat for this species within the study area. The likelihood of significant impacts is low.

Disrupt the breeding cycle of an important population

This alignment is unlikely to disrupt the breeding of this population. The likelihood of significant impacts is low.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Alignment will reduce the size of potential habitat available but unlikely to the extent that the species will decline. The likelihood of significant impacts is low.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

The construction footprint is close to records of this species (occupied habitat) which currently supports a low density of weeds. Road construction could facilitate weed spread into this area through construction machinery and track use. With the implementation of mitigations in Section 9.8, the likelihood of significant impacts is low.

Introduce disease that may cause the species to decline

There are no known disease risks for this species. An unidentified leaf defoliation/miner pest was observed on plants in 2018 (N. McCaffrey pers. obs.) which caused leaf damage to multiple plants however these plants have since recovered (2019, 2020). The likelihood of significant impacts is low.

Interfere with the recovery of the species

As the alignment does not directly impact any known individuals of this species, it is unlikely to interfere substantially with the recovery of this species.

Location of the proposed freeway may reduce dependence of fuel-reduction burning to protect the township therefore reduce the negative effects of repeated burning on Ben Major Grevillea. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

With the implementation of mitigations in Section 9.8, the overall likelihood of significant impacts is low.

9.10.11 Ornate Pink Fingers

Lead to a long-term decrease in the size of an important population of a species

Alignment avoids all records of this species, with the nearest records located >600 m away. Therefore, a long-term decrease in the size of an important population of the species is not anticipated. The likelihood of significant impacts is low.

Reduce the area of occupancy of an important population

Alignment will not impact areas of occupancy of this species. The likelihood of significant impacts is low.

Fragment an existing important population into two or more populations

Given the scattered occupancy of individual plants and their location from the construction footprint, it is unlikely that the alignment will further contribute to fragmentation of the populations in the area. The likelihood of significant impacts is low.

Adversely affect habitat critical to the survival of a species

Alignment will not impact habitat critical to the survival of this population. The likelihood of significant impacts is low.

Disrupt the breeding cycle of an important population

Alignment will not impact breeding for this species. The likelihood of significant impacts is low.

Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

Alignment will not impact habitat for this species. The likelihood of significant impacts is low.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Road construction could facilitate weed spread into the area through construction machinery and from the road itself, prompting edge effects. However, known records of this species are >600 m away and are unlikely to be impacted by weed invasion. The likelihood of significant impacts is low.

Introduce disease that may cause the species to decline

There are no known disease risks for this species. The likelihood of significant impacts is low.

Interfere with the recovery of the species

The alignment will not substantially impact the recovery of this species. The likelihood of significant impacts is low.

Overall likelihood of a significant impact

The overall likelihood of significant impacts is low.

9.11 Conclusion

This chapter characterises the existing environment of the study area and describes potential impacts of the project construction and operation in line with the EES scoping requirements.

9.11.1 Vegetation and habitat

Sixteen Ecological Vegetation Classes were mapped within the study area. The flora and fauna assessment also recorded two EPBC Act listed threatened ecological communities (Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plain, and White Box-Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Grasslands) and one FFG Act threatened community (Victorian Temperate Woodland Bird Community) within the study area.

Construction of the project will require the removal of approximately 47.95 ha of vegetation and habitat. Of this, 32.8 ha of FFG Act listed Victorian Temperate Woodland Bird Community and 0.312 ha of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains is expected to be impacted. Up to 348 large trees (both in patches and scattered) and 7 small scattered trees have the potential to be impacted by the project. This includes those trees which occur outside the construction footprint, but which would have greater than 10% impact upon their Tree Protection Zone, resulting in a likely loss of the tree. Small trees in patches have not been considered in the tree assessment as these are partly accounted for through Ecological Vegetation Class impacts. However, these will be assessed in detail once the detailed design has been confirmed.

Wetlands in the study area are seasonal wetlands and provide potential habitat for various wetland bird and frog species, including threatened species. Nine high priority wetlands were identified within the study area that could be impacted by changes to surface water regimes resulting from the project.

9.11.2 Flora

The project is expected to impact habitat for significant flora species including the Matted Flax-lily *Dianella amoena*, River Swamp Wallaby-grass *Amphibromus fluitans* and Yarra Gum *Eucalyptus yarraensi.* Impacts to these species are considered to be low with the implementation of recommended mitigation measures.

9.11.3 Fauna

Fourteen significant fauna species were considered to have a moderate to high likelihood of occurrence in the study area. Impact from the construction and operation of the project is not considered to be significant for all but one of these species: Golden Sun Moth. The project will require the removal of 1.672 ha of confirmed habitat and 9.431 ha of high potential habitat, as well as being likely to lead to an increase in habitat fragmentation and present a barrier to dispersal. The appropriate offsets will be identified and secured in the next phase of the project once the detailed design is confirmed.

9.11.4 Construction impacts

Given the short-term nature of any high levels of noise, vibration and light generating activities, the impacts of construction noise and vibration on wildlife are expected to be minor. Nevertheless, minimisation of light spill, noisy and high vibration work near sensitive habitats from July-October inclusive is recommended during the construction of the project where possible.

Mortality of wildlife during construction may occur during clearing, or during instances when wildlife strays into the construction zone. The impacts will differ for different species depending on their ability to move out of the way of moving vehicles, the extent to which the species is attracted to the road, and (if a bird or bat) the height at which the species flies. Proposed measures to manage these impacts include the utilising wildlife crossings and fencing in strategic locations to direct fauna to safer crossing points, culvert design, two stage clearing, replacement hollows and the closing of trenches at night.

9.11.5 Operation impacts

During operation of the bypass, mortality from the road is expected to be highest: near wetlands; where the road is at grade or above; in cleared farmland areas where there are Eastern Grey Kangaroos; and through Camp Hill State Forest where there are Black Wallabies, Brush-tailed Phascogales and possums.

The study area and surrounds are likely to be affected by a low level of light pollution during operation. The spread of light across wetlands is expected to be a greater impact than light spread into woodland habitats.

The fauna habitat in the study area is already fragmented to some degree, particularly through roads and historical clearing for agriculture. Nevertheless, the connectivity which currently exists among the remaining patches of native vegetation will be affected by the proposed road. The project will seek to maintain connectivity through mindful design, restoration and revegetation of natural areas and by utilising wildlife crossings in strategic locations.

9.11.6 Cumulative impacts

The results of the cumulative impact assessment indicated that the combined impact of the Beaufort Bypass, together with the four projects within the cumulative impact assessment area, were unlikely to result in a significant cumulative impact on any of the species or communities included in the assessment. However, unmitigated, the impacts of the four projects combined with impacts associated with the Beaufort Bypass could potentially result in a minor cumulative impact on native vegetation and on some species, particularly those which may be impacted by the Beaufort Bypass including Yarra Gum, Brolga, Brown Toadlet and Golden Sun Moth.

9.11.7 Mitigation

A range of mitigation measures have been provided in response to the identified impacts, which aim to avoid, reduce and/or mitigate potential impacts to threatened species and their habitat. Following the implementation of the mitigation measures, residual impacts for the significant ecological values identified in the assessment range from low to high subject to nature, extent and duration of impact.

9.11.8 Offsets

State offsets will be required for native vegetation and habitat under the Guidelines for the Removal, Destruction or Lopping of Native Vegetation (DELWP 2017). Based on the current construction footprint, 2.041 general habitat units are likely to be required, as well as species offsets for Ben Major Grevillea, Emerald-lip Greenhood and Rough Wattle. An alternative offset arrangement has been endorsed for the Wimmera Scentbark and the species offset obligations will not be required due to the habitat characteristics of the study area being inconsistent with the habitat requirements for the species. The EPBC Act Environmental Offsets Policy will apply as residual impacts on Golden Sun Moth remain significant, even after mitigation. The impact on Golden Sun Moth habitat is estimated to be 13.925 ha. The final EPBC Act offset requirements will be determined when a suitable site/s is identified. Details of any EPBC Act offset requirements and offset site options will be provided in a Site Offset Management Plan.