

Environment
Effects Statement

Chapter 25

Ecology



Chapter 25

Ecology

This chapter provides an assessment of the ecological impacts associated with the construction and operation of North East Link. This chapter is based on the impact assessment presented in Technical report Q – Ecology.

The ecology of Victoria and Australia is valued by the community and is recognised through legislation and policies which are designed to conserve native flora, fauna, habitat and ecological communities.

While the area within the project boundary is highly urbanised and fragmented, it does contain significant ecological values. Areas of the highest ecological value occur near the Yarra River and its associated floodplain. An understanding of the existing ecological values is critical to the assessment of project-related impacts on native flora, fauna, habitat and ecological communities.

The EES scoping requirements set out the following evaluation objective for ecology:

- **Habitat and biodiversity** – To avoid or minimise adverse effects on vegetation (including remnant, planted and regenerated), listed rare and threatened species and ecological communities, habitat for listed threatened species, listed migratory species and other protected flora and fauna, and address offset requirements for residual environmental effects, consistent with relevant state policies.

To assess the potential effects of the project on ecology, an ecological impact assessment was undertaken. The assessment included extensive surveys of aquatic and terrestrial habitat in the study area to determine the flora, fauna and ecological communities present.

The evaluation objective above also requires the assessment of planted trees, which are exempt from the requirement for a permit to remove native vegetation under clause 52.17 of the Victorian Planning Provisions. This vegetation is however considered in the ecology assessment in the context of habitat provision. The assessment of planted vegetation is presented in:

- Technical report G and Chapter 15 – Arboriculture.

What is ecology?

For the purpose of this assessment, ecology is defined as aquatic and terrestrial flora, fauna and habitat. This includes ecological communities.

25.1 Method

Informed by the risk assessment described in Chapter 4 – EES assessment framework, the ecological assessment involved the following key tasks:

- A review of relevant national, state and local legislation.
- A study area for ecology was established as shown in Figure 25-1. This was defined in two ways; the study area, which is generally inclusive of a five-kilometre buffer from the project; and the project boundary, which is the area within which the project would be contained. The study area was used to determine the ecological values in proximity to the project, while the project boundary indicates the area of the potential direct impact of North East Link due to land clearing. Indirect impacts are considered where they extend beyond the project boundary
- A desktop assessment and baseline data review was conducted.
- Site visits were undertaken to assess the likelihood of the presence of flora, fauna and ecological communities within the project boundary – this was an extensive program of fieldwork which took more than 18 months.
- Consultation occurred with relevant local councils and government agencies.
- Existing conditions within the project boundary were characterised for flora, fauna and ecological communities.
- A risk assessment prioritised the impact assessment.
- The likely and potential ecological impacts during the project's construction and operation were assessed.
- Environmental Performance Requirements (EPRs) were developed in response to the impact assessment. The residual risk ratings and the assessment of impacts presented in this chapter assume implementation of the EPRs. Refer to Chapter 27 – Environmental management framework for the full list of EPRs.

What are the risk categories?

Risk levels were categorised as very low, low, medium, high or very high. When an impact is a known or certain consequence of the project, the rating is indicated as 'planned'. The results of the risk assessment were used to prioritise the focus of the impact assessments.

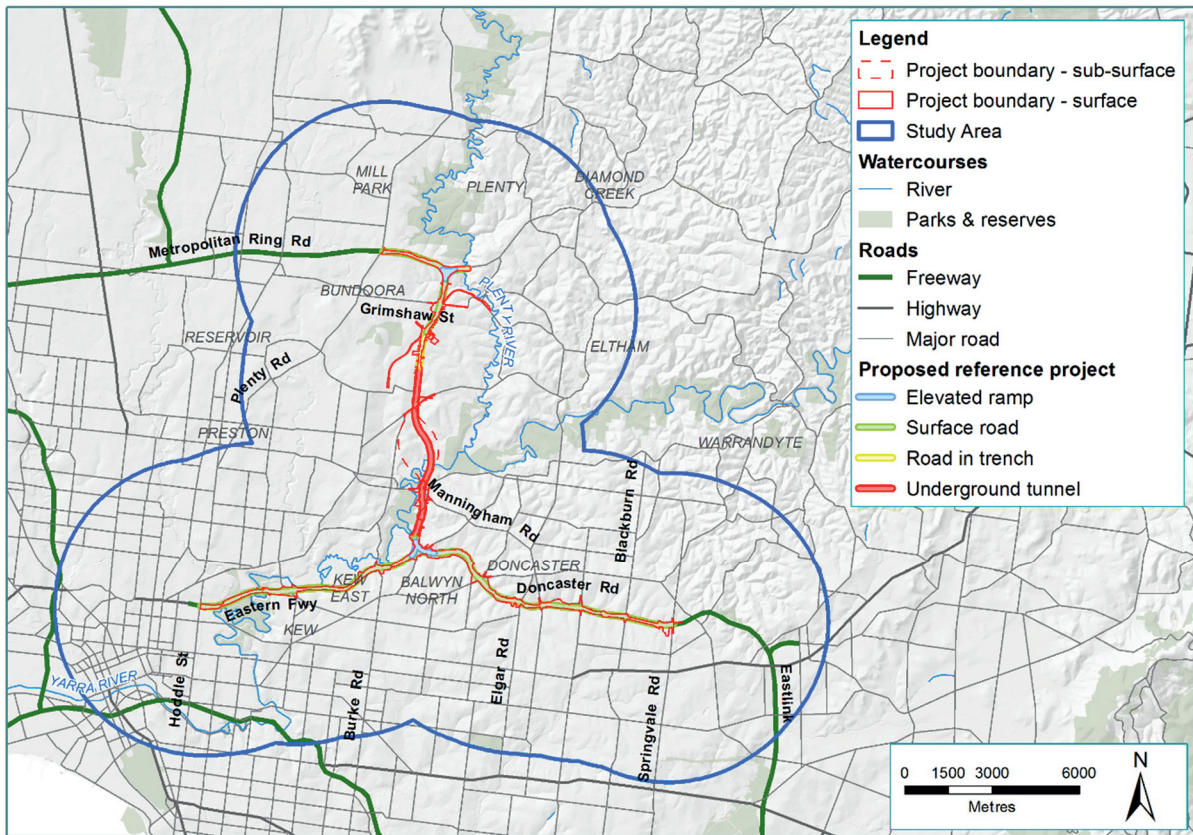


Figure 25-1 Ecology study area and project boundary



25.2 Existing conditions

This section outlines the existing conditions of the North East Link project boundary that relate to flora, fauna and aquatic values.

25.2.1 Flora and ecological communities

Threatened and non-threatened native flora and ecological communities were identified for the ecology impact assessment.

Native vegetation within the project boundary was found to generally be in poor to moderate condition, with the ecological values present largely reflecting the long history of urban land use across the surrounding landscape. However, despite the highly urbanised landscape, the project boundary does contain substantial ecological values, particularly in the following areas:

- The Yarra River, its floodplain and parks including Warringal Parklands and Banyule Flats, Bolin Bolin Billabong, Kew Billabong and Willsmere Park
- Simpson Barracks
- Koonung Creek
- Banyule Creek.

What are ecological communities?

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. Its structure, composition and distribution are determined by environmental factors such as soil type, position in the landscape, altitude, climate and water availability.

In addition, substantial areas of the project boundary support vegetation planted for amenity purposes along public roads and within recreation reserves.

Threatened flora

'Threatened' species refers to those species that are listed under the following:

- *Environment Protection and Biodiversity Conservation Act 1999* ('EPBC Act'): The EPBC Act is Australia's key legislation for the protection of threatened species and ecological communities
- *Flora and Fauna Guarantee Act 1988* ('FFG Act'): The FFG Act is Victoria's key legislation for the conservation of Victoria's native species. The Act establishes a threatened species list, a protected species list and a list of threatened 'communities of flora and fauna', to identify those species and communities that require management to conserve. Species that are 'listed' under the FFG Act are considered threatened for the purpose of this assessment. Species that are 'protected' are not considered threatened, but require a permit to remove.

- Department of Environment, Land, Water and Planning (DELWP) threatened species advisory list: The advisory list has no legal status, but may be considered in planning assessments and for the purposes of vegetation removal offsets. Species in 'rare' and 'poorly known' categories are not threatened, but were considered as part of the ecology assessment.

Based on these listings, an assessment was undertaken to determine the presence or likelihood of species occurring within the project boundary. Those species found to have a moderate or higher likelihood of occurrence are listed in Table 25-1. No threatened ecological communities listed under the EPBC Act or communities of flora and fauna listed under the FFG Act were present within the project boundary. One EPBC Act listed community, the Grassy Eucalypt Woodland of the Victorian Volcanic Plain, was identified in a discrete site along the M80 Ring Road (otherwise known as the Metropolitan Ring Road), however this was determined to be outside the project boundary.

Table 25-1 Threatened flora species present or likely to occur within the project boundary

Common name	Scientific name	EPBC Act	FFG Act	Threatened Species Advisory List
Matted Flax-lily	<i>Dianella amoena</i>	EN	L	e
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	VU		
Clover Glycine	<i>Glycine latrobeana</i>	VU	L	v
Charming Spider-orchid	<i>Caladenia amoena</i>	EN	L	e
Green-striped Greenhood	<i>Pterostylis chlorogramma</i>	VU	L	v
Short Water-starwort	<i>Callitriche brachycarpa</i>		L	v
Arching Flax-lily	<i>Dianella longifolia</i> var. <i>grandis</i>			v
Studley Park Gum	<i>Eucalyptus</i> X <i>studleyensis</i>			e
Austral Crane's-bill	<i>Geranium solanderi</i> var. <i>solanderi</i> s.s.			v
Silurian Striped Greenhood	<i>Pterostylis</i> sp. aff. <i>striata</i> (Silurian)			e
Wine-lipped Spider-orchid	<i>Caladenia oenochila</i>			v

Key

EPBC Act	EN – Endangered, VU – Vulnerable
FFG Act	L – Listed
Threatened Species Advisory List:	e – Endangered, v – Vulnerable

Matted Flax-lily

Matted Flax-lily is a small, tufted lily, endemic to south-east Australia which generally occurs in grassland and grassy woodland habitats. A number of populations are known in the northern suburbs of Melbourne, typically within native vegetation alongside road or rail corridors and in conservation reserves. The habitat of Matted Flax-lily has been substantially cleared so remaining populations are mostly small and highly fragmented. Matted Flax-lily can form dense to sparse patches up to five metres wide and so can be difficult to distinguish between individual plants and patches of plants.

Targeted surveys were undertaken to assess the presence of Matted Flax-lily within the project boundary. A total of 95 Matted Flax-lily plants/patches were recorded and mapped within the project boundary. Of these, 83 plants/patches were within Simpson Barracks, with sizes ranging from a few leaf tufts to large plants/patches covering up to four square metres. Four plants/patches were also observed near the M80 Ring Road interchange. Along the Hurstbridge rail line, one large patch and seven plants/patches were observed at three separate locations. An additional 200 plants/patches were observed or have previously been recorded outside the project boundary at Simpson Barracks, with 123 of these recorded during the project surveys and an additional 77 recorded during historical surveys at the site over the past 12 years. Matted Flax-lily were observed to be in healthy condition.

What are the types of surveys undertaken?

'Targeted surveys' refer to fieldwork undertaken to with the specific purpose of identifying a particular species. These would be generally be undertaken at a seasonally appropriate time of year to identify the species.

'Field assessments' are more general assessments where multiple values may be identified. Where presence of species is known, such as the Grey-headed Flying-fox, within the project boundary, no targeted surveys were required.

River Swamp Wallaby-grass

River Swamp Wallaby-grass is an aquatic perennial that occurs in natural as well as man-made low flow water-bodies, including swamps, lagoons, billabongs and dams. The optimal habitat for this species within the project boundary occurs in wetlands associated with the floodplain of the Yarra River.

The desktop assessment identified nine recent records within the study area, including one 2007 record within the project boundary at the Trinity Grammar School Sporting Complex wetlands. River Swamp Wallaby-grass was not observed during targeted surveys, although suitable areas of habitat include Banyule Swamp, Trinity Grammar School Sporting Complex wetlands and Bolin Bolin Billabong.

Based on the quality of habitat within the project boundary, the number of recent nearby records and results of targeted surveys, it is assumed that River Swamp Wallaby-grass occurs within the project boundary.

Clover Glycine

Clover Glycine is a small perennial herb. It is endemic to south-east Australia and grows mainly in grasslands and grassy woodland habitats. Clover Glycine has been heavily impacted by land clearing, grazing and weed invasion and the alteration of fire regimes, leading to significant fragmentation of the population.

The project boundary is largely an unsuitable habitat for Clover Glycine. Much of the area consists of a modified understorey with varying levels of weediness. Generally, the most common weeds are grassy species, which compete in the ground layer, generally making the environment unsuitable for Clover Glycine due to the high biomass. Areas with a higher potential to support Clover Glycine include Simpson Barracks, Banyule Reserve and some elevated flats along the Koonung Creek valley.

The assessment concluded that Clover Glycine has a moderate likelihood of occurring within the project boundary due to the potentially suitable habitat, however no individuals were observed during targeted surveys.

Charming Spider-orchid

Charming Spider-orchid is endemic to Victoria and has been recorded in the north-east suburbs of Melbourne. It is typically found in grassy dry forest.

No individuals were observed during field assessments and while potential habitat may exist within the project boundary, the closest historical record of the orchid is located three kilometres from the project boundary, which was recorded in 1996. Targeted surveys were therefore not undertaken.

Green-striped Greenhood

Green-striped Greenhood generally prefers moist areas of heathy and shrubby forests.

No individuals were observed during targeted surveys and although potentially suitable habitat exists within the project boundary.

Short Water-starwort

Short Water-starwort is a mostly terrestrial, creeping species from the Otway Ranges and northern outskirts of Melbourne, found on sites subject to inundation.

No individuals were observed during field assessments although this species was observed within the project boundary in 2017, with one record confirmed in Banyule Swamp.

Targeted field surveys did not identify Short Water-starwort within the project boundary.

Arching Flax-lily

Arching Flax-lily is a perennial graminoid that grows up to 1.3 metres tall in solitary tufts or loose patches. Urban expansion means many remaining populations of this species are very small and fragmented in Victoria, where it is mainly concentrated in the Volcanic Plain and Riverina.

Five individuals were observed within the project boundary during field assessments; one in Simpson Barracks, one in Coleen Reserve and three at Yarra Bend Park.

Studley Park Gum

Studley Park Gum is a hybrid of two non-threatened native species, the River Red Gum *Eucalyptus camaldulensis* and Swamp Gum *Eucalyptus ovata*. It is largely found within the City of Banyule and at Studley Park along the Yarra River.

The field assessment identified eight large Studley Park Gums and several cohorts of varying age within Simpson Barracks (numbers not determined), two individuals near Watsonia railway station within the project boundary, and one incidental record in Banyule Flats (outside the area directly impacted by the project). After discussions with DELWP, NELP has committed to undertaking further field surveys to better understand the presence of Studley Park Gum at Simpson Barracks and to estimate the number of individuals potentially impacted by the project.

Austral Crane's-bill

Austral Crane's-bill is a long-lived trailing, perennial herb that is increasingly rare in Victoria due to loss of habitat. This species generally grows in sheltered sites in grassy woodlands with seasonally moist soils and with exposure to strong sunlight.

No individuals were observed during field assessments. However, potentially suitable sheltered grassy woodland habitat exists within the project boundary.

Silurian Striped Greenhood

The Silurian Striped Greenhood is generally confined to the Shire of Nillumbik area where it is found in the drier woodlands. The closest historical record of the species to the project is located in or immediately adjacent to the Hurstbridge rail line reserve.

No individuals were observed during targeted surveys although suitable habitat may exist within the project boundary.

Wine-lipped Spider-orchid

The Wine-lipped Spider-orchid is a slender, erect, perennial herb that grows from tubers. It is largely known from the foothills immediately east of Melbourne and may respond positively to summer fires. Optimal habitat for this species is relatively moist, grassy forest or woodland, often in shaded habitats.

Wine-lipped Spider-orchid was not observed during field assessments. However, potentially suitable habitat may exist within the project boundary.

Rare species

'Rare' species are established by the threatened species advisory list published by the Victorian Department of Environment, Land, Water and Planning (DELWP). Rare species are those of which relatively few populations are known or when they are restricted to a relatively small area but are not considered threatened. The assessment identified rare species which have a moderate or higher likelihood of occurring within the project boundary:

- Veined Spear-grass *Austrostipa rudis subsp. australis*
- Pale-flower Crane's-bill *Geranium sp. 3*
- Austral Tobacco *Nicotiana suaveolens*
- *Pterostylis clivosa*
- Emerald-lip Greenhood *Pterostylis smaragdina*
- Floodplain Fireweed *Senecio campylocarpus*
- Annual Fireweed. *Senecio glomeratus subsp. Longifructus*.

Protected flora species

Thirty-seven flora recognised as protected under the FFG Act were recorded on public land in the project boundary during field surveys. These species would likely be impacted by the project.

Ecological Vegetation Class (EVC)

EVCs are a classification used to describe vegetation communities that are native to Victoria. EVCs are described through a combination of floristics, lifeforms and ecological characteristics as defined at <<https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks>>. Each EVC relates to a specific bioregion, which are geographic areas in Victoria that are classified using a range of attributes such as climate, geomorphology, geology, soils and vegetation.

EVCs are assigned a threatened status, which indicates the extent and rarity of the EVC within the bioregion. These are defined as:

- Presumed extinct – probably no longer present in the bioregion
- Endangered – contracted to less than 10 per cent of former range or pre-European extent
- Vulnerable – contracted to 10 to 30 per cent of former range or pre-European extent
- Depleted – greater than 30 per cent and up to 50 per cent of pre-European extent remains
- Rare – EVC is rare but not depleted, degraded or threatened
- Least concern – greater than 50 per cent of pre-European extent remains.

The results of the field assessment of EVCs are listed in Table 25-2.

Table 25-2 Results of habitat hectare assessment within the project boundary

EVC No.	EVC	Status	Area of habitat assessed within project boundary (ha)
Gippsland Plain bioregion			
47	Valley Grassy Forest	Vulnerable	3.31
53	Swamp Scrub	Endangered	0.23
55	Plains Grassy Woodland	Endangered	18.11
56	Floodplain Riparian Woodland	Endangered	6.35
68	Creekline Grassy Woodland	Endangered	0.88
83	Swampy Riparian Woodland	Endangered	15.26
164	Creekline Herb-rich Woodland	Endangered	0.06
175	Grassy Woodland	Endangered	1.21
308	Aquatic Sedgeland	Endangered	0.06
641	Riparian Woodland	Endangered	0.21
821	Tall Marsh	Not listed	0.90
937	Swampy Woodland	Endangered	0.23
Highlands–Southern Fall bioregion			
18	Riparian Forest	Least concern	1.57
22	Grassy Dry Forest	Least Concern	2.75
47	Valley Grassy Forest	Vulnerable	0.30

EVC No.	EVC	Status	Area of habitat assessed within project boundary (ha)
Victorian Volcanic Plain bioregion			
55	Plains Grassy Woodland	Endangered	0.61
56	Floodplain Riparian Woodland	Endangered	0.05
641	Riparian Woodland	Endangered	0.02
Total within project boundary (ha)			52.11

25.2.2 Terrestrial fauna

Fauna habitat and non-threatened native fauna

While habitat within the project boundary is considerably urbanised and fragmented, it still includes habitats that support fauna, including forests and woodlands, scattered trees and shrubs, waterways and wetlands. Areas of highest ecological value for fauna occur particularly near the Yarra River and its associated floodplain in the Banyule and Bulleen area. The Yarra River provides the most significant wildlife corridor in the study area and the eastern suburbs of Melbourne. Other areas of notable value to terrestrial fauna include eucalypt woodland in Simpson Barracks and along Koonung Creek.

Habitats within the project boundary tend to persist with compromised ecological integrity due to considerable disturbance and are now mostly dominated by common and adaptable fauna, particularly birds. These include the Noisy Miner *Manorina melanocephala*, Rainbow Lorikeet *Trichoglossus haemotodus* and Red Wattlebird *Anthochaera carunculata*). Possums are also present such as the Common Ringtail Possum *Pseudocheirus peregrinus* and Common Brushtail Possum *Trichosurus vulpecula*). However, less common fauna do use some habitats in the project boundary, particularly habitats along the Yarra River. Wetlands in the area along the river and within the golf courses provide specific habitat for waterbirds such as ducks, cormorants, egrets, herons and gallinules as well as frogs.

Threatened and migratory fauna

For terrestrial fauna, ‘threatened’ species refers to species that are listed as threatened under the:

- *Environment Protection and Biodiversity Conservation Act 1999* (‘EPBC Act’) – the EPBC Act is Australia’s key legislation for protection of threatened species.
- *Flora and Fauna Guarantee Act 1988* (‘FFG Act’) – the FFG Act is Victoria’s key legislation for the conservation of Victoria’s native species. For fauna, the Act establishes a threatened species list to identify species that require management to conserve. Species ‘listed’ under the FFG Act are considered threatened for the purpose of this assessment.
- Department of Environment, Land, Water and Planning (DELWP) threatened species advisory lists – while species advisory lists have no legal status they may be considered in planning assessments and are considered for the purposes of vegetation removal offsets. Species listed under Near Threatened and Data Deficient categories on the advisory lists are not considered threatened fauna.

As part of this assessment, EPBC Act listed migratory species were also considered. Under the EPBC Act, Australia has an obligation to protect and conserve habitat for species that migrate internationally and whose survival depends on habitats in Australia.

Seventy-four species of terrestrial fauna identified in the study area are considered threatened and 26 species are listed as migratory. However, not all these species are likely to occur within the project boundary frequently or regularly. Many are now extremely rare in the Melbourne area. This section presents the threatened and migratory fauna known to be present, or considered likely to occur, within the project boundary.

Table 25-3 identifies the 23 species that were considered to have a moderate or high likelihood of occurrence within the project boundary, or were identified as requiring consideration specifically by Victoria’s DELWP or the Australian Department of Environment and Energy (DoEE). If they do occur within the project boundary, presence is most likely within the Banyule Flats and Yarra Flats areas.

Table 25-3 Threatened and migratory fauna species with potential to occur within the project boundary

Common name	Scientific name	EPBC Act	FFG Act	Threatened Species Advisory List
Mammals				
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	VU	L	vu
Common bent-wing bat	<i>Miniopterus schreibersii oceanensis</i>		L	vu

Common name	Scientific name	EPBC Act	FFG Act	Threatened Species Advisory List
Birds				
Swift Parrot	<i>Lathamus discolor</i>	CR	L	en
Australasian Bittern	<i>Botaurus poiciloptilus</i>	EN	L	en
Australian Painted Snipe	<i>Rostratula australis</i>	EN	L	cr
Latham's Snipe	<i>Gallinago hardwickii</i>	Mi		nt
Powerful Owl	<i>Ninox strenua</i>		L	en
Grey Goshawk	<i>Accipiter novaehollandiae</i>		L	vu
White-throated Needletail	<i>Hirundapus caudacutus</i>	Mi	L	vu
Lewin's Rail	<i>Ardea intermedia</i>		L	en
Baillon's Crake	<i>Porzana pusilla</i>		L	vu
Little Bittern	<i>Ixobrychus minutus</i>		L	en
Eastern Great Egret	<i>Ardea modesta (=alba)</i>		L	vu
Intermediate Egret	<i>Ardea intermedia</i>		L	en
Little Egret	<i>Egretta garzetta</i>		L	en
Blue-billed Duck	<i>Oxyura australis</i>		L	en
Australasian Shoveler	<i>Anas rhynchotis</i>			vu
Hardhead	<i>Aythya australis</i>			vu
Musk Duck	<i>Biziura lobata</i>			vu
Reptiles				
Glossy Grass Skink	<i>Pseudemoia rawlinsoni</i>			vu
Amphibians				
Growling Grass Frog	<i>Litoria raniformis</i>	VU	L	en
Brown Toadlet	<i>Pseudophryne bibroni</i>		L	en
Southern Toadlet	<i>Pseudophryne semimarmorata</i>			vu

Key

EPBC Act CR – Critically Endangered, EN – Endangered, VU – Vulnerable, Mi – Migratory

FFG Act L – Listed

Threatened Species Advisory List cr – Critically Endangered, en – Endangered, vu – Vulnerable, nt – near threatened (not a category of threat)

Grey-headed Flying-fox

The Grey-headed Flying-fox uses a wide range of habitats across its distribution, from lowland rainforest and coastal Stringybark forests, to agricultural land and suburban gardens. This species occurs across the Melbourne area, foraging in flowering and fruiting trees.

Grey-headed Flying-fox have been reported as using habitat around Melbourne for more than 100 years. Numbers have been increasing, possibly due to a loss of habitat in New South Wales and Queensland and the creation of a reliable food supply around Melbourne. A sizeable colony that took up residence in the Melbourne Royal Botanic Gardens was relocated to Yarra Bend Park in Kew in 2003. The colony size fluctuates with breeding season. Over summer, the Yarra Bend colony can swell to more than 30,000 individuals although during winter the population can reduce to around 6,000 individuals. The flying-fox camp was visited in November 2017 to ascertain current habitat use and the northern limits of roosting flying-foxes. Roosting flying-foxes were observed around 70 metres from the Eastern Freeway and around 400 metres (or 700 metres downstream) from the nearest river crossing.

The Grey-headed Flying-fox is common at night across Melbourne and was observed in small numbers flying overhead during nocturnal field assessments at several locations within the project boundary.

Targeted surveys were not undertaken for this species. As individuals are known to forage across the entire study area, its presence was assumed.

Common Bent-wing Bat

The Common Bent-wing Bat favours caves for roosting and the airspace above tree canopy for foraging. The bat is considered likely to forage above some habitats within the project boundary. This species was not detected during the assessment.

Swift Parrot

The Swift Parrot is a winter migrant to Victoria from breeding areas in Tasmania. In Victoria, the Swift Parrot prefers dry, open eucalypt forests. Typically, a portion of the population flies through the Melbourne area on northerly and southerly migrations to central or western Victoria and further north. The Swift Parrot is reported sporadically in small numbers across Melbourne in most years, where suitable eucalypts occur and flower at appropriate times of the year. Occasionally, the Swift Parrot is recorded in urban parks, gardens, street trees and golf courses with flowering trees and shrubs.

The majority of recordings of Swift Parrot relevant to the study area are from north of the Yarra River. Specific locations in recent years include the Gresswell Forest Nature Conservation Reserve, Macleod railway station, La Trobe University and some areas in Greensborough and Plenty. The trees in and around Macleod railway station are considered to be priority habitat for Swift Parrot as up to 40 Swift Parrots were observed between May and July 2015 in trees in that area. Most of these trees are outside the project boundary

Through desktop investigations and field habitat assessments, it was determined the Swift Parrot has at least some potential to occasionally visit flowering trees within the project boundary, but is unlikely to use any of those habitats to a great degree. While Swift Parrots may forage in trees in the project boundary occasionally and opportunistically, there is little evidence to suggest that trees or habitat patches within the project boundary are particularly favoured or visited regularly by this species.

Australasian Bittern and Little Bittern

The Australasian Bittern and Little Bittern are secretive species, rarely seen or reported. They prefer dense tall vegetation in permanent freshwater swamps and wetlands, particularly when dominated by sedges, rushes and reeds.

Within the study area, suitable habitat for these species occurs mainly along the Yarra River, particularly around Banyule Swamp. Potential habitat along Koonung Creek and Banyule Creek is degraded and disturbed with only isolated patches of vegetation. These areas provide marginal habitat and are considered unlikely to support either species.

Within the project boundary, records of the Australasian Bittern are concentrated around the Yarra River floodplain. The Little Bittern has fewer records at this location, with additional records around La Trobe University. There are no records of either species along Koonung Creek or Banyule Creek and neither species was detected during the assessment.

Australian Painted Snipe

The Australian Painted Snipe is a rare, nomadic species that can utilise any suitable wetland across Australia when conditions are favourable. This species is widespread but rare throughout most of eastern Australia.

The most suitable habitat for this species is in and around Banyule Swamp. There is potentially suitable habitat at Bolin Bolin Billabong although there are no historical records of the species at that location. Considering the low number of records, it is considered unlikely that habitats within the project boundary support this species.

Latham's Snipe

Latham's Snipe is a summer migrant to Australia, returning each year to Japan and eastern Russia to breed during the northern summer. This species is present in southern Australia only during the warmer months, from around August to March.

Latham's Snipe is a highly mobile species that forages in wet and flooded grasslands, preferably subjected to little disturbance. Latham's Snipe is a regular visitor to the study area. Many of the records are from the Yarra River floodplain, including Bolin Bolin Billabong and Banyule Flats, as well as records further afield near La Trobe University and Dandenong Creek.

Banyule Flats occasionally attracts larger numbers of this species and is likely to be considered 'important habitat' under the EPBC Act. Outside the Yarra River floodplain, locations within the project boundary where this species may occur are typically degraded, disturbed and within urbanised areas and not anticipated to attract or support more than small numbers of this species.

Powerful Owl

In Victoria, the Powerful Owl favours tall, wet eucalypt forests as well as drier forest types which have hollow-bearing eucalypt trees.

Current research by Deakin University found there are many pairs of resident Powerful Owls along the Yarra River floodplain, including within parts of the study area. Powerful Owls have been regularly reported in the Banyule Flats area and fledging chicks have been reported there in multiple years. Deakin researchers are confident that more breeding pairs reside along the Yarra River downstream of the Banyule area. Foraging habitat for this species is known to extend to Koonung Creek and Banyule Creek at least occasionally.

Targeted surveys for Powerful Owls were conducted within the project boundary where vegetation removal and surface impacts would be expected (that is, not including the tunnelled section). No Powerful Owls or trees with apparently suitable breeding hollows were detected during the targeted surveys.

Grey Goshawk

The Grey Goshawk favours woodlands, forests and riparian habitats in wetter areas. It is a generally uncommon but regular visitor to the Melbourne area. The species has been recorded along the Yarra River floodplain and in other well-treed areas surrounding or near wetlands such as around La Trobe University. There are numerous records of Grey Goshawk in the Banyule Flats area, as recently as 2018. It is considered unlikely the Grey Goshawk uses habitat within the project boundary for breeding but it may use suitable habitat for foraging.

White-throated Needletail

The White-throated Needletail occurs above most types of habitat, particularly wooded areas, including forest and rainforest and woodland. This species is reported to be almost exclusively aerial within Australia, although birds do roost in trees at least occasionally.

Needletails are likely to forage occasionally in the airspace of the project boundary, but unlikely to have a substantial association with the terrestrial habitats. The White-throated Needletail was not detected during the assessment.

Baillon's Crake and Lewin's Rail

The Baillon's Crake and Lewin's Rail both prefer densely vegetated wetlands. The project boundary contains suitable habitat for these species along the Yarra River in the Banyule and Bulleen areas. There are records of these species within the study area, particularly near Banyule Swamp.

Baillon's Crake also appears to occur occasionally along Koonung Creek. Both species may visit Banyule Creek, but there are no historical records of either species from that waterway. Neither species was detected during the assessment.

Little Egret, Intermediate Egret and Eastern Great Egret

These three species of egret forage across a wide range of habitats, including saltwater and freshwater wetlands, mudflats, estuaries, lakes, dams, river margins, small waterways and wet grassland areas.

The study area contains suitable habitat for these species, particularly along the Yarra River floodplain but also along the smaller waterways, Koonung Creek and Banyule Creek.

These species may visit locations within the project boundary along the Yarra River floodplain to forage. However none are likely to use habitats within the project boundary to breed. The Eastern Great Egret is generally far more common than the other two species in the Melbourne area and was seen at Banyule Swamp during field assessments.

Australasian Shoveler, Hardhead, Blue-billed Duck and Musk Duck

These four duck species use a wide range of habitats. The Australasian Shoveler is a filter feeding duck and uses well-vegetated larger wetlands, dams and lakes. The Blue-billed and Musk Ducks are diving ducks that tend to prefer deep open water in wetlands, dams, lakes and slow-flowing rivers. The Hardhead uses a range of habitats including deep permanent wetlands, dams, lakes, slow-flowing rivers, as well as brackish wetlands and water storage ponds, and occasionally estuarine and littoral habitats such as saltpans, coastal lagoons and sheltered inshore waters.

The study area contains suitable habitat for these species along the Yarra River floodplain. Suitable habitats include the Yarra River, Banyule Swamp and possibly some of the larger dams within golf courses. These habitats are of limited extent and are consequently of moderate to low value to these species.

Larger man-made wetlands along Koonung Creek may attract small numbers of Hardhead but are unlikely to attract the other species. Banyule Creek is generally not considered suitable for these species.

Glossy Grass Skink

The Glossy Grass Skink prefers swamp and lake edges, saltmarshes and boggy creeks with dense vegetation. There are very few records of this species in the study area; one from Bolin Bolin Billabong in 1991 and the other along the Plenty River in 1988.

The project boundary contains potentially suitable habitat along each of the waterways, particularly along the Yarra River floodplain. However, the combined long history of disturbance across the Melbourne area and introduced predators such as cats, rats and foxes may mean this species is less abundant than the habitat presence suggests. Smaller waterways (Koonung Creek and Banyule Creek) are considered unlikely to support this species due to their narrow habitat extent and poor condition.

Opportunistic daytime searches for this species, and all reptiles, were undertaken at all locations visited in October and November 2017, and targeted searches for the species were undertaken at additional locations in December 2018. This included Simpson Barracks, Bolin Bolin Billabong and other wetlands and billabongs that were considered to provide the most suitable habitats within and near the project boundary. No Glossy Grass Skinks were detected. An undocumented population may persist locally within the project boundary.

Growling Grass Frog

The Growling Grass Frog is found mostly amongst non-shaded emergent vegetation, including rushes, reeds and sedges, in or at the edge of still or slow-flowing water bodies such as lagoons, swamps, lakes, ponds, farm dams, open vegetated wetlands, flooded paddocks and drains. Typically, it requires a mosaic of wetland habitats. Floodplains tend to provide suitable habitat for this species, in that they are predominantly wet and contain a range of waterbody types.

Historically, the Growling Grass Frog was widespread and common in Victoria, absent only from the driest and highest parts of the state. In the last few decades, the species suffered widespread population declines and has now disappeared from much of its former range.

There are no records of the Growling Grass Frog in the study area since 1991, which coincides with the timing of population declines, and no Growling Grass Frogs were detected during targeted surveys. The Yarra River floodplain clearly provides potentially suitable habitat for the Growling Grass Frog but the species currently appears to be absent from the habitats and resources within the project boundary. No individuals were identified during targeted surveys.

Brown Toadlet and Southern Toadlet

Most records of these species near the study area are from before 1980. One more recent record from Alphington Park (2005) on the north side of the Yarra River suggests that toadlets may persist in small areas of suitable habitat.

Targeted surveys for both species of toadlets were undertaken in April and May 2018. Most potential habitat locations were found to be disturbed and degraded. Results of the targeted survey led to the conclusion that toadlets are unlikely to persist within the project boundary and if present, are likely to be very localised and in small numbers only.

25.2.3 Aquatic species and ecosystems

Aquatic habitats

The study area is located within the Yarra River catchment and intersects with sections of the Yarra River, Merri Creek, Plenty River, Koonung Creek and Banyule Creek as shown in Figure 25-2. A number of permanent and ephemeral natural wetlands are also present, notably including Bolin Bolin Billabong and Banyule Swamp.

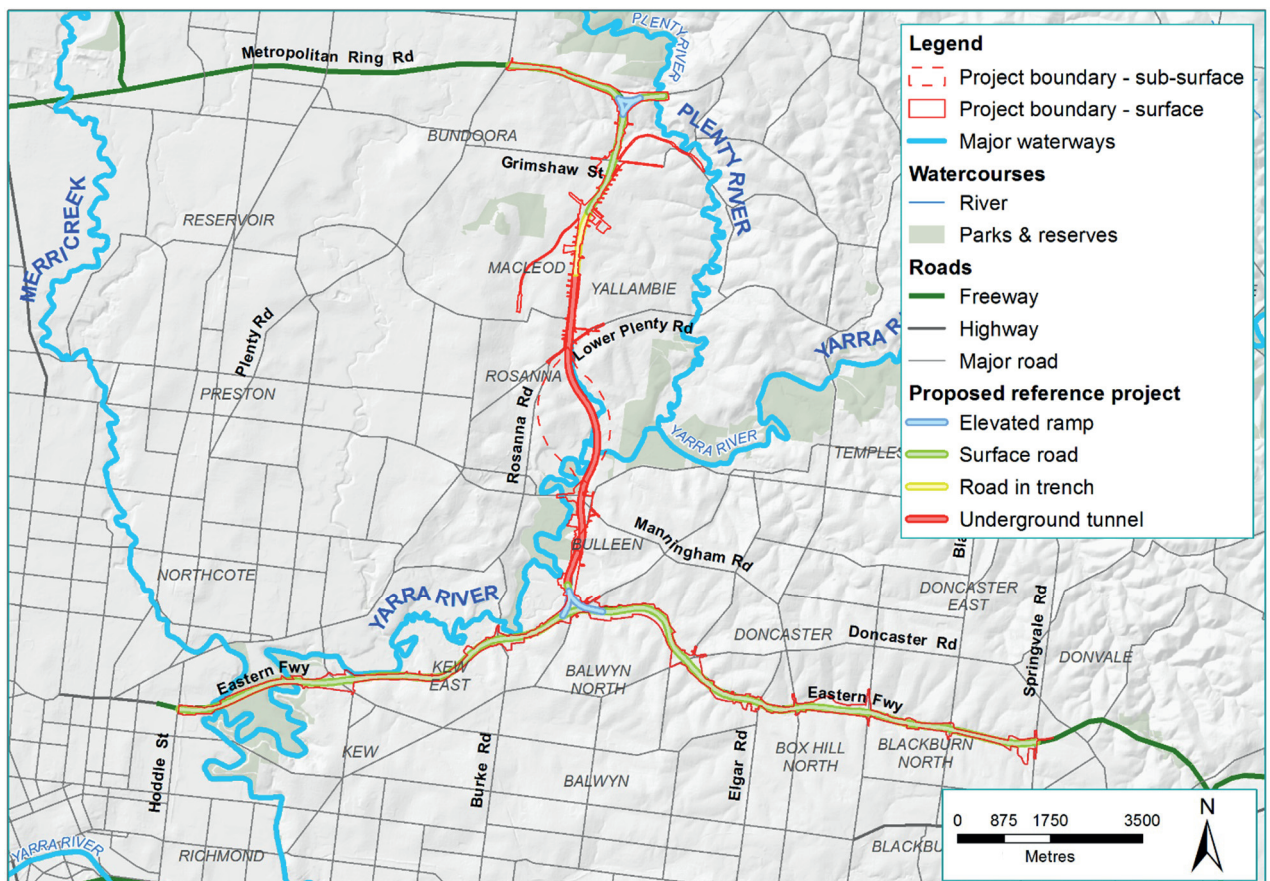


Figure 25-2 Major waterways intersecting with the project boundary



The Yarra River catchment lies north and east of Melbourne, beginning on the southern slopes of the Great Dividing Range in the forested Yarra Ranges National Park. The upper reaches of the Yarra River and its major tributaries flow through forested, mountainous areas. Most of the land along rivers and creeks in the middle and lower sections has been cleared for agriculture or urban development. Within the study area, the Yarra River consists of an extensive floodplain that comprises a number of land uses including public recreation, conservation and special use zones such as golf courses. The Yarra River and its associated floodplain in the Banyule and Bulleen area retains high ecological value. The river provides the most significant wildlife corridor within the study area and within the eastern suburbs of Melbourne. Wetlands in this area include Bolin Bolin Billabong and Banyule Swamp. Tributaries of the Yarra River were considered in the ecological assessment.

Koonung Creek is a tributary of the Yarra River. Koonung Creek is approximately 12 kilometres long and begins near Springvale Road in Blackburn North. The creek meanders back and forth either side of the Eastern Freeway for much of its length before it outfalls into the Yarra River. Overall, the catchment is heavily urbanised and disturbed and the channel is heavily modified. The creek has a highly modified catchment and receives high volumes of urban stormwater drainage. The channel has been extensively modified in the landscape, with erosion control works, tunnelling and realignment all impacting the natural geomorphology and instream habitat of the waterway.

Banyule Creek originates within Simpson Barracks. From Blamey Road, Banyule Creek generally runs parallel to Greensborough Road through Simpson Barracks to an open reserve north of Drysdale Road.

At Drysdale Road and Lower Plenty Road, the creek crosses under the roads. South of Lower Plenty Road, the creek continues through an open reserve near residential properties until it meets the Yarra River.

The creek is approximately four kilometres in length. Banyule Creek is highly modified and receives urban runoff, has a realigned channel, very little native vegetation and contains a high diversity of introduced species.

Fish surveys were undertaken in Plenty River, Banyule Creek and Koonung Creek as part of the fieldwork for the ecology impact assessment for North East Link. Fish surveys identified a high prevalence of exotic species and a limited diversity of native fish species. Fish surveys were not undertaken in the Yarra River because this waterway has been well-studied and the presence of species has been established. Additionally, modifications to the Yarra River are not proposed as part of North East Link.

Threatened species

Threatened aquatic species potentially found in waterways within or intersecting the study area were identified as part of the ecology impact assessment. Those species considered to have a moderate or high likelihood of occurrence in the project boundary are listed in Table 25-4.

Table 25-4 Threatened aquatic species present or likely to occur within the project boundary

Common name	Scientific name	EPBC Act	FFG Act	Threatened Species Advisory List
Australian Grayling	<i>Prototroctes maraena</i>	VU	L	vu
Australian Mudfish	<i>Neochanna cleaver</i>		L	cr
Macquarie Perch	<i>Macquaria australasica</i>	EN	L	en
Murray Cod	<i>Maccullochella peelii</i>	VU	L	vu
Broad-shelled Turtle	<i>Chelodina expansa</i>		L	en
Murray River Turtle	<i>Emydura macquarii</i>			vu

Key

EPBC Act CR – Critically Endangered, EN – Endangered, VU – Vulnerable, Mi – Migratory

FFG Act L – Listed

Threatened Species Advisory List cr – Critically Endangered, en – Endangered, vu – Vulnerable, nt – near threatened (not a category of threat)

Australian Grayling

Australian Grayling occur in coastal rivers and streams in south-eastern Australia. They usually prefer cool, clear waters but can also occur in turbid water.

Although there are no reliable population estimates, Australian Grayling are reported to be relatively uncommon and only caught in small numbers. Research suggests there can be large, annual fluctuations in abundance depending on prevailing conditions.

Australian Grayling are known to occur in the Yarra River, between Mullum Mullum Creek and Dights falls, and eggs and larvae have been retrieved at Fairfield. As such the Australian Grayling are likely to occur within the project boundary. The habitat of Plenty River was found to provide a potential migration corridor for the species from the Yarra River.

The habitat assessment of all other waterways in the study area concluded the presence of Australian Grayling was unlikely, but is possible in waterways with direct connectivity to the Yarra River and where suitable habitat is present. The habitat assessment of Banyule Creek identified significant barriers to fish passage that would prevent Australian Grayling from moving upstream from the Yarra River. Koonung Creek was also found to contain some significant covered sections that are potential barriers to fish passage that may impede the upstream movement of fish from the Yarra River. Australian Grayling are not expected to inhabit the disconnected waterbodies such as Bolin Bolin Billabong and Banyule Swamp.

Australian Mudfish

Australian Mudfish tend to inhabit permanent and ephemeral stagnant freshwater swamps and drains, preferring areas with muddy or silty bottoms and thick instream and emergent vegetation. The species is capable of surviving some natural drying of its wetland habitat.

Australian Mudfish are considered to live within Merri Creek and the lower Yarra River. In the Yarra River it has been found below Dights Falls near Melbourne. This means the Australian Mudfish is likely to occur within the project boundary. Given the species appears unable to migrate very far inland it is unlikely to be within other waterways within the project boundary.

Broad-shelled Turtle

The Broad-shelled Turtle lives only in permanent, deep water. Broad-shelled turtles nest in autumn and nests can be located more than 500 metres from the water.

The Broad-shelled Turtle has been recorded in the Yarra River upstream of the project boundary and may possibly be found in the Yarra River near the project boundary. It is not likely to inhabit other waterways in the study area due to an absence of suitable deep pool habitat.

Macquarie Perch

Macquarie Perch inhabit cool and clear freshwater reaches of rivers with deep holes and shallow riffles, as well as lakes and reservoirs. In rivers they prefer cool areas with aquatic vegetation, large boulders, woody debris and overhanging banks.

A self-sustaining population exists in the Yarra River from fish translocated in the 1920s. Due to connectivity with the Yarra River, there is a high potential for the species to also occur in Merri Creek. The species is also reported as living in Mullum Mullum Creek and the Plenty River. Barriers to fish passage exist in Banyule Creek and Koonung Creek which may impede the upstream movement of fish from the Yarra River. The species is not expected to be in the disconnected waterbodies such as Bolin Bolin Billabong and Banyule Swamp. As such, the Macquarie Perch is likely to occur within the project boundary.

Murray Cod

Murray Cod live in a variety of habitats including rivers, lakes and billabongs. Although they prefer the main channel of rivers they can be found in inundated floodplain channels during high flows although this is reported as limited. The species is strongly associated with structural woody habitat, deep, slow flowing water close to river banks.

The species is endemic to river systems of the Murray–Darling Basin and has been successfully introduced to the Yarra River. Given the territorial and sedentary nature of the species and its preference to inhabit deeper areas of rivers, the Murray Cod is expected to occur within the project boundary in the Yarra River. It is also likely they occur in Merri Creek and Plenty River due to their connectivity with the Yarra River and available habitat. The species is not expected to be in the disconnected waterbodies such as Bolin Bolin Billabong and Banyule Swamp nor in Banyule Creek and Koonung Creek due to the presence of barriers to movement and absence of suitable habitat.

Murray River Turtle

The Murray River Turtle inhabits lagoons, rivers and backwater. It is known from the Yarra River upstream of the project boundary, but is not likely to inhabit other waterways in the project boundary due to an absence of suitable deep pool habitat.

25.3 Construction impact assessment

This section discusses the construction impacts associated with North East Link that relate to ecology.

The impacts identified for the construction of North East Link that relate to ecology are grouped according to five main themes:

- Threatened flora and ecological communities
- Non-threatened native flora and ecological communities
- Threatened terrestrial fauna
- Non-threatened native terrestrial fauna
- Aquatic species and ecosystems.

The potential for impacts associated with these main themes are discussed in the following sections.

25.3.1 Threatened flora and ecological communities

The risk pathways associated with threatened flora and ecological communities are summarised in Table 25-5 and discussed below.

Table 25-5 Risk table: Construction – threatened flora and ecological communities

Risk ID	Risk pathway	Risk rating
Risk EC01	Land clearing during construction impacting threatened flora and ecological communities	Planned (moderate consequence)
Risk EC04	Construction activities resulting in erosion/sedimentation, dust, litter or release of contaminants leading to loss or degradation of threatened flora and ecological communities	Low
Risk EC05	Construction activity leading to the introduction or spread of weeds, pest species, or pathogens that leads to the reduction of ecological values	Low
Risk EC06	Dewatering of groundwater during construction resulting in changes to terrestrial groundwater dependent ecosystems	Medium
Risk EC07	Construction activity causes soil compaction that leads to the loss or degradation of threatened flora and ecological communities	Low
Risk EC26	Construction of tunnels causes ground settlement or tree root interactions causing death of native trees, degradation of vegetation quality or vitality of native vegetation	Low

Land clearing

The construction of roads, tunnels and ancillary infrastructure requires the removal of vegetation. The assessment considered the potential for this to impact threatened flora and ecological communities (risk EC01).

It is estimated that 95 Matted Flax-lily, five Arching Flax-lily and more than 10 large Studley Park Gum would be impacted by land clearance.

Despite the assumed presence of River Swamp Wallaby-grass within the project boundary, there are not expected to be significant impacts to the species as the majority of suitable habitat would not be impacted by land clearing. There are not anticipated to be significant impacts on other threatened flora species.

Through detailed design the impacts to Matted Flax-lily would be minimised. Removed Matted Flax-lily and Arching Flax-lily would be moved to suitable receptor sites, which would be managed through a Salvage and Translocation Plan (EPR FF7). This plan is provided in Appendix K of Technical report Q – Ecology. The plan describes the criteria for selecting suitable recipient sites as well as details of translocation management actions, and establishes procedures for the salvage, propagation, translocation and monitoring of Matted Flax-lily and Arching Flax-lily.

Impacts to the Studley Park Gum would be minimised through detailed design and offset, where impacts are unavoidable, according to the DELWP Guidelines for the removal, destruction or lopping of native vegetation (EPR FF2). To further mitigate impacts on Studley Park Gum, seed would be collected from individuals within the project boundary and propagated in a nursery. Propagated plants would then be incorporated into project landscaping (EPR AR3). Through detailed design and construction, the footprint of works would be minimised which may provide opportunities to reduce impacts on threatened flora (EPR LP1). To manage inadvertent impacts to threatened flora during construction, a Construction Environmental Management Plan (CEMP) would be developed and implemented that would include measures to protect areas of retained native vegetation (EPR EMF2). Tree retention would be maximised through detailed design (EPR AR1). A tree protection plan would be implemented to manage trees to be retained throughout construction (EPR AR2).

Erosion, sedimentation, dust, litter and contaminants

The assessment considered the potential for construction activities to cause erosion, sedimentation, dust, litter and the release of contaminants that impact threatened flora (risk EC04).

Construction activities such as surface works and excavation can mobilise sediments and contaminants and generate dust and litter which impact threatened flora.

To address this risk to threatened flora, a CEMP and Spoil Management Plan would be prepared to implement erosion protection measures, sedimentation and discharge controls and management of chemicals, fuels and hazardous materials (EPR EMF2 and EPR CL1). Management measures for chemicals, fuels and hazardous materials would be developed and implemented (EPR CL5). Waste management measures would be implemented in accordance with Victoria's *Environment Protection Act 1970* (EPR SCC4). A Tree Protection Plan would be developed and implemented so that retained trees are adequately protected from construction-related activities (EPR AR2). Discharges and runoff would meet the current relevant State Environment Protection Policy (EPR SW1).

Spread of weeds, pest species and pathogens

The assessment considered the potential for the project to spread weeds, pest species and pathogens which would reduce threatened flora species and ecological communities (risk EC05).

Seeds of weed species and other pathogens can become lodged in construction plant and equipment when driven through or used in infested areas. The seeds and pathogens may be carried some distance before being deposited in areas free from previous infestations. Plant and equipment being used within the project boundary could also cause off-site infestations of weed species and other pathogens.

Management requirements would be implemented to avoid the spread of introduction of weeds and pathogens during construction (EPR FF3) and incorporated into a CEMP (EPR EMF2). A Spoil Management Plan would also be developed to manage spoil (EPR CL1). Management measures for waste would be developed and implemented to limit attracting animal pests (EPR SCC4).

Groundwater drawdown

The assessment considered the potential for groundwater drawdown to impact threatened flora, ecological communities and large trees during construction (risk EC06).

Any excavation that intercepts the groundwater table has the potential to change groundwater condition. The extent and magnitude of potential groundwater drawdown during the project's construction has been determined through groundwater modelling as described in Chapter 22 – Groundwater. For construction, modelling was undertaken for the year 2024 to provide an indication of the likely groundwater changes during the project's construction.

What is groundwater drawdown?

Groundwater drawdown is the lowering of the water table from the existing groundwater level.

Where vegetation relies on this groundwater and can no longer access it, degradation or death of vegetation can occur during periods of limited rainfall or drought.

The modelling identified potential for groundwater drawdown to impact ecological values in areas around Simpson Barracks and Bolin Bolin Billabong. Potential impacts to Bolin Bolin Billabong are discussed in Section 25.3.5 below. Drawdown was not predicted through Banyule Flats and Warringal Parklands and so impacts to groundwater dependent ecosystems are not anticipated in these areas.

The project's construction could reduce the availability of groundwater for large trees, beyond the project boundary that rely on this water source. One threatened species, the Studley Park Gum, has potential to be impacted by groundwater drawdown. Without mitigation, it is estimated that one Studley Park Gum has a moderate risk of being impacted and two have a low risk of being impacted during construction. Other threatened flora within the study area were determined unlikely to be impacted by groundwater drawdown. At Simpson Barracks where groundwater drawdown is anticipated, the depth to groundwater has been modelled to be around 10 metres at the shallowest point, which would be only accessible by large trees. Matted Flax-lily and Arching Flax-lily would therefore not be impacted by groundwater drawdown. Populations of Matted Flax-lily and Arching Flax-lily in other locations within the study area would not be in areas of groundwater drawdown.

While a number of trees are at risk from groundwater drawdown, it is anticipated these trees would be retained with implementation of EPRs throughout construction. A Groundwater Dependent Ecosystem Monitoring and Mitigation Plan would be developed and implemented to monitor flora, fauna and ecological communities potentially impacted by groundwater drawdown. This would include measures such as watering for stressed vegetation (EPR FF6). Groundwater would be monitored before and during construction (EPR GW2) and a Groundwater Management Plan would be implemented (EPR GW4). A predictive groundwater and geotechnical model would be developed and strategies implemented to mitigate changes to groundwater levels (EPR GW1 and EPR GM1).

Soil compaction

The assessment considered the potential for the project's construction to impact threatened flora due to soil compaction (risk EC07).

Movement of heavy vehicles, plant and equipment can cause the compaction of soil. Compacted soil can change the movement of water, gases and plant roots which can impact the health of flora.

The implementation of a CEMP and a Spoil Management Plan would reduce the potential for impact to threatened flora by measures such as designating routes for movement of heavy traffic and locations for storage of construction materials and stockpiling spoil. Fencing could also be used to protect threatened flora during construction (EPR EMF2, EPR CL1 and EPR FF2). A Tree Protection Plan would be implemented to manage impacts to trees to be retained during construction (EPR AR2).

Ground settlement

The assessment considered the potential for the construction of tunnels to impact threatened flora and ecological communities by ground settlement or interactions with tree roots through tunnelling (risk EC26).

It is estimated that settlement of around two millimetres would occur at Bolin Bolin Billabong, up to 35 millimetres through the Banyule Swamp area and between two to six millimetres within Simpson Barracks. In all these areas, the magnitude of settlement is considered to be unlikely to cause damage or degradation to threatened flora and ecological communities.

25.3.2 Non-threatened native flora and ecological communities

The risk pathways associated with non-threatened native flora and ecological communities are summarised in Table 25-6 and discussed below. This section addresses all native flora and ecological communities which are not considered threatened as defined in Section 25.2.1 above.

Table 25-6 Risk table: Construction – non-threatened flora and ecological communities

Risk ID	Risk pathway	Risk rating
Risk EC02	Land clearing during construction impacting non-threatened flora and ecological communities	Planned (moderate consequence)
Risk EC03	Construction activities resulting in erosion/sedimentation, dust, litter or release of contaminants leading to loss or degradation of non-threatened flora and ecological communities	Low
Risk EC05	Construction activity leading to the introduction or spread of weeds, pest species, or pathogens that leads to the reduction of ecological values	Low
Risk EC06	Dewatering of groundwater during construction resulting in changes to terrestrial groundwater dependent ecosystems	Medium
Risk EC08	Construction activity causes soil compaction that leads to the loss or degradation of non-threatened flora and ecological communities	Low
Risk EC26	Construction of tunnels causes ground settlement or tree root interactions causing death of native trees, degradation of vegetation quality or vitality of native vegetation	Low

Land clearing

The assessment considered the land clearing required for the project's construction and the associated impact to non-threatened native flora and ecological communities (risk EC02).

The construction of the project's roads, tunnels and ancillary infrastructure would require the removal of native vegetation. Total loss of native vegetation is assumed within the project boundary although this is considered to be a conservative assessment because impacts within the boundary would be reduced through detailed design. This includes all construction compounds and laydown areas. The estimated impact of North East Link on non-threatened native vegetation is summarised in Table 25-7 with vegetation types presented in Table 25-2 of Section 25.2 (existing conditions). These losses include trees that are just outside the project boundary, where at least 10 per cent of the tree protection zone within the project boundary.

Loss of planted trees as defined in Section 25.2.1 of this chapter is not considered in this assessment but presented in Chapter 15 – Arboriculture.

Table 25-7 Estimated loss of non-threatened native vegetation by land clearing

Vegetation type	Description	Estimated loss
Native vegetation	Patches of plants that are indigenous to Victoria, including trees, shrubs, herbs and grasses	52 ha
Large trees within patches	A tree with a diameter at breast height (DBH) of greater than or equal to the large tree benchmark for the relevant EVC, which is usually between 60 cm and 80 cm DBH	92 trees
Scattered trees	A native tree that is not part of a patch	170 trees (55 large, 115 small)

Loss of a significant area of non-threatened native vegetation throughout the Banyule Flats and Warringal Parklands would be avoided by tunnelling.

A total of 37 flora species protected under the FFG Act would be impacted by land clearance. These are not considered threatened but would require a permit to remove (EPR FF5).

It is anticipated that loss of vegetation would be reduced during detailed design and so the projected estimated loss is considered conservative. Vegetation that could not be retained would be offset according to the DELWP Guidelines for the removal, destruction or lopping of native vegetation. An offsetting strategy for the project has been developed to demonstrate how the loss of this vegetation would be offset. This offsetting strategy is provided in Appendix L of Technical report Q – Ecology (EPR LP1 and EPR FF2). Impacts to areas of EVC to be retained during the project's construction would be managed through the CEMP (EPR EMF2 and EPR FF2). Tree retention would be maximised through detailed design (EPR AR1) and a Tree Protection Plan would be developed and implemented (EPR AR2).

Erosion, sedimentation, dust, litter and contaminants

Construction activities such as road upgrades and excavation can mobilise sediments and contaminants which can impact non-threatened native vegetation (risk EC03).

To address this risk to non-threatened flora, a CEMP and Spoil Management Plan would be prepared to implement erosion protection measures, sedimentation and discharge controls and management of chemicals, fuels and hazardous materials (EPR EMF2 and EPR CL1). Management measures for chemicals, fuels and hazardous materials would be developed and implemented (EPR CL5).

Waste management measures would be implemented in accordance with Victoria's *Environment Protection Act 1970* (EPR SCC4). A Tree Protection Plan would be developed and implemented to ensure that retained trees are adequately protected from construction-related activities (EPR AR2). Discharges and runoff pathways would meet the current relevant State Environment Protection Policy requirements (EPR SW1).

Spread of weeds, pest species and pathogens

The assessment considered the potential for spread of weeds, pest species and pathogens that would reduce non-threatened native flora and ecological communities (risk EC05).

Seeds of weed species and other pathogens can become lodged in construction plant and equipment when driven through or used in infested areas. The seeds and pathogens may be carried some distance before being deposited in areas free from previous infestations. Plant and equipment used within the project boundary could result in off-site infestations of weed species and other pathogens.

Management requirements for weeds and pathogens would be implemented (EPR FF3) and incorporated into a CEMP (EPR EMF2). A Spoil Management Plan would be developed to manage potentially contaminated construction spoil to reduce the risk of spreading weeds and pathogens outside construction sites (EPR CL1). Management measures for waste would be developed and implemented to limit attracting animal pests (EPR SCC4).

Groundwater drawdown

The assessment considered the potential for groundwater drawdown to impact terrestrial ecosystems during construction (risk EC06).

An area of vegetation around the northern tunnel portal has a moderate to high likelihood of being negatively impacted by groundwater drawdown during construction. There is potential for reduced availability of groundwater for large trees that rely on this water source. Without mitigation, it was found that seven large trees within Simpson Barracks have potential for death or degradation due to groundwater drawdown. A further nine large trees outside Simpsons Barracks would likely be impacted by drawdown associated with construction of the Lower Plenty interchange and the cut-and-cover tunnels.

Areas of vegetation in the Yarra River floodplain are likely to be accessing groundwater. However, it was determined these areas would unlikely be negatively impacted by groundwater drawdown because of the small magnitude of drawdown anticipated and the close proximity of groundwater to the surface. Similarly, ephemeral billabongs of the Yarra River floodplain are not anticipated to be impacted as potential drawdown would not be significant enough to impact native vegetation.

The Banyule Flats and the Warringal Parklands are predicted to experience minimal change to groundwater levels and flow during construction and operation, and so are not anticipated to experience impacts associated with groundwater drawdown.

While a number of trees are at risk from groundwater drawdown, it is anticipated these trees could be retained with implementation of the project's EPRs during construction. A Groundwater Dependent Ecosystem Monitoring and Mitigation Plan would be developed and implemented to monitor flora, fauna and ecological communities potentially impacted by groundwater drawdown. This would include measures such as watering for stressed vegetation (EPR FF6). Groundwater would be monitored before and during construction (EPR GW2) and a Groundwater Management Plan would be implemented (EPR GW4). A predictive groundwater and geotechnical model would be developed and strategies implemented to mitigate changes to groundwater levels (EPR GW1 and EPR GM1).

Soil compaction

The assessment considered the potential for impact to non-threatened native flora and ecological communities due to soil compaction (risk EC08).

The movement of heavy vehicles, plant and equipment can cause the compaction of soil, which has potential to impact native vegetation and non-threatened flora.

The implementation of a CEMP would reduce the potential for this to impact to threatened flora, by designating routes for the movement of heavy traffic and locations for the storage of construction materials and stockpiling spoil. Fencing could also be used to protect native vegetation and non-threatened flora during construction (EPR EMF2, EPR FF2 and EPR CL1). A Tree Protection Plan would be implemented to manage impacts to retained trees throughout construction (EPR AR2).

Ground settlement

The assessment considered the potential for the construction of tunnels to impact non threatened native vegetation by ground settlement or interactions with tree roots (risk EC26).

It is estimated that settlement of around two millimetres would occur at Bolin Bolin Billabong, up to 35 millimetres through the Banyule Swamp area and between two to six millimetres within Simpson Barracks. In all these areas, the magnitude of settlement is considered to be unlikely to cause damage or degradation to native flora and ecological communities.

25.3.3 Threatened and migratory terrestrial fauna

The risk pathways associated with threatened and migratory terrestrial fauna are summarised in Table 25-8 and discussed below.

Table 25-8 Risk table: Construction – threatened and migratory terrestrial fauna

Risk ID	Risk pathway	Risk rating
Risk EC09	Construction noise, vibration and/or lighting resulting in elevated disturbance of threatened fauna	Low
Risk EC11	Land clearing during construction resulting in the loss or degradation of habitat supporting threatened fauna	Low
Risk EC13	Construction activities resulting in the loss of important habitat for EPBC Act Migratory species	Low
Risk EC14	Habitat fragmentation resulting in reduced effectiveness of terrestrial wildlife corridors and creation of barriers to fauna movement	Low
Risk EC15	Construction activities resulting in erosion/sedimentation, litter or release of contaminants into wetlands and waterways leading to degradation of terrestrial fauna habitat	Low
Risk EC20	Construction activities within/around waterways resulting in loss or degradation of habitat for threatened aquatic and terrestrial fauna	Low

Disturbance from noise, vibration and lighting

The assessment considered the potential for construction-related noise, vibration and lighting to disturb and impact threatened fauna (risk EC09).

Noise, vibration and lighting can disturb or displace fauna to varying degrees. Disturbing a species to the point that it abandoned breeding habitat would be considered a severe impact, while localised and temporary disturbance of small numbers of individuals from marginal foraging habitat would be relatively inconsequential.

The majority of the project boundary supports threatened species only occasionally. One exception is the Grey-headed Flying-fox which has a camp at Yarra Bend Park. Construction works in this location would include a bridge upgrade and widening of the Eastern Freeway, but this is unlikely to cause disturbance significant enough to impact the Grey-headed Flying-fox. As this section of the Eastern Freeway is already very noisy and well-lit at night, changes in noise, vibration or light due to the project's construction are not anticipated to impact the camp.

A Construction Noise and Vibration Management Plan (CNVMP) would be prepared and implemented to minimise the impacts of noise and vibration on threatened and migratory species (EPR NV4). Measures would be developed to minimise light spill during construction to any known significant fauna habitat (EPR LV3).

Land clearing

The assessment considered the potential for land clearing to impact threatened fauna (risk EC11).

Construction of new roads and the widening of existing roads would require land to be cleared of vegetation, which has the potential to impact threatened fauna. Loss and degradation of habitat reduces foraging, nesting and dispersal opportunities and confines fauna to the extent of suitable habitat that remains. Loss of too much habitat, relative to the original patch, can threaten the viability of some populations, particularly where alternative habitats are not available.

Habitats along the corridor that support threatened terrestrial fauna are mainly confined to the Yarra River floodplain including Bolin Bolin Billabong, Banyule Flats, and Banyule Swamp. No land clearing would occur in these areas due to tunnelling under the Yarra River.

Simpson Barracks, Koonung Creek and the Yarra River crossing are locations which may occasionally be used or visited by threatened terrestrial fauna and where land clearing for the project would occur. Habitat loss at these locations is not expected to greatly impact threatened terrestrial fauna as the patches proposed to be removed are small and unlikely to be important to the survival of these species. Loss of native and planted trees across the alignment may result in minor and localised loss of occasional foraging habitat.

At the Yarra River crossing along the Eastern Freeway there would be clearing of some foraging habitat for the nearby Grey-headed Flying-fox camp. Clearing would not impact roosting or breeding habitat, extending no more than 10 metres south of the existing freeway bridges toward the camp. The nearest Grey-headed Flying-fox roosting locations are approximately 700 metres downstream from the proposed works, or approximately 400 metres directly, so impacts to this population are not anticipated considering the small amount of clearance and the extent of similar habitat remaining.

The trees surrounding Macleod railway station are considered of high value for Swift Parrots. Most of the trees that the Swift Parrots used in 2015 are outside the project boundary, but some are within the project boundary. Minor impacts (such as pruning) may be necessary to allow safe access to signal boxes, but by confining works to the rail trench, or designing works around these trees, the project expects to largely avoid impacts on these trees within the project boundary, and any impact that occurs is expected to be minor and unlikely to discourage Swift Parrots from foraging in those trees in future.

Other threatened species that may occasionally use or visit habitats within the study area (such as Eastern Great Egret or Hardhead) are not expected to be detrimentally affected by changes to habitat from the project. Those species tend to be fairly widespread and mobile, and are already making regular or occasional use of degraded habitats within a large urbanised area.

During detailed design the removal of native vegetation and fauna habitat would be minimised. This would include minimising the disturbance to threatened and migratory fauna species (EPR LP1 and EPR FF2). Vegetation protection measures would be implemented during construction by the development and implementation of a CEMP (EPR EMF2 and EPR FF2). Tree retention would be maximised through detailed design (EPR AR1) and a Tree Protection Plan would be developed and implemented to protect retained vegetation (EPR AR2). Where native vegetation could not be retained, it would be offset according to the DELWP Guidelines for the removal, destruction or lopping of native vegetation (EPR FF2).

Migratory species

The assessment considered the potential for construction activities to impact habitat used by migratory fauna (risk EC13). Losing important habitat for migratory species could impact the success or recovery of a species internationally.

The Yarra River floodplain, particularly Banyule Swamp and Banyule Flats, is likely to be considered important habitat for Latham's Snipe. Because this area would be tunnelled under, there would be no land clearing of this habitat.

Changes to groundwater during the project's construction and operation, based on modelling presented in Chapter 22 – Groundwater would not impact the Latham's Snipe as changes are considered unlikely to cause death or degradation of vegetation, or to change surface water levels in this location. There are no other sites in the project boundary known to attract an ecologically significant proportion of the Latham's Snipe or any other migratory species' population, or that would be considered important habitat.

The White-throated Needletail may use or visit habitat within the project boundary occasionally, but is unlikely to be impacted by habitat loss as it is not reliant on this vegetation.

During detailed design the removal of native vegetation and fauna habitat would be minimised. This would include minimising the disturbance to threatened and migratory fauna species (EPR LP1 and EPR FF2). Where vegetation could not be retained, it would be offset according to the DELWP Guidelines for the removal, destruction or lopping of native vegetation (EPR FF2).

EPRs specific to groundwater drawdown are discussed in Section 25.3.2 above.

Habitat fragmentation

The assessment considered the potential for habitat fragmentation caused by land clearing to impact threatened fauna (risk EC14).

The project's construction would require the removal of habitat which may result in localised fragmentation of some fauna habitats. Fragmentation of habitat can reduce the ability of fauna to disperse across a landscape and may threaten the viability of some populations.

The most important habitat and wildlife corridor within the study area is the riparian forests and wetlands associated with the Yarra River floodplain, particularly around the Banyule Flats, Banyule Swamp, Yarra Flats and Bolin Bolin Billabong. This area would be avoided through tunnelling and so the project is not expected to disrupt this area as fauna habitat or its role as a wildlife corridor.

Other habitats that may experience some localised fragmentation include those along Banyule Creek and Koonung Creek. However, these habitats are already narrow, degraded and fragmented. In terms of ecological function, these potential wildlife corridors are already compromised and predominantly used by common, mobile and adaptable species. Additional minor fragmentation due to the project is not expected to alter the ecology of those habitats.

During detailed design the removal of native vegetation and fauna habitat would be minimised. This would include minimising the disturbance to threatened and migratory fauna species (EPR LP1 and EPR FF2). A Tree Canopy Replacement Plan would be developed and implemented to mitigate the loss of tree canopy (EPR AR3).

Erosion, sedimentation, litter and contaminants

The assessment considered the potential to impact threatened terrestrial fauna due to erosion, sedimentation, litter and contaminants caused by construction activities (risk EC15).

With relevant EPRs, impacts to threatened native terrestrial fauna due to erosion, sedimentation, dust, litter or contaminants are not anticipated. To manage these risks, a CEMP would be prepared to implement erosion protection measures, sedimentation and discharge controls and management of chemicals, fuels and hazardous materials (EPR EMF2 and EPR CL5). Waste management measures would be implemented in accordance with the *Environment Protection Act 1970* (EPR SCC4).

Discharge and run-off from the project would meet the current relevant State Environment Protection Policy requirements (EPR SW1). A Surface Water Management plan would be developed and implemented to manage wastewater (EPR SW5). Water quality monitoring would be undertaken to establish baseline conditions and a surface water monitoring program would be developed and implemented (EPR SW4). Modifications to all waterways would be designed and undertaken to mitigate changes to flow, and to minimise the potential for erosion, sediment plumes and exposure to contaminated materials during construction (EPR SW8). Measures would be developed and implemented to maintain bank stability of waterways (EPR SW9).

Construction activities around waterbodies

The assessment considered the potential for construction activities within/around waterways to cause the loss or degradation of habitat for threatened terrestrial fauna (risk EC20)

Existing wetlands within the project boundary identified as possible locations for water sensitive urban design features such as Simpson's Lake at the Kew Golf Course may attract threatened terrestrial fauna occasionally. This fauna could include avian species such as Baillon's Crane, which may utilise this habitat for foraging. Given those wetlands are relatively small and in an area that supports numerous similar ponds and wetlands that could also be used for foraging, the impact is expected to be minor. Mobile wetland species are likely to adapt to the temporary loss of small areas of habitat.

To address this risk, standing trees would be retained within the waterbody. The project's construction period would be minimised and undertaken outside the typical nesting period time where practicable. The waterbody would be refilled after construction if draining was required (EPR FF9).

25.3.4 Non-threatened native terrestrial fauna

The risk pathways associated with non-threatened terrestrial fauna are summarised in Table 25-9 and discussed below.

Table 25-9 Risk table: Construction – non-threatened terrestrial native fauna

Risk ID	Risk pathway	Risk rating
Risk EC10	Construction noise, vibration and/or lighting resulting in a significant impact on non-threatened fauna	Low
Risk EC12	Land clearing during construction resulting in the loss or degradation of habitat supporting non-threatened fauna	Planned (moderate consequence)
Risk EC14	Habitat fragmentation resulting in reduced effectiveness of terrestrial wildlife corridors and creation of barriers to fauna movement	Low

Risk ID	Risk pathway	Risk rating
Risk EC15	Construction activities resulting in erosion/sedimentation, litter or release of contaminants into wetlands and waterways leading to degradation of terrestrial fauna habitat	Low
Risk EC17	Land clearing during construction resulting in reduced viability of non-threatened native fauna populations	Low
Risk EC19	Construction activities resulting in the death or injury of native fauna	Low

Disturbance from noise, vibration and lighting

The assessment considered the potential for disturbance from noise, vibration and lighting from construction activities to impact non-threatened terrestrial fauna (risk EC10).

Impacts on non-threatened terrestrial fauna are expected to be minimal but more widespread than those on threatened fauna, due to the ubiquitous distribution of non-threatened fauna and the localised distribution of threatened fauna along the project corridor. Fauna that live in or visit habitats within the project boundary already tolerate substantial disturbance from noise and vibration and have coping mechanisms for persisting in noisy environments, therefore impacts would be considered negligible.

Measures would be developed to minimise light spill during construction on any known significant fauna habitat (EPR LV3).

Habitat fragmentation

The assessment considered the potential for habitat fragmentation caused by land clearing to impact non-threatened terrestrial native fauna (risk EC14).

The project's construction would require the removal of habitat which may cause localised fragmentation of some fauna habitats. Fragmentation of habitat can reduce the ability of fauna to disperse across a landscape and may threaten the viability of some populations.

Overall, given that the non-threatened native terrestrial fauna that use the study area are typically mobile and adaptable, construction is not anticipated to impact those species through habitat fragmentation.

Through detailed design, the removed of native vegetation would be minimised as well as impacts on habitat connectivity (EPR FF2). A Tree Canopy Replacement Plan would be developed and implemented to replace the loss of tree canopy (EPR AR3).

Modifications to waterways would be managed through EPRs as discussed in Section 25.3.3 above.

Erosion, sedimentation, litter and contaminants

The assessment considered the project's potential to impact non-threatened terrestrial fauna due to erosion, sedimentation, litter and contaminants caused by construction activities (risk EC15).

With implementation of the project EPRs listed in Section 25.3.3 above, impacts to non-threatened native terrestrial fauna due to erosion, sedimentation, litter or contaminants are not anticipated.

Land clearing

The assessment considered the project's potential for land clearing to impact non-threatened native terrestrial fauna (risk EC12 and risk EC17).

Construction of new roads and the widening of existing roads would require land to be cleared of vegetation, which has the potential to impact fauna. Loss and degradation of habitat reduces foraging, nesting and dispersal opportunities and confines fauna to the extent of suitable habitat that remains.

The population of Eastern Grey Kangaroos (*Macropus giganteus*) at Simpson Barracks would be impacted by habitat loss. Simpson Barracks contains a relatively large area of remnant eucalypt woodland in an otherwise urbanised part of Melbourne. This habitat is not accessible to the public and only used for defence-related activities. This means the habitat is in relatively good condition in the context of the study area. The site is fenced on all sides, which contains the kangaroo population and limits its access to alternative habitat resources.

It was determined that around eight hectares of woodland habitat would be lost at Simpson Barracks of the approximately 52 hectares assumed to provide suitable habitat for kangaroos. There are also grassy maintained areas, such as sporting ovals and a parade ground, which are known to be used by kangaroos and not included in this total. It is not known how reliant the kangaroo population is on the area of impacted vegetation, but many of the observations of kangaroos are from the well-watered grassy parade ground beyond the project boundary. Based on the current size of the population and the available resources, this habitat loss is highly unlikely to jeopardize the viability of the current population.

For other non-threatened native terrestrial fauna, habitat loss would be localised and mostly comprise small discrete patches, which is not anticipated to jeopardise the viability of non-threatened native fauna populations that use those habitats.

During detailed design the removal of native vegetation and fauna habitat would be minimised (EPR FF2). Vegetation protection measures would be implemented during construction by the development of a CEMP including the development of no-go zones (EPR EMF2 and FF2). Tree retention would be maximised through detailed design (EPR AR1) and a Tree Protection Plan would be developed and implemented (EPR AR2). Where vegetation could not be retained, it would be offset according to the DELWP *Guidelines for the removal, destruction or lopping of native vegetation* (EPR FF2). Measures would be implemented to protect native fauna that are encountered during construction in accordance with the *Wildlife Act 1975* (EPR FF1).

Construction activities

The assessment considered the potential for the project's construction activities to cause death or injury to native fauna (risk EC19).

There is potential for fauna to be killed or injured during land clearing or other construction activities. Fauna most at risk are those that reside in habitats to be removed and that have limited mobility, dependent young or that move into construction areas. Fauna most likely to be encountered in a construction site are non-threatened native common species.

Injury or death of some fauna may occur, but is expected to be infrequent and localised and most likely to affect individuals rather than populations or species.

The CEMP would include measures to manage fauna in compliance with the *Wildlife Act 1975*, including undertaking pre-clearance surveys and inspections (EPR FF1, EPR EMF2).

Construction activities around waterbodies

The assessment considered the potential for the project's construction activities within and around waterways to cause the loss or degradation of habitat for non-threatened native terrestrial fauna (risk EC23)

There are wetlands within the project boundary and identified as a possible location for managing surface water and so they may require modification. Most importantly, this includes Simpson's Lake at Kew Golf Course which is known to support a small nesting colony of non-threatened waterbirds, including Australian White Ibis, Little Pied Cormorant, Little Black Cormorant, and Australasian Darter. Works are not planned here as part of the reference project, but could be proposed at the detailed design stage since the lake is within the project boundary. The birds currently nest in the dead and alive trees (native and non-native flora species) that line the edge of the lake, particularly on the western, southern and eastern sides. Construction activities in the wetland have potential to degrade the habitat if the trees were removed.

To address this risk, standing trees would be retained within the waterbody. The construction period would be minimised and undertaken outside the typical nesting time where practicable. The lake would be refilled after construction if draining was required (EPR FF9). Through detailed design, the removal of fauna habitat would be minimised (EPR FF2). A Tree Protection Plan would be implemented to manage trees to be retained throughout construction (EPR AR2).

25.3.5 Aquatic species and ecosystems

The risk pathways associated with aquatic species and ecosystems are summarised in Table 25-10 and discussed below.

Table 25-10 Risk table: Construction – aquatic species and ecosystems

Risk ID	Risk pathway	Risk rating
Risk EC09	Construction noise, vibration and/or lighting resulting in elevated disturbance of threatened fauna	Low
Risk EC16	Construction activities resulting in erosion/sedimentation, litter or release of contaminants into wetlands and waterways leading to degradation of aquatic fauna habitat	Low
Risk EC18	Waterway modification (eg channelisation, piping, bank stabilisation) resulting in loss or degradation of habitat for non-threatened native aquatic fauna	Low
Risk EC20	Construction activities within/around waterways resulting in loss or degradation of habitat for threatened aquatic and terrestrial fauna	Low
Risk EC21	Construction activities within/around waterways resulting in loss of connectivity and impeded passage for threatened aquatic species	Low
Risk EC22	Construction activities within/around waterways resulting in loss of connectivity and impeded passage for non-threatened native aquatic species	Low
Risk EC23	Construction activities within/around waterways resulting in loss or degradation of habitat for non-threatened native aquatic and terrestrial fauna	Low
Risk EC24	Dewatering of groundwater during construction resulting in changes to aquatic groundwater dependent ecosystems	Low
Risk EC25	Construction of tunnels causes ground settlement that changes drainage flow and/or hydrology of wetlands	Low

Erosion, sedimentation, litter and contaminants

The assessment considered the project’s potential to degrade aquatic habitats due to erosion, sedimentation, litter and contaminants caused by construction activities (risk EC16).

Aquatic habitats are directly connected to stormwater and runoff, which can transport sediments and contaminants mobilised by construction. Water and sediment contamination can cause toxicity, physical stress and behavioural effects on aquatic fauna. Due to the high degree of urbanisation of the catchments, waterways and wetlands in the project boundary, aquatic fauna that exist there already have some tolerance for degraded, polluted and contaminated aquatic habitats.

Nevertheless, through appropriate construction environmental management and monitoring of waterways, exacerbation of existing impacts to aquatic habitats can be minimised.

Through detailed design and construction, structures would be constructed to minimise impacts to aquatic habitat (EPR FF4). Other relevant EPRs are discussed in Section 25.3.3 above.

Non-threatened native aquatic fauna

The assessment considered the potential for waterway modification and associated construction activities to degrade habitat and impede passage for non-threatened native aquatic fauna (risk EC18, risk EC22 and risk EC23).

Modification of Koonung Creek would include diversion and naturalisation of some sections and covering of others. Banyule Creek would be enclosed in its upper reaches within Simpson Barracks.

The current form of Koonung Creek contains constructed channels, drop structures and approximately three kilometres of covered sections. The construction of further covered sections, over an estimated distance of one kilometre, and other changes to waterway form, may create additional barriers that could impede passage for native aquatic species. There is potential for the further loss of light within Koonung Creek to alter fish behaviour, particularly affecting resident fish on a local scale but the majority of species are expected to be tolerant to the changing conditions. Diversion and naturalisation of Koonung Creek are not anticipated to impact non-threatened native species.

Enclosing Banyule Creek is not anticipated to impact non-threatened native fish species as the headwaters are ephemeral, known to dry out, and do not support native fish. The loss of natural waterway in this reach of Banyule Creek has a very low risk of impacting the viability of aquatic fauna populations outside the area of direct waterway modification.

Waterway modifications would be undertaken to minimise impacts to aquatic ecology and undertaken in a way that mitigates to the extent practicable the effects of changes to flow (EPR SW8). Discharges and runoff pathways would meet the current relevant State Environment Protection Policy requirements (EPR SW1). Through detailed design and construction, structures would be designed to minimise impacts to aquatic habitat (EPR FF4).

The management of surface water runoff and bank stability during the project's construction is essential to protecting environmental conditions in waterways. This would be done by developing and implementing a Surface Water Management Plan (EPR SW5) and developing and implementing measures to minimise erosion and protect bank stability (EPR SW9). The implementation of a water quality monitoring program would provide some guidance on the effectiveness of stream rehabilitation and identify any environmental degradation that could require remediation (EPR SW4).

Threatened aquatic fauna

The assessment considered the potential for waterway modification and construction activities within and around waterways to impact threatened aquatic species (risk EC20 and risk EC21).

Given that within the study area only the Yarra River is likely to contain threatened aquatic species, no impacts on threatened aquatic species is anticipated because tunnelling would be used to avoid direct impacts on the river.

There is potential for the project to disturb one threatened fish species, the Australian Grayling, due to noise and vibration from bridge strengthening works and from the construction of a shared use path near the Yarra River.

To address this risk, measures to avoid and mitigate intense noise and vibration impacts near waterways would be developed and implemented, particularly to protect the Australian Grayling during migration and breeding times (EPR FF8).

Through detailed design and construction, structures would be designed to minimise impacts to aquatic habitat (EPR FF4). Construction-related noise and vibration would be managed through the development of a Construction Noise and Vibration Management Plan which would consider threatened fauna (EPR NV4). Discharges and runoff pathways would meet the current relevant State Environment Protection Policy requirements (EPR SW1) and chemicals and fuels would be managed during construction to minimise the risk of runoff into waterways. Water quality (EPR SW4) and flow velocities (EPR SW6) would be monitored during construction. A Surface Water Management Plan would be developed and implemented (EPR SW5).

Groundwater drawdown

The assessment has considered the potential for groundwater changes to impact aquatic groundwater dependent ecosystems during the project's construction (risk EC24).

Changes to groundwater levels during construction have the potential to alter the hydrology of waterways and wetlands that rely on groundwater and subsequently impact aquatic ecosystems. Aquatic habitats that were assessed for potential groundwater impacts include Banyule Creek, Banyule Swamp, Bolin Bolin Billabong and the Yarra River.

Within areas of potential groundwater drawdown, Banyule Creek was found not to be reliant on groundwater. Therefore, dewatering of groundwater during construction is not expected to result in any change to the aquatic ecosystem of Banyule Creek.

While the Yarra River is potentially connected to groundwater, the contribution of groundwater to the river flow is relatively small. Accordingly, groundwater drawdown from the project's construction is not anticipated to impact aquatic ecosystems in the Yarra River.

The pool at the eastern end of Bolin Bolin Billabong was found to have some groundwater dependency.

The amount of water in the pool is highly variable over time, influenced by overbank flooding and environmental flows. There are varying opinions about the degree of permanency of the pool, with some reports suggesting it dries naturally once in 10 years, and others suggesting it never dries out. A drop in local groundwater level would be expected to lower the water level in the pool. This wetland is within the area modelled as likely to be impacted by groundwater drawdown during the project's construction, with changes to groundwater levels predicted to be between 0.1 and 0.5 metres. As the surface water level in the deep pool is linked to groundwater levels, the groundwater drawdown could cause a lowering of pool water level.

The size of the pool varies throughout the flooding and drying cycle, and the vegetation naturally varies correspondingly. Any reduction of pool size due to groundwater drawdown would reduce the aquatic habitat. However, Short-finned Eel *Anguilla australis*, which is a common and relatively abundant species, is the only native fish known to occur in this pool. Lowering of water levels in the deep pool would reduce the amount of habitat available but this would have a minor impact as the ecosystem and fish community is periodically refreshed during overbank flooding or managed inundation events from the Yarra River.

A groundwater and surface water monitoring program would be required to establish baseline conditions and assess impacts (EPR GW2 and EPR SW4). A groundwater model (EPR GW1) and a Spoil Management Plan may be required to understand and respond to any changes in environmental condition detected during monitoring (EPR CL1). Protection of the aquatic habitat in Bolin Bolin Billabong would be required (EPR FF2 and EPR FF4). A Groundwater Dependent Ecosystem Monitoring and Mitigation Plan would need to be developed and implemented to monitor flora, fauna and ecological communities potentially impacted by groundwater drawdown (EPR FF6). Supplemental watering of the billabong by topping up the wetland with inputs from other sources may be suitable. Melbourne Water is actively managing the hydrological regime of Bolin Bolin Billabong. Long term tunnel and trench drainage design would minimise changes to groundwater levels (EPR GW3). A Groundwater Management Plan would be implemented to protect groundwater quality and manage interactions with groundwater (EPR GW4).

Ground settlement

The assessment considered the potential for settlement caused by tunnelling works to impact wetlands (risk EC25).

Settlement at Bolin Bolin Billabong is modelled to be around two millimetres, which is not anticipated to impact aquatic species and ecosystems.

Banyule Swamp is maintained by a manmade levee which would likely be constructed of local soil or weathered rock. Changes to pond water levels would not occur unless the levee was lowered substantially due to settlement.

Banyule Swamp would be monitored to determine any changes to the levee (EPR GM2 and EPR GM3) with a water level monitoring program. Any observed changes to wetland levels would be identified for remediation works if required (EPR GM4).

25.4 Operation impact assessment

This section discusses the operational impacts associated with North East Link that relate to ecology.

The impacts identified for the operation of North East Link that relate to ecology are grouped according to five main themes, as they were for the construction impacts. The potential for impacts associated with these themes are discussed in the following sections.

25.4.1 Threatened flora and ecological communities

The operational risk pathways associated with threatened flora and ecological communities are summarised in Table 25-11 and discussed below.

Table 25-11 Risk table: Operation – threatened flora and ecological communities

Risk ID	Risk pathway	Risk rating
Risk EC28	Shading from structures causing the loss or degradation of threatened flora and ecological communities	Low
Risk EC29	Groundwater changes during operation resulting in changes to terrestrial groundwater dependent ecosystems	Medium

The potential impacts associated with each of the risk pathways above are discussed in the following sections.

Shading

The assessment considered the potential for shading from structures to cause the loss or degradation of threatened flora and ecological communities (risk EC28).

Shading causes a reduction in photosynthetically active radiation (PAR) available to plants. Adverse effects of PAR can include decline in plant growth, flowering and reproductive growth. Each species has a different tolerance to levels of PAR, with some instances where shading can be beneficial.

As threatened flora within the study area are not located in areas where the project’s proposed elevated structures would cause shading, there would not be an impact to threatened flora in addition to land clearing.

Groundwater drawdown

The assessment considered the potential for changes in groundwater levels during the project’s operation to impact threatened flora (risk EC29).

After excavation for the construction of North East Link was completed, groundwater in some areas would likely adjust to new levels. Changes to groundwater levels have been modelled with results discussed in Chapter 22 – Groundwater. Modelling has been undertaken for the year 2075, which is anticipated to be 50 years after North East Link’s construction.

It is predicted that three large Studley Park Gum would experience degradation or death due to changes in groundwater levels in Simpson Barracks. Other threatened flora within the study area, such as the Matted Flax-lily, were determined unlikely to be impacted by groundwater drawdown as the root systems are too shallow to be accessing groundwater as discussed in Section 25.3.1 above.

These trees are assumed to be lost and would be offset according to the DELWP Guidelines for the removal, destruction or lopping of native vegetation (EPR FF2). Nonetheless, the project’s tunnels would be designed to minimise any groundwater level changes (EPR GW3). A Groundwater Management Plan would be implemented to protect groundwater quality and manage interactions with groundwater (EPR GW4). Groundwater would be managed through operation in accordance with relevant legislation (EPR GW5).

25.4.2 Non-threatened native flora and ecological communities

The risk pathways associated with non-threatened native flora and ecological communities during the project’s operation are summarised in Table 25-12 and discussed below.

Table 25-12 Risk table: Operation – non-threatened native flora and ecological communities

Risk ID	Risk pathway	Risk rating
Risk EC27	Shading from structures causing the loss or degradation of non-threatened flora and ecological communities	Low
Risk EC29	Groundwater changes during operation resulting in changes to terrestrial groundwater dependent ecosystems	Medium
Risk EC40	Groundwater changes in the vicinity of the tunnel causing long-term detrimental changes in terrestrial and aquatic ecosystems	Low

Shading

The assessment considered the potential for shading from the project's elevated structures and noise walls to cause the loss or degradation of non-threatened native flora and ecological communities (risk EC27).

The tolerance of plants for shaded conditions varies considerably between species. Vegetation areas potentially affected by shading would include those located in the immediate vicinity of noise walls and under new elevated structures. Understorey plants are generally more vulnerable than established trees.

Shade modelling has not been completed as part of this assessment, as a conservative approach has been taken to vegetation loss which assumes there would be 100 per cent loss within the project boundary. As all elevated structures would be contained within the project boundary, all vegetation directly below the elevated structures is assumed to be lost. There is potential that vegetation immediately south of noise walls along the Eastern Freeway could experience shading; however, as a conservative approach has been taken to vegetation loss, these shaded areas are already captured in calculated losses and vegetation offsets (EPR FF2).

To minimise impacts of shading on retained native vegetation near the project boundary, overhead structures and noise walls would be designed to maximise penetration of light to the ground (EPR LP4).

Groundwater drawdown

The assessment considered the potential for changes in groundwater levels during the project's operation to impact non-threatened native flora and ecological communities (risk EC29 and risk EC40).

Following the completion of excavation for the project's construction, groundwater in some areas is expected to adjust to new levels. Changes to groundwater levels have been modelled and are discussed in Chapter 22 – Groundwater.

It is estimated that around 19 large trees could experience degradation or premature death due to changes in groundwater levels in Simpson Barracks. A further 14 large trees may be impacted outside of Simpson Barracks by drawdown associated with construction of the project's northern tunnel portal. It should be noted that over time, younger (not large) trees, whose roots are shallower and so unlikely to be impacted by drawdown are likely to replace these trees as they grow and mature. These 33 large trees have been assumed lost and are accounted for in offset calculations (EPR FF2).

The Yarra Flats was assessed for potential to be impacted by groundwater drawdown. The pool at the eastern end of Bolin Bolin Billabong has potential to experience a reduction in size due to a change in groundwater level. It is not anticipated this change would impact native flora and ecological communities at this location due to the cycles of drying and filling the billabong currently experiences as discussed in Section 25.3.5.

In the Banyule Flats area, groundwater drawdown has been modelled to be less than 0.1 metre. This degree of drawdown is not anticipated to impact native flora and ecological communities at this location.

To mitigate this risk, supplemental watering through topping up the wetland with inputs from other sources may be suitable for the billabong. Maintaining surface water levels in the pool through supplementation from groundwater is expected to provide the lowest risk method for maintaining the environmental conditions that support this ecosystem. Melbourne Water is actively managing the hydrological regime of Bolin Bolin Billabong. Through detailed design, tunnels and trenches would minimise changes to groundwater levels (EPR GW3). A pre-construction and construction groundwater monitoring program would be undertaken (EPR GW2). A Groundwater Management Plan would be implemented to protect groundwater quality and manage interactions with groundwater (EPR GW4). Groundwater would be managed through operation in accordance with relevant legislation (EPR GW5). A Groundwater Dependent Ecosystem Monitoring and Mitigation Plan would be developed and implemented to monitor Bolin Bolin Billabong (EPR FF6). As a number of trees are anticipated to be lost due to groundwater drawdown, these would be offset according to the DELWP Guidelines for the removal, destruction or lopping of native vegetation (EPR FF2).

25.4.3 Threatened terrestrial fauna

The risk pathway associated with threatened terrestrial fauna is summarised in Table 25-13 and discussed below.

Table 25-13 Risk table: Operation – threatened terrestrial fauna

Risk ID	Risk pathway	Risk rating
Risk EC31	Operational noise, vibration or lighting resulting in elevated disturbance to threatened fauna	Low

The assessment considered the potential for noise, vibration and lighting to impact threatened fauna during operation (risk EC31).

The operation of North East Link would generate noise from vehicles and require lighting at night which may disturb or displace threatened fauna. Significant vibration is not anticipated to occur due to traffic.

The majority of the study area is not known to support threatened species other than infrequent visitors. One exception is the Grey-headed Flying-fox, which has a camp at Yarra Bend Park. This section of the Eastern Freeway is already very noisy and well-lit at night due to high levels of traffic volumes and lighting. As discussed in Chapter 9 – Traffic and transport, there would be slight increases in traffic along the Eastern Freeway between Hoddle Street and Chandler Highway during operation.

Incremental increases in light and noise related to this increase in traffic volume are not anticipated to impact the camp due to the distance of the camp from the road and the relatively small increase in traffic volumes.

Reduced traffic volumes around the Yarra River floodplain area are anticipated. The floodplain is the most suitable habitat to support other threatened species within the project boundary. Roads near this area such as Rosanna Road, Manningham Road and Lower Heidelberg Road, would experience reduced traffic volumes due to the North East Link tunnels and so increases in lighting and traffic noise are not anticipated.

Lighting would be designed to minimise spill and disturbance to sensitive fauna sites, including at Yarra Bend Park (EPR LV4).

25.4.4 Non-threatened native terrestrial fauna

The risk pathways associated with non-threatened native terrestrial fauna are summarised in Table 25-14 and discussed below.

Table 25-14 Risk table: Operation – non-threatened native terrestrial fauna

Risk ID	Risk pathway	Risk rating
Risk EC32	Operational noise, vibration or lighting resulting in significant impact on non-threatened native fauna	Low
Risk EC34	Increased volumes of traffic resulting in death or injury of native fauna	Low

Noise, vibration and lighting

The assessment considered the potential for noise, vibration and lighting associated with changes in traffic volumes to impact non threatened native terrestrial fauna during operation (risk EC32).

The current environment within the project boundary is noisy and well-lit due to the current high levels of traffic volumes and urbanisation. As discussed in Chapter 9 – Traffic and transport, there would be changes in traffic volumes within the project boundary which has potential to increase and decrease lighting and traffic noise. For example, traffic volumes in roads around the Yarra River floodplain would reduce while traffic volumes on the Eastern Freeway would increase. This may lead to gradual changes in fauna composition in some areas, with tolerant species dominating noisy areas and less tolerant species moving to quieter areas. Overall, given the existing environment, impacts on non-threatened native fauna species due to traffic noise and vibration are anticipated to be minimal.

Lighting would be designed to minimise spill and disturbance to sensitive fauna sites (EPR LV4).

Increased traffic

The assessment considered the potential for increased traffic volumes during operation to increase the incidence of injury or death of native fauna (risk EC34).

With changes in traffic volumes, there is the potential for increased death or injury of fauna during attempted road crossings. Fauna most at risk are mobile fauna that readily cross barriers such as main roads at ground level to reach other habitat patches.

As discussed in Chapter 9 – Traffic and transport, key areas of increased traffic volumes expected during operation would be along the Eastern Freeway and the M80 Ring Road. Both these roads already have relatively high volumes of traffic and so increases in volumes associated with North East Link are not anticipated to significantly increase death or injury to native fauna. Traffic volumes would also reduce in some areas within the project boundary near the Yarra River floodplain, which includes some of the highest value habitat for native fauna.

Measures to manage fauna, and to deal with injured fauna if found would be specified in the Operational Environment Management Plan (EPR EMF2).

25.4.5 Aquatic species and ecosystems

The risk pathways associated with aquatic species and ecosystems are summarised in Table 25-15 and discussed below.

Table 25-15 Risk table: Operation – aquatic species and ecosystems

Risk ID	Risk pathway	Risk rating
Risk EC30	Shading of waterways from structures causing the loss or degradation of aquatic and riparian vegetation that degrades aquatic habitat quality	Medium
Risk EC33	Enclosing waterways resulting in reduced viability of native aquatic species	Low
Risk EC35	Groundwater changes during operation resulting in changes to aquatic groundwater dependent ecosystems	Low
Risk EC36	Changed waterway form resulting in loss of connectivity and impeded passage for native aquatic species	Medium
Risk EC37	Changes to stormwater drainage resulting in hydraulic impact to waterways that degrades aquatic ecosystems	Low
Risk EC38	Increased road traffic resulting in increased pollutants (metals, hydrocarbons) in stormwater runoff to waterways that degrades aquatic ecosystems	Low
Risk EC39	Shading of waterways resulting in reduced nutrient processing, leading to increased nutrient transport that degrades downstream aquatic ecosystems	Medium
Risk EC40	Groundwater changes in the vicinity of the tunnel causing long-term detrimental changes in terrestrial and aquatic ecosystems	Low

Shading

The assessment considered the potential for shading and modification of waterways during operation to impact aquatic ecology (risk EC30, risk EC33 and risk EC39).

Vegetation in waterways provides important ecosystem functions that contribute to the quality of aquatic habitat and support aquatic fauna. Aquatic vegetation provides nutrient processing, reduces erosion and supports aquatic species. As discussed in Section 25.4.1 above, shading can impact the extent and quality of vegetation, which can impact aquatic habitat and reduce ecosystem services the waterway provides.

The degree of shading over the Yarra River is not anticipated to significantly change the availability of light from new or modified bridges. Any increase in shading of the Yarra River at these locations would be negligible compared with the natural shading from riparian vegetation and channel topography.

There is potential that shading over Koonung Creek from noise walls and the enclosing of waterways could impact aquatic ecology. Areas where Koonung Creek would be modified to a covered channel would experience complete shading, and areas south of proposed noise walls would experience partial shading. Instream vegetation that processes nutrients, reduces erosion and supports aquatic species may not persist where waterways are enclosed. Enclosing waterways may also deter fish from moving through these dark areas.

Through detailed design and construction, short and long-term impacts on aquatic habitat would be minimised (EPR FF4). Shading from elevated structures and noise walls would be minimised through detailed design (EPR LP4) as discussed in EES Attachment II – Urban Design Strategy. Waterway modifications would be undertaken in a way that minimises impacts to aquatic ecology (EPR SW8).

Modification of waterways

The assessment considered the potential for the modification of waterways to impact native aquatic species during operation (risk EC36).

Modification of Koonung Creek and Banyule Creek may cause a loss of connectivity in these waterways. The project would not require direct modifications to the Yarra River.

In Banyule Creek, channel modification would occur at the headwaters which do not currently provide important aquatic habitat for native fish or aquatic fauna. Impacts to aquatic species are therefore not anticipated.

Koonung Creek contains native fish species that require connectivity between habitats. The change of waterway form, specifically the enclosing of the channel, may impede passage of these species. The current form of Koonung Creek contains constructed channels, drop structures and approximately three kilometres of covered sections. The construction of further covered sections and other changes to waterway form may create additional barriers that could impede passage for native aquatic species.

Fish surveys undertaken in Koonung Creek indicated that few species of native fish were present, and the occurrence of mostly large mature individuals in upstream reaches highlights the absence of young recruits. This means these native fish have limited capacity to recruit within this waterway, and may not be impacted by further piping of the creek.

Through detailed design and construction, short and long-term impacts on aquatic habitat would be minimised (EPR FF4). Consideration would be given to flow velocities and structures to avoid the creation of new barriers for aquatic species (EPR SW5). Waterway modifications would be undertaken to minimise impacts to aquatic ecology (EPR SW8). Principles of water sensitive urban design would be adopted to integrate stormwater treatment into the project design to protect water quality (EPR SW11).

Groundwater drawdown

The assessment considered the potential for groundwater drawdown during operation to impact aquatic species and ecosystems (risk EC35 and risk EC40).

The pool at the eastern end of Bolin Bolin Billabong has potential to reduce in size due to groundwater level changes as it has been determined this pool may have some level of groundwater dependency. The modelled groundwater drawdown of <0.5 metres is well within the range of water level change experienced in the pool during the dry phase. Under current conditions, as the billabong recedes from an occasional fully inundated state to the remnant pool, water quality deteriorates to the point that it only supports tolerant aquatic fauna. Therefore, the ecological significance of the lowered water levels is uncertain, although there is no evidence this pool provides refuge habitat for any threatened aquatic species. Water levels in this wetland may need to be managed to maintain the ecological condition of the billabong.

In the Banyule Flats area, groundwater drawdown during operation has been modelled to be less than 0.1 metres. This degree of drawdown is not anticipated to impact aquatic species and ecosystems at this location.

There are no other areas in the study area where groundwater drawdown is anticipated to impact aquatic ecosystems.

To mitigate this risk, contingency measures would be implemented to minimise the loss of groundwater through drawdown. This may include supplemental watering which would top up the wetland with inputs from other sources. Melbourne Water is actively managing the hydrological regime of Bolin Bolin Billabong. Tunnels would be designed to minimise changes to groundwater levels during operation. Tunnels would be designed to minimise changes to groundwater levels during the project's operation (EPR GW3). A pre-construction and construction groundwater monitoring program would be undertaken (EPR GW2). A Groundwater Management Plan would be implemented to protect groundwater quality and manage interactions with groundwater (EPR GW4). Groundwater would be managed through operation in accordance with relevant legislation (EPR GW5).



A Groundwater Dependent Ecosystem Monitoring and Mitigation Plan would be developed and implemented to monitor flora, fauna and ecological communities potentially impacted by groundwater drawdown (EPR FF6).

Pollutants and nutrients

The assessment considered the potential for impacts to aquatic ecosystems due to quality and volume of stormwater (risk EC37 and risk EC38).

Urban stormwater damage and degrade aquatic ecosystems. The increase in impervious surfaces associated with new infrastructure has the potential to increase runoff into waterways within the study area.

There is also the potential for the quality of stormwater runoff to be impacted by the increase in traffic. Vehicles generate road-borne pollution such as hydrocarbons and metals, which are carried by stormwater when it rains.

Water sensitive urban design and integrated water management would be adopted in designing the stormwater treatment to capture runoff before it reaches waterways (EPR SW11). The design of the road and drainage network would minimise impacts to aquatic habitats (EPR FF4). Modifications to waterways would be designed and undertaken to mitigate the effects of changes to flow (EPR SW8). Flood risk would not be increased by project infrastructure (EPR SW6) and discharges and runoff pathways would meet the current relevant State Environment Protection Policy requirements (EPR SW1).

25.5 Conclusion

This chapter has identified and assessed existing conditions, risks and associated impacts to ecology from North East Link. Application of the project EPRs would minimise impacts on ecological systems, however there would be impacts on some values as follows.

Flora and ecological communities

- An estimated 52 hectares of native vegetation and 262 native trees (scattered and large trees) would potentially be lost due to land clearing for the project's construction, and an additional 32 native trees (scattered and large trees) could potentially be lost during operation due to groundwater drawdown.
- Impacts to threatened flora communities listed under State or Commonwealth legislation are not anticipated.
- Land clearing required for the project's construction would impact three threatened flora species – around 95 Matted Flax-lily, five Arching Flax-lily, 10 large Studley Park Gum. An additional three Studley Park Gum may be impacted by groundwater drawdown. While River Swamp Wallaby-grass is assumed to be present within the project boundary, impacts on this species are not anticipated. Impacts are not anticipated to other threatened flora and ecological communities.

Terrestrial fauna

- The project's construction would cause localised impacts on non-threatened terrestrial fauna, but not affect the persistence of any species.
- The project would have negligible impacts on the three threatened terrestrial fauna species that regularly use habitats within the project boundary – Grey-headed Flying-fox, Powerful Owl and Swift Parrot. Impacts on other threatened fauna species

Aquatic species and ecosystems

- The project would have negligible impacts on the six threatened aquatic species that may use habitats within the project boundary.
- The modification of Koonung Creek and Banyule Creek would impact the extent and quality of aquatic habitat.

In response to the EES evaluation objective described at the beginning of this chapter, effects of the project on ecology have been assessed and EPRs identified (described in full in Chapter 27 – Environmental management framework) to minimise or avoid impacts to flora, fauna and aquatic values.