

2 AUTHORISATION OF AMENDMENT C229 - SOUTHERN BROWN BANDICOOT ENVIRONMENTAL SIGNIFICANCE OVERLAY

FILE REFERENCE INT1767924

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RECOMMENDATION

That authorisation be sought from the Minister for Planning under Section 9 of the *Planning and Environment Act 1987* to prepare Amendment C229 which proposes to apply the Environmental Significance Overlay - Schedule 7 (ES07) to the townships of Bunyip, Garfield and Tynong to ensure future development considers the provision of habitat corridors for the protection of the Southern Brown Bandicoot

Attachments

1 Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay	75 Pages
2 Environment Significance Overlay Schedule 7	6 Pages
3 Amendment C229 documents	6 Pages
4 Amendment map	1 Page

EXECUTIVE SUMMARY

The Southern Brown Bandicoot (SBB), *Isodon obesulus obesulus* is recognised as an endangered mammal under State and Federal legislation, that is found within the Shire, predominantly in the area south of the Princes Freeway in the Koo Wee Rup Swamp area and in the townships and surrounds of Bunyip, Garfield and Tynong. Landowners, Council, State, and Commonwealth authorities have a responsibility to identify and protect endangered species under Federal and State legislation.

Recent subdivisions in the townships of Bunyip, Garfield and Tynong have resulted in inconsistent planning permit requirements and outcomes to protect the SBB. A number of developers have cleared all Bandicoot habitat on a site by site basis, therefore creating gaps in the SBB movement corridors, while others have been required to provide 10 - 50 metre wide vegetation corridors with onerous management requirements for Council. These inconsistent outcomes have led to additional costs for developers and Council and is likely to lead to the extinction of the SBB within these townships.

In early 2016 Council engaged Ecology Australia to prepare a Habitat Protection Strategy and it provides a strategy for the protection and enhancement of habitat for the SBB including a proposed Schedule to the Environmental Significance Overlay (ESO).

The Environmental Significance Overlay Schedule 7 (ES07) is proposed to be introduced into the Cardinia Planning Scheme to protect the bandicoot habitat corridors in the townships of Bunyip, Garfield and Tynong. This report recommends that authorisation to prepare Planning Scheme Amendment C229 to the Cardinia Planning Scheme be sought from the Minister for Planning.

BACKGROUND

The SBB is a small ground-dwelling mammal which is listed as “Endangered” under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* and is also protected by the Victorian Government *Flora and Fauna Guarantee Act 1988 (FFG Act)*.

The SBB live in dense understorey vegetation including native vegetation, exotic long grass and prickly dense weeds such as blackberries as it protects them from predators such as cats and foxes. Known threats to the SBB include predation, increasing number of road fatalities, loss of habitat and corridor fragmentation (through the clearing of native and exotic vegetation) and new urban infrastructure such as solid fences blocking their movements between habitat areas.

Cardinia Shire is home to a large and distinctive SBB population cluster within the former Koo Wee Rup Swamp area which comprises four smaller sub-populations in Dalmore-Koo Wee Rup, Bayles, Cardinia-Rythdale, and Garfield-Longwarry, as identified in the *Southern Brown Bandicoot Strategic Management Plan (Ecology Australia, 2009)*.

Applications for residential subdivisions have been increasing in Bunyip, Garfield and to a lesser extent Tynong. Referrals are required to the Commonwealth Department of Environment who administer the *EPBC Act (1999)* if there is seen to be a likely detrimental impact on the species such as blocking a movement corridor or removing important habitat. It is difficult for Council Officers to advise applicants on the likelihood of a Commonwealth referral as this is not triggered by a certain size of subdivision and sits outside the planning process. Developers are generally required to undertake detailed SBB surveys which are expensive with variable quality and outcomes. And some have been required to incorporate linear SBB habitat corridors and prepare onerous Bandicoot Management Plans. Smaller scale subdivisions (typically 2-10 lots) have not been referred to the Commonwealth, but their cumulative impacts are leading to the loss of SBB habitat and critical gaps or blocks in the SBB movement corridors.

The current ad hoc pattern of subdivisions has led to some properties having no or inadequate provision of habitat for the species, where other properties have variable width corridors and inconsistent management requirements. Without a holistic approach to create and preserve SBB habitat the cumulative impacts of development will likely result in the local extinction of the SBB within these townships. For these reasons, Council Officers decided to undertake a proactive approach to better manage this situation and improve overall outcomes.

In early 2016 Council's Environment department engaged Ecology Australia to develop a Habitat Protection Strategy for Bunyip, Garfield and Tynong. The Strategy presents an approach for the protection and enhancement of habitat for SBB in two parts:

1. *Part A - presents an overview of the current situation and an overall approach to developing planning controls to protect the SBB within the townships. Also provided are standards and guidelines for the maintenance and enhancement of bandicoot habitat within the townships, and recommendations for supporting conservation measures.*
2. *Part B - provides specific recommendations for a SBB Schedule to the ESO, and application in the Cardinia Planning Scheme, which should be read in conjunction with Part A.*

The Strategy found that within Cardinia Shire the SBB live and travel within the vegetated railway corridor, drains and thin vegetated strips along roadsides and fence-lines. The SBB require free movement between properties to forage and be able to visit other SBB and breed. A key risk to the ongoing viability of the populations is lack of genetic diversity as a result of inbreeding within isolated populations.

In 2009 Council developed the *Southern Brown Bandicoot Strategic Management Plan* for the former Koo Wee Rup swamp area. One of the high priority actions of the Management Plan was to

'Investigate a specific Southern Brown Bandicoot Overlay as a schedule of Environmental Significance Overlay'.

It is proposed to introduce Schedule 7 to the ESO Overlay into the Cardinia Planning Scheme to provide a consistent approach to development in Bunyip, Garfield and Tynong.

The ESO is considered to be the most appropriate planning tool in order to provide adequate protection for the SBB and deliver coordinated SBB management outcomes across all development.

The purpose of the ESO is:

- *To identify areas where the development of land may be affected by environmental constraints.*
- *To ensure that development is compatible with identified environmental value.*

Specifically, the environmental objective to be achieved for Schedule 7 to the ESO is:

- To minimise adverse impacts resulting from the use and development of land on the Southern Brown Bandicoot by maintaining, enhancing and connecting key habitat.

The proposed ES07 will be applied to the front setback of affected properties, adjacent to roadside vegetation and requires specific vegetation to be planted. Planting in the front setback makes it easy for Council Officers to monitor the vegetation for compliance and ensures that residents retain privacy in the rear yard. The proposed ES07 provides guidance and planning permit requirements on a number of matters including setbacks, landscaping, vegetation coverage, vegetation removal, and fencing.

The *Habitat Protection Strategy (2017)* provides additional information and recommendations regarding public education, habitat enhancement, sample suitable subdivision designs, sample fence designs, temporary shelter designs for SBB when their habitat is removed and designs for fauna underpasses (culverts). These recommendations do not form part of the ES07 but provide additional information on how to protect the SBB to the community, residents and developers.

POLICY IMPLICATIONS

Plan Melbourne

Direction 6.5 of Plan Melbourne is to Protect and restore natural habitats, and it recognises that natural habitats need to better protect native flora and fauna, and enhance the communities knowledge and acceptance of wildlife in area they live.

The amendment supports this objective.

State Planning Policy Framework (SPPF)

The amendment is consistent with a number of strategies in Clause 12.01-1 (Protection of biodiversity) of the SPPF:

- *Avoids and minimises significant impacts, including cumulative impacts, of land use and development on Victoria's biodiversity.*
- *Assists in the re-establishment of links between isolated habitat remnants that contain high value biodiversity.*
- *Ensure that decision making takes into account the impacts of land use and development on Victoria's high value biodiversity.*

Local Planning Policy Framework (LPPF)

The amendment is consistent with a number of strategies in Clause 21.02-3 (Biodiversity) of the MSS (Municipal Strategic Statement):

- *Ensure that the siting of buildings and works avoids and minimises the removal or fragmentation of native vegetation, especially in areas of biodiversity significance, and where appropriate, building envelopes should be approved as part of subdivision plans to minimise the removal of vegetation.*
- *Avoid the fragmentation of land in areas of biodiversity significance and create new habitat corridors/biolinks.*
- *Encourage or, if appropriate, require landowners to undertake steps to conserve and enhance sites of biodiversity significance through a Conservation Covenant, or agreements under Section 173 of the Planning and Environment Act 1987.*
- *Protect and enhance the habitat of threatened flora and fauna species, including the growling grass frog and southern brown bandicoot.*

RELEVANCE TO COUNCIL PLAN

Council Plan item 3 *Our Environment* discusses the importance of continuing to plan and manage the natural and built environment for present and future generations. The following objectives of the *Council Plan (2017)* are relevant to Amendment C229:

3.3 Enhanced natural environment

- 3.3.7 - Protect and improve biodiversity by increasing the area of natural ecosystems across the Shire
- 3.3.8 - Preserve and improve our bushland and natural environment by implementing weed management programs and continuing work on high conservation bushland reserves and roadsides.

CONSULTATION/COMMUNICATION

The amendment has been reviewed by internal Council departments and was developed as a joint project between Strategic Planning and Environment.

The amendment will go through a public exhibition process once authorisation is received. This will involve notification to affected parties, including landowners.

Internal

- Development and Compliance Services - The *Habitat Protection Strategy (2017)* and the ES07 have been presented to this department for their understanding and comments.
- Strategic and Economic Development - The *Habitat Protection Strategy (2017)* and ES07 has been presented to this department for their understanding and comments.
- Operations - Officers have met with the Operations Unit confirm the proposes ES07 won't adversely impact on regular roadside slashing and drainage works.
- Infrastructure Services - Officers met with the Infrastructure Services department to confirm the proposed ES07 won't impact on upgrading unsealed roads.

External

- Department of Environment, Land, Water and Planning (DELWP) - Biodiversity officers from the Forest, Fire and Regions Department of DELWP have provided support for the proposal on biodiversity grounds. The Planning Services Department have also indicated the use of the ESO is an appropriate provision for the conservation of the southern brown bandicoot.

FINANCIAL AND RESOURCE IMPLICATIONS

Resources have been allocated in the 2017/18 budget of the Strategic Planning department for the planning scheme amendment process.

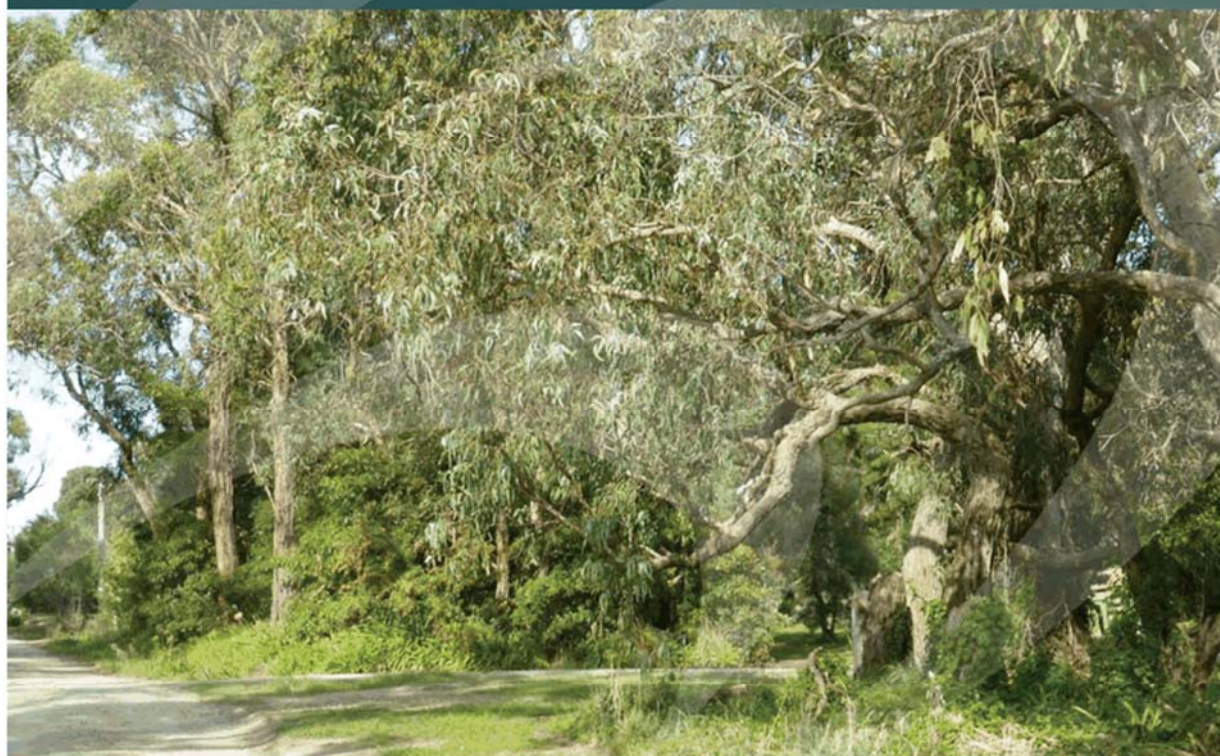
CONCLUSION

The planning scheme amendment to introduce the ES07 to Bunyip, Garfield and Tynong is required to ensure a holistic and coordinated approach to the protection and management of habitat for the endangered SBB population. The application of the ES07 will reduce onerous requirements for both developers and Council in relation to the management and protection of the SBB.

It is recommended that Council resolve to seek authorisation from the Minister for Planning to prepare Planning Scheme Amendment C229 to the Cardinia Planning Scheme.



Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay



Prepared for: Cardinia Shire Council

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Cover photo: Roadside vegetation along Abeckett Road, Bunyip (2016)



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Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay



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1 Introduction

Ecology Australia, in association with Planned F.X., was engaged by Cardinia Shire Council to assist with the development of statutory planning mechanisms, to protect habitat for the nationally endangered Southern Brown Bandicoot (south-eastern sub-species: *Isoodon obesulus obesulus*), within the townships of Bunyip, Garfield and Tynong, which are under increasing pressure from development.

The Shire of Cardinia is a predominantly rural municipality, in Melbourne's outer south-east, experiencing rapid population growth. While most urban development within the Shire is confined to growth areas located on the eastern fringe of Melbourne's metropolitan area, a number of smaller townships are also experiencing significant urban growth, including Bunyip and Garfield, which are satellites of Melbourne's South East Growth Area.

The Shire also supports some of the last remaining populations of Southern Brown Bandicoots south-east of Melbourne, which have persisted despite the widespread loss and fragmentation of native vegetation across the region. The semi-rural townships of Bunyip and Garfield, in particular, are well known for supporting local populations of the species. However, the long-term persistence of Southern Brown Bandicoots within these townships is at risk from potential impacts associated with increasing urbanisation.

The local planning scheme can play a role in protecting biodiversity by helping to limit the potentially negative impacts of development with the use of planning controls. However, this role applies only to new use and development of land. Thus, the persistence of Southern Brown Bandicoots is also likely to benefit from other measures, to mitigate potential impacts which cannot be addressed through the planning scheme.

1.1 Background

The semi-rural townships of Bunyip, Garfield and Tynong, within the Shire of Cardinia, are expected to undergo substantial growth over the next 20 years. As part of Melbourne's growth area, Bunyip and Garfield, in particular, have considerable capacity for future growth. As a result, applications to Council for the subdivision of residential land within these townships, and to a lesser extent Tynong, have increased in recent years. These have included proposals for the redevelopment of existing residential lots for one or more dwellings, and subdivision of larger landholdings.

Although Southern Brown Bandicoots currently occur throughout residential areas of these townships, intensification of urban development has the potential to alter the characteristics of the townships which may have enabled bandicoots to persist. New developments can result in the removal of native and exotic vegetation used by bandicoots, increased barriers to movement, an increase in the patchiness of habitat, and the potential for additional predatory domestic animals.

There are currently few statutory triggers that would require the consideration of conservation measures for the Southern Brown Bandicoot in the assessment and approval of these developments. Current planning provisions, including the Victorian Native Vegetation Clearing Controls and zoning of land, do not provide adequate protection for habitat or other characteristics of the township that help support bandicoot populations.

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) currently provides the only trigger for the assessment of potential impacts to the Southern Brown Bandicoot, with guidelines for the referral of actions to the federal environment minister (see Section 4.1). The guidelines outline thresholds to assess the risk that a particular action will have a significant impact on the Southern Brown Bandicoot, triggering the need for a referral and mitigation measures (DSEWPC 2011, DoE 2013). However, many small-scale developments, typically 2–10 lot subdivisions, do not trigger a referral. Their cumulative effects have the potential to significantly reduce the area of occupancy for bandicoots through the loss and isolation of habitat used by bandicoots, thereby reducing the likely persistence of bandicoots within the townships.

Within the townships, several developments have triggered referrals to the federal environment minister under the EPBC Act; these developments have been required to incorporate conservation buffers (development exclusion zones) of varying width, to be maintained in accordance with an associated Management Plan for the species. Many other developments have been approved by Council without any requirements. As a result, there is at present, inconsistency regarding the requirement for conservation measures to be incorporated into new subdivisions, and the specifications surrounding these measures.

1.2 Scope and Objectives

The integration of conservation requirements for the Southern Brown Bandicoot into the planning scheme can provide a statutory mechanism that accounts for both small and large-scale developments, and provides a means of imposing appropriate conditions for the use or development of land that will mitigate, protect or enhance habitat for the Southern Brown Bandicoot. The planning controls can ensure that there is a consistent approach to ensuring that conservation requirements for the Southern Brown Bandicoot are taken into account across all new residential developments.

This document presents a strategy for the protection and enhancement of habitat for Southern Brown Bandicoots within Garfield, Bunyip and Tynong, in two parts:

- Part A – presents an overview of the current situation and an overall approach to developing planning controls to protect the Southern Brown Bandicoot within the townships. Also provided are standards and guidelines for the maintenance and enhancement of bandicoot habitat within the townships, and recommendations for supporting conservation measures;
- Part B – provides specific recommendations for a Southern Brown Bandicoot Schedule to the Environmental Significance Overlay, and application in the Cardinia Planning Scheme, which should be read in conjunction with Part A.

PART A – The Strategy

2 Strategy Area

The Shire of Cardinia is located in Melbourne's outer south-east, and is one of several 'interface' municipalities, which encompass both rural and urban land. The majority of the Shire comprises rural land used for agricultural production, throughout which there are 19 townships and a number of localities which support rural residential areas. The existing urban centres of Beaconsfield, Officer and Pakenham, on Melbourne's periphery, support the majority of the human population in Cardinia Shire and form part of the Casey – Cardinia Growth Area. They will accommodate most of the future residential and commercial development within the Shire (Cardinia Shire 2009).

The townships of Bunyip, Garfield and Tynong are located within the rural landscape; however, Garfield and Bunyip are also included within Melbourne's Urban Growth Boundary. They are located within a major transport corridor, linking Melbourne to the Latrobe Valley and Gippsland; the Princes Freeway bypasses the three townships to the north, while the Melbourne - Sale Railway connects the townships along their southern boundaries (Figure 1). The rural land between Tynong and Bunyip has been identified in Cardinia's Municipal Strategic Statement as agricultural land with significant environmental and landscape value (Cardinia Shire 2016).

The three townships are located primarily within the Highlands-Southern Fall bioregion, with small areas in the south of Tynong falling within the Gippsland Plain. The area forms part of the East Victorian Dissected Uplands, and is dominated by Palaeozoic granites and yellow duplex soils. Modelling of pre-European vegetation communities indicates that the area formerly supported a complex of Lowland Forest, Swampy Riparian Woodland, Grassy Woodland, Damp Heathy Woodland, Herb-rich Foothill Forest and Swamp Scrub Ecological Vegetation Classes (EVCs) (DELWP 2016). Most of the native vegetation in this area has been cleared following European settlement, resulting primarily from a long land-use history of intensive agriculture, and to a lesser extent, residential development.

2.1 Bunyip

The township of Bunyip is bounded approximately by the Princes Freeway to the north, McNamara Road to the west, the Melbourne – Sale railway to the south, and by the Bunyip River to the east. Tea Tree Creek flows along the northern extent of the township, to the south of the Princes Freeway (Figure 1).

Bunyip has been identified as one of the townships with the potential for substantial future growth; it was included in the Urban Growth Boundary, as defined by the *Melbourne 2030* strategy, under Amendment C55 to the Cardinia Planning Scheme. The local population is expected to grow to approximately 3,200 by 2021 (Cardinia Shire 2009).

The majority of the township is covered by residential zoning, comprising Low Density Residential Zone (LDRZ), much of which is also covered by a Vegetation Protection Overlay (VPO), and General Residential Zone 1 (GRZ1). The town centre, which extends along the railway line, supports a number of other minor zonings, including Commercial (C1Z), Industrial (IN1Z), and Public Use (PUZ2, PUZ3, PUZ4, PUZ7). Bunyip has also retained a number of areas which are as yet, undeveloped. They include two areas of land currently zoned as Farm Zone (FZ1), at the northern end of McNamara Road and Nash Road; it is understood that these areas will be re-zoned to residential in due course (see Figure 2).

Bunyip is recognised as having a higher proportion of larger-sized residential lots than other townships; lot sizes range from 500 m² to 8 ha, typically supporting single-storey detached dwellings with a generous set-back from the street (Cardinia Shire 2008).

The Bunyip Township Strategy states that future development is to be focused on medium-density infill, and low-density residential development with varying lot-sizes (Cardinia Shire 2008). The strategy also identifies four residential precincts: established residential areas; new residential areas; low-density residential areas; and special residential areas, with guidelines provided for development within these areas (Cardinia Shire 2008). New developments, over the last five years, have occurred surrounding the town centre, but have also included the development of large, undeveloped landholdings in General Residential and Low Density Residential Zones at the outskirts of the township (e.g. 61-140 Nash Road, Lot 1 Nylander Road).

Given the prevalence of relatively large lot sizes within Bunyip, remnants of native vegetation are scattered throughout residential areas of the township, particularly in the Low Density Residential area to the east, around Abeckett Road. Remnant vegetation within the township predominantly comprises Lowland Forest. Grassy Woodland and Swamp Scrub remnants occur in small patches south of the railway line and east of Bunyip-Modella Road, while the Bunyip River supports remnants of Swampy Riparian Woodland (DELWP 2016). There are also a number of small reserves which support remnant vegetation, the largest of which is Bunyip Sanctuary, located on the northern boundary of the township. The northern half of this reserve supports remnant Lowland Forest, while the southern half — a recent addition — has been cleared historically, but will be revegetated in parts, and include recreation facilities.

2.2 Garfield

The township of Garfield is mostly located north of the Melbourne – Sale Railway line, and is generally bounded by Tea Tree Creek to the north, Ti Tree Road to the east, Beswick Street to the south, and land at the end of Barker Road to the east (Figure 1).

Garfield has also been identified as having the potential for substantial future growth (Cardinia Shire 2008), and is included in Melbourne's Urban Growth Boundary (see Figures 1 and 3). The township comprises mostly residential land; the main zoning being General Residential Zone 1 (GRZ1). Low Density Residential (LDRZ) areas are located along the northern boundary of the township (much of which is currently undeveloped), and on the eastern boundary. The commercial centre of the township comprises a relatively narrow strip of land along the southern side of the railway line. There are also small areas of Public Use Zones (PUZ2, PUZ4, PUZ6) and Public Park and Recreation Zone (PPRZ).

Residential areas within Garfield are characterised by single, detached dwellings, and lot sizes typically range from 500 m² to 16 ha (Cardinia Shire 2002). The highest density development occurs near the centre of the township, between Garfield Road and Jefferson Road, and south of Archer Road, within the General Residential Zone. Recent residential development has occurred largely within this area, but has also included the subdivision of larger landholdings in Low Density Residential areas (e.g. 555 Railway Avenue).

Pockets of remnant Lowland Forest and Herb-rich Foothill Forest remain on the northern and western outskirts of the township. The largest of these patches occurs across several properties to the south of Barker Road and east of Garfield Road. High density development near the centre of the township has

resulted in a greater level of vegetation clearance than in Bunyip, with only small fragments of vegetation scattered throughout this area. The railway line supports fragmented patches of vegetation, formerly Grassy Woodland, while remnants of Swampy Woodland also remain on Tea Tree Creek.

2.3 Tynong

Tynong is a small rural township on the Melbourne – Sale Railway (Figure 1). Residential development along the railway line is covered by a Neighbourhood Residential Zone (NR1Z), whilst the remainder of residential land, along Tynong Road, is covered by Low Density Residential Zone, as well as a Vegetation Protection Overlay (VPO) and Environmental Significance Overlay (ESO1) (see Figure 4).

Significant areas of remnant vegetation remain within the Green Wedge land adjoining residential areas to the east, which have been mapped as Herb-rich Foothill Forest (DELWP 2016). Some of this vegetation extends into residential areas at the northern end of Tynong Road. Small remnants of Damp Heathy Woodland have also been mapped along Tynong Road. The railway line through Tynong formerly supported Swampy Woodland, although little vegetation remains along this section of the railway (DELWP 2016).

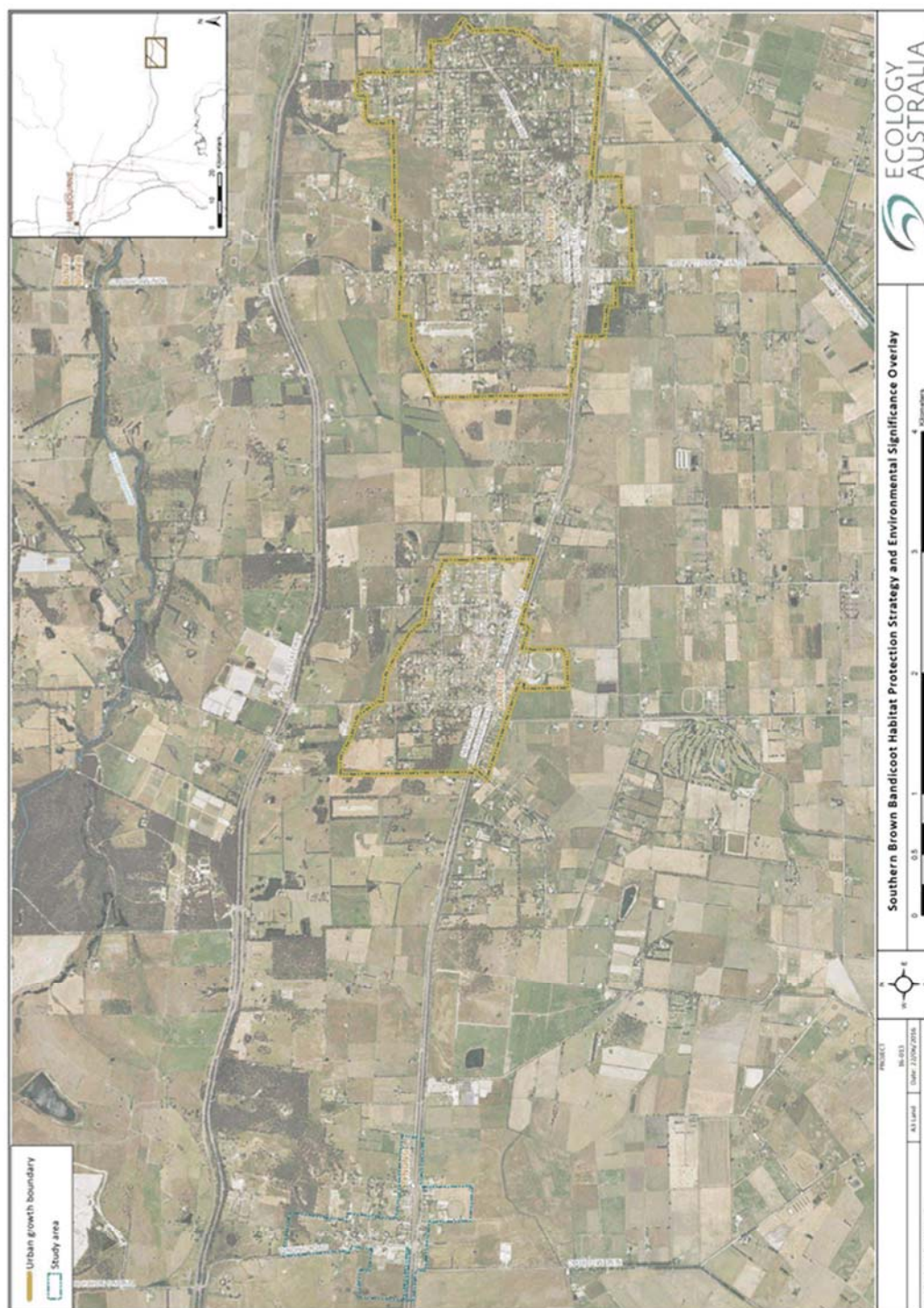


Figure 1 Strategy Area, as defined by township boundaries for Tynong, Garfield and Bunyip

Final

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3 Southern Brown Bandicoot

3.1 Status and Distribution

The Southern Brown Bandicoot is a medium-sized, ground-dwelling marsupial with a broad but fragmented distribution across southern Australia. The south-eastern mainland subspecies (*I. o. obesulus*), found in coastal and near-coastal regions of New South Wales, Victoria and South Australia, is listed as Endangered under the Commonwealth EPBC Act 1999, and as threatened under the Victorian *Flora and Fauna Guarantee Act 1988*. Since European settlement, this subspecies has suffered a dramatic decline in distribution and abundance across its entire range, primarily due to habitat loss from urban and agricultural development, and introduced mammalian predators (Brown and Main 2010).

In Victoria, the Southern Brown Bandicoot occurs in five main regional populations. Southern Brown Bandicoots within the Shire of Cardinia form part of the south-central sub-population; this population, as defined by Coates et al. (2008), extends from Cranbourne north-east toward Drouin and south to Cape Liptrap, with an isolated population at Wilsons Promontory.

The south-central region is the most populated in Victoria, and has seen extensive land clearance for agriculture and urban development. At the time of European settlement, Southern Brown Bandicoots were reportedly very common throughout this region, and until the 1960s, could be found in south-eastern suburbs of Melbourne, such as Clayton, Springvale, Dingley and Rowville (Dixon 1966, Seebeck 1977). However, they have since been eliminated from most areas of intensive agricultural and urban development, with a pattern of local extinction radiating from Melbourne, as the city expanded.

The Shire of Cardinia encompasses some of the last remaining habitat for Southern Brown Bandicoots in the region, and covers a significant portion of the currently known geographic extent of the south-central sub-population. Within the Shire, the species is known from a number of areas north of Western Port (formerly part of the Koo Wee Rup Swamp), including Dalmore and Koo Wee Rup, Cardinia, Bayles and Lang Lang, and from the foothills of the Dandenong Ranges, between Tynong and Bunyip (Coates et al. 2008, Ecology Australia 2009).

3.2 Habitats

Southern Brown Bandicoots use a variety of habitats with low dense vegetation cover. In eastern Victoria, this has included Swamp Scrub, Swampy Riparian Woodland, Swampy Woodland, Heathy Woodland, Coastal Heathland, Lowland Forest and banksia woodlands (Braithwaite and Gullan 1978, Opie et al. 1990, Menkhorst 1995, Paull 1995, Rees and Paull 2000, Ecology Australia 2009).

For the Southern Brown Bandicoot, vegetation structure is more important than floristics; dense understorey vegetation, up to 1 m in height, is the most important habitat requirement (Lobert 1990, Paull 1995, Claridge and Barry 2000, Sanderson and Kraehenbuehl 2006, Brown and Main 2010, DSEWPC 2011). This structural element provides protection from predators and shelter from local environmental conditions. Low, dense vegetation is also important for nesting (Lobert and Lee 1990, Paull 1995). Bandicoots rarely venture far from cover, typically foraging in open areas adjacent to cover, or in small clearings within dense vegetation (Heinsohn 1966, Quin 1985, FitzGibbon et al. 2007, Ecology Australia 2009).

Where native vegetation has been degraded or diminished in extent, dense woody weeds such as Blackberry (*Rubus fruticosus* agg.), Gorse (*Ulex ueropaeus*) or African Boxthorn (*Lycium ferocissium*) can provide alternative cover, replacing the structural elements of a native understorey, and can play an important role in facilitating the persistence and dispersal of bandicoots in highly modified landscapes (Paull 1995, Alessio 2002, Sanderson and Kraehenbuehl 2006, Ecology Australia 2009, Packer 2013).

Across much of the south-central region of Victoria, where native vegetation has been extensively cleared, bandicoots are generally confined to small, degraded vegetation remnants with an understorey dominated by environmental weeds, such as blackberry, and exotic pasture grasses on private land, in small public reserves and along utility corridors. Suitable habitat in this region is substantially within the private land estate and on utility land, where it is subject to a number of threatening processes (Ecology Australia 2009, Brown and Main 2010).

3.3 Population Ecology

The biological and ecological traits of the Southern Brown Bandicoot are consistent with a life-history strategy that is well-adapted to exploiting patchy and temporarily favourable habitats, such as heathland, which are prone to regular disturbance from fire (Cockburn 1990, Lobert and Lee 1990, Tyndale-Biscoe 2005).

Like other bandicoot species, Southern Brown Bandicoots have a high reproductive capacity, characterised a very short gestation period (c. 12 days), the rapid development of young (c. 45 days), and the ability of females to re-enter oestrus just prior to weaning young, allowing them to produce two to three litters during favourable conditions (Cockburn 1990, Lobert and Lee 1990). Juvenile dispersal capacity is thought to be high; young disperse shortly after weaning, often colonising habitat some distance from the mother's home range (Stoddart and Braithwaite 1979, Cockburn 1990).

Their reproductive strategy, combined with the early dispersal of juveniles and high dispersal capability, enables bandicoots to rapidly respond to, and colonise, adjacent habitats during favourable conditions (Tyndale-Biscoe 2005). As a result, the occupancy and use of habitats by bandicoots may vary considerably over time with local environmental conditions, such as rainfall, food availability and predation levels, which can influence local distribution and abundance (Brown and Main 2010, DoE 2015).

These characteristics also enable them to colonise and exploit fragmented habitats in highly modified environments, as occurs in some rural and peri-urban landscapes. In these landscapes in particular, connectivity between habitats is considered critical to the long-term persistence of the species, determining whether small patches contribute to the overall area of available habitat, and enabling recolonisation of isolated patches, following local extinctions (FitzGibbon et al. 2007, Coates et al. 2008, Ecology Australia 2009).

The south-central region of Victoria is a predominantly agricultural region that has been largely cleared of native vegetation, but is characterised by a network of drains, waterways, railway corridors and roadsides. These utility easements comprise linear vegetation remnants that not only provide habitat, but are likely to be important in facilitating the dispersal of bandicoots, enabling them to move through and persist within the largely agricultural and urban matrix (Coates et al. 2008, Ecology Australia 2009).

4 Statutory and Planning Context

This section outlines the broader context for the protection and management of Southern Brown Bandicoot populations, particularly as it relates to legislation and policy. The development of a strategy and planning controls to protect bandicoot habitat within the townships of Tynong, Bunyip and Garfield, will sit within this framework, and must therefore, be consistent with the requirements of the relevant legislation, policy and local conservation strategies.

4.1 Commonwealth Legislation

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) pertains to 'Matters of National Environmental Significance', which includes listed threatened species and ecological communities, listed migratory species, Commonwealth Marine Areas and Ramsar Wetlands. Provisions under the EPBC Act form the primary legislative mechanism for the protection and management of biodiversity in Australia. Actions that may have a significant impact on listed items must be referred to the Federal Government for assessment and approval. Most projects are assessed on a case-by-case basis; however, under the provisions of the EPBC Act, the Federal Government may also approve actions relating to plans, policies or programs being implemented by agencies such as State or local government, under a Strategic Assessment (e.g. see Section 4.2.1).

The Southern Brown Bandicoot (south-eastern sub-species) is listed as Endangered under the EPBC Act. A National Recovery Plan has been drafted in response (Brown and Main 2010). Potential impacts to the Southern Brown Bandicoot are assessed under the EPBC Act with reference to the EPBC Act 'Significant Impact Guidelines 1.1' (DoE 2013), and EPBC Act Referral Guidelines for the Southern Brown Bandicoot (DSEWPC 2011). These documents assist proponents in determining whether proposed actions require referral to the Federal Government for assessment and approval.

4.2 State Legislation and Policy

The *Victorian Flora and Fauna Guarantee Act 1988* (FFG Act) is Victoria's primary legislature for flora and fauna. It lists species and ecological communities recognised as rare or threatened in Victoria. All public authorities are required to have regard to the objectives of the Act in carrying out their functions, and in managing native species or threats to native species and communities. The Southern Brown Bandicoot is listed as a threatened species under the FFG Act.

The *Planning and Environment Act 1987* establishes a legislative framework for planning the use, development and protection of land in Victoria. The State Planning Policy Framework sets out state-wide policies and strategies for land use and development, and applies to all planning schemes in Victoria. It includes policies on the built environment, environmental and landscape values, transport and infrastructure. Planning schemes, derived from the 'template' of the Victorian Planning Provisions, set out policies, strategies and controls for each municipality; these are discussed further in Section 5, in relation to the three townships. The *Planning and Environment Act 1987* is also the primary legislation for regulating and implementing the Victorian Government's urban development program *Melbourne @ 5 Million*, which involved the extension of Melbourne's Urban Growth Boundary, assessed under an EPBC Act Strategic Assessment (see below).

4.2.1 Melbourne's Strategic Assessment

As part of the expansion of Melbourne's UGB, the Victorian Government undertook a Strategic Impact Assessment of Melbourne's new urban growth precincts, under an agreement with the Federal Government. The Strategic Impact Assessment Report details the likely impacts of urban expansion on 'Matters of National Environmental Significance', listed under the EPBC Act, and the measures required to mitigate these impacts (DSE 2009). This has led to the development of Sub-regional Strategies for some species listed under the EPBC Act, including the Southern Brown Bandicoot, for the South-east Growth Area. A Sub-regional Species Strategy for the Southern Brown Bandicoot has been developed to mitigate the likely impacts on Southern Brown Bandicoots, identified as part of the Strategic Assessment. It takes into consideration populations and habitats, both within, and beyond the Growth Boundary (DELWP 2014), including Tynong, Bunyip and Garfield. The strategy outlines a number of possible measures, with a focus on predator control (see also Ecology Australia 2013). However, the Sub-regional Strategy for the Southern Brown Bandicoot is undergoing significant review, and is not yet finalised. The Sub-regional Strategy is intended to be a key mechanism for achieving conservation outcomes for the Growth Areas, and influence Precinct Structure Planning by State and Local Government, through the identification of important populations and habitats.

4.3 Local Conservation Strategies

Cardinia Shire Council, in association with Casey City Council and Melbourne Water, in 2009, commissioned the development of a strategic management plan for the conservation of Southern Brown Bandicoots, within the former Koo Wee Rup Swamp area (Ecology Australia 2009). This plan outlined a number of management objectives and actions to improve the viability of populations in the region, including populations between Tynong, Bunyip and Garfield. The development of planning controls, through a Schedule to an Environmental Significance Overlay, to protect Southern Brown Bandicoot habitat on private land, was a key recommendation of the Plan (Ecology Australia 2009).

The Western Port Biosphere Reserve Foundation initiated the Southern Brown Bandicoot Recovery program in 2003, and established the Southern Brown Bandicoot Recovery Group in 2011. The Foundation works in collaboration with other organisations to undertake actions that will assist with the recovery of the species, including on-ground fox control, habitat restoration, community engagement, and research and monitoring. Facilitation of the Recovery Program is one of the key strategic actions under the Western Port Biosphere's Living Strategy; recovery actions also form key components of the Western Port Biosphere Reserve Biodiversity Plan (WPB 2015).

5 Existing Planning Provisions

Protection of biodiversity within the planning scheme can be achieved through three mechanisms:

1. State-wide Native Vegetation Clearing Controls (i.e. Clause 52.17)
2. Zoning and
3. Overlays.

The Native Vegetation Clearing controls limit the removal of native vegetation; zoning identifies and limits permitted land uses; and overlays can provide additional controls to limit works, development and the removal of native vegetation which would not otherwise be addressed under Clause 52.17. All three mechanisms can have considerations for biodiversity as part of a planning permit application.

5.1 Native Vegetation Controls

Clause 52.17 (Native Vegetation) of the planning scheme provides a means of limiting the loss of native vegetation within Victoria and is part of all planning schemes. The purpose of this clause is to:

'ensure permitted clearing of native vegetation results in no net loss in the contribution made by native vegetation to Victoria's biodiversity'.

Under Clause 52.17 a permit is required to remove native vegetation on land in one ownership, of 0.4 ha or greater; although, some exemptions apply (e.g. fire protection, fence maintenance, planted vegetation, weeds).

Clause 52.17 is considered the minimum 'baseline conservation provisions' for limiting the loss of biodiversity on a state-wide basis (DPCD 2002). The focus of 52.17 and the associated policy (Biodiversity Assessment Guidelines, DEPI 2013) is on protecting state-wide values. As such protection of local biodiversity values may not be achieved using this planning mechanism, particularly where habitat occurs for threatened species that is highly modified.

Under the associated policy, an application to remove, destroy or lop native vegetation must be classified as one of the following risk-based pathways: Low, Moderate or High, as defined in the Biodiversity assessment guidelines (DEPI 2013). Permits to remove native vegetation are only required under Moderate or High risk pathways. The majority of native vegetation remnants within the townships of Bunyip, Garfield and Tynong are classified under the Low risk pathway.

5.2 Zones

5.2.1 Residential Zones

The townships of Bunyip, Garfield and Tynong are covered primarily by residential zones, including General Residential Zone (GRZ), Neighbourhood Residential Zone (NRZ) and Low Density Residential Zone (LDRZ). Areas covered by the higher-density GRZ and NRZ are typically focused towards the centre of the townships; with LDRZ areas around the outer edges of the townships (see Figures 2 – 4). These zonings provide for both medium-density infill, where urban character can be protected (GRZ and NRZ), and for low-density housing (LDRZ) within the three townships. In largely urban environments, zoning is not considered the best way to achieve biodiversity objectives; biodiversity assets are best protected using overlays (DPCD 2002), as discussed in Section 5.3.

General Residential Zone

The General Residential Zone facilitates the development and use of land for residential and related urban purposes. It enables moderate levels of housing growth, whilst allowing for the preservation of neighbourhood character. It also encourages housing diversity, including a mixture of single dwellings, dual occupancies or unit developments on a diversity of lot sizes (DTPLI 2013); however, there is no mandatory minimum lot size.

The General Residential Zone currently covers established residential areas of the townships, which support standard lots, as well as larger, undeveloped landholdings, with a wide range of block sizes ranging from smaller multi dwelling lots to 4 ha (see Figures 2 – 4). Under this zoning a permit is required to subdivide land, but no permit is required for the construction or extension of one dwelling on a lot, provided the lot is larger than 300 m² in area.

Neighbourhood Residential Zone

The Neighbourhood Residential Zone facilitates the development and use of land for residential purposes, but can be used to limit opportunities for increased residential development, in recognition of neighbourhood character, or where areas of environmental or landscape significance have been identified (DTPLI 2013). It is typically applied to areas where the primary housing comprises single dwellings and dual occupancies, and no significant change is desired for the area.

Neighbourhood Residential Zone covers established residential areas within the township of Tynong (Figure 4). Under this zoning, a permit is required to subdivide land, but no permit is required to construct or extend on dwelling on a lot (provided the lot is larger than 300 m² in area), or to construct or extend a fence within 3 m of a street. Residential development is generally restricted to two dwellings on a lot.

Low Density Residential Zone

Low Density Residential Zoning is typically used on the fringes of urban areas to provide for low-density residential development comprising of single dwellings or two dwellings; it affords the lowest housing density of the residential zones.

The Low Density Residential Zones of the three townships cover properties with a large range of lot sizes from approximately 2000 m² to 16 ha (Figures 2 – 4). A permit is required to subdivide land under this zoning; Low Density Residential Zoning typically allows for allotments to be subdivided to 4000 m² where there is no connection to reticulated sewerage and to 2000 m² where there is a sewerage connection.

5.2.2 Public Use Zones

Public Use Zones recognise land for public utility, community services and facilities, and provide for associated land uses consistent with the intent of the reserved land. Several areas of Public Use occur within the three townships, the main site being the Melbourne – Sale Railway.

Public Use Zone 4 – Transport

The Melbourne – Sale Railway is zoned under Schedule 4 to the Public Use Zone. There are no permit requirements under this zoning to construct a building or carry out works for transport purposes.

5.3 Overlays

In addition to the requirements of the zone, further planning provisions may apply to a site or area through the application of an overlay. However, overlays do not change the intent of the zone, and therefore, the consideration and application of an overlay must consider the current and likely future land use and development pattern.

The two overlays applied to the three townships, include a Design and Development Overlay and Vegetation Protection Overlay. Low Density Residential areas across the three townships are variously covered by a Design and Development Overlay and Vegetation Protection Overlay (see Figures 2 – 4).

5.3.1 Design and Development Overlay

A Design and Development Overlay sets out requirements for the siting and design of buildings and works, to achieve design objectives for development, with regard to the existing pattern of subdivision within an area, amenity and particular environmental features and constraints of the landscape.

A Design and Development Overlay (Schedule 1) covers the Low Density Residential Zones of Bunyip and Garfield (Figures 2 and 3). Under this overlay, a permit is required to construct any building or carry out works, unless particular conditions are met. These conditions include building setbacks from roads, property boundaries and waterways. Restrictions are also placed on the removal of native vegetation in areas of botanical or zoological significance, as mapped by the (then) Department of Natural Resources and Environment. While some of these requirements can contribute to the protection of natural values, this is not a primary focus of the overlay controls.

5.3.2 Vegetation Protection Overlay

Vegetation Protection Overlays are specifically intended for the protection of significant native and exotic vegetation, including individual trees, stands of trees or areas of vegetation. However, they typically do not protect modified habitats, and do not include buildings, works or subdivision requirements. Other planning controls are required if these development impacts need to be managed.

A Vegetation Protection Overlay has been applied to parts of the Low Density Residential Zone within the townships of Bunyip, Garfield and Tynong, where significant areas of remnant native vegetation have been identified (see Figures 2 – 4). Under this overlay, a permit is required to remove, destroy or lop any vegetation specified within the schedule; although, exemptions apply.

5.3.3 Environmental Significance Overlay

An Environmental Significance Overlay is specifically used to protect natural values. It has a broader application than a Vegetation Protection Overlay, providing not only for the protection of native vegetation, but also wider environmental values. An Environmental Significance Overlay may contain additional controls for subdivision, buildings and works (including fence construction, and provision of landscaping).

An Environmental Significance Overlay (Schedules 1 – 6) covers several areas of Cardinia Shire, including:

- Northern Hills (ESO 1);
- Western Port Coastal Wetlands (ESO 2);
- Other Significant Sites (ESO 3);

- Pakenham North Ridge (ESO 4);
- Cardinia Road Precinct Structure Plan (ESO 5); and
- Officer Conservation Living Area (ESO 6).

There is currently no Environmental Significance Overlay over any of the three townships.

Environmental Significance Overlays can be applied in situations where habitat for threatened species may be highly modified and which, despite retaining structural elements that allow the species to survive, may not necessarily qualify as 'native vegetation'. They are also useful for protecting habitat elements for threatened species that may be scattered throughout a landscape, where the overlay is applied over broad areas within which suitable habitat may occur. Both of these situations apply to Southern Brown Bandicoots and bandicoot habitat within the three townships.

Under the Environmental Significance Overlay, a permit is required to:

- Subdivide the land;
- Remove, destroy or lop any vegetation, including native, exotic or dead vegetation;
- Construct a building or construct or carry out any works; or
- Construct a fence; if specified in a schedule to the overlay.

Application of the ESO over the townships would introduce these requirements, except where exemptions are specified.

5.4 Limitations of the Planning Scheme

The protection of biodiversity through the planning scheme is limited to new use and development. Many activities adversely affecting biodiversity occur as part of land management practices associated with existing use and development over which the planning system has no control (DPCD 2002). These activities may include:

- Clearing of vegetation for bushfire protection measures or fence maintenance;
- Plantings, including garden plantings;
- Domestic animals; and
- General day to day activities.

Zones and Overlays can assist with identifying and protecting areas supporting particular biodiversity values by restricting development and works, but management cannot be a condition within a schedule. Management can be encouraged through other biodiversity strategies implemented by a Council, as well as Council-run incentive programs and other programs such as Bush Tender and thirty party offsets.

Other incentive schemes to manage potential impacts associated with urban development, including habitat enhancement schemes, sensitive management of public assets and utility corridors, and public engagement and education are discussed in Section 9.

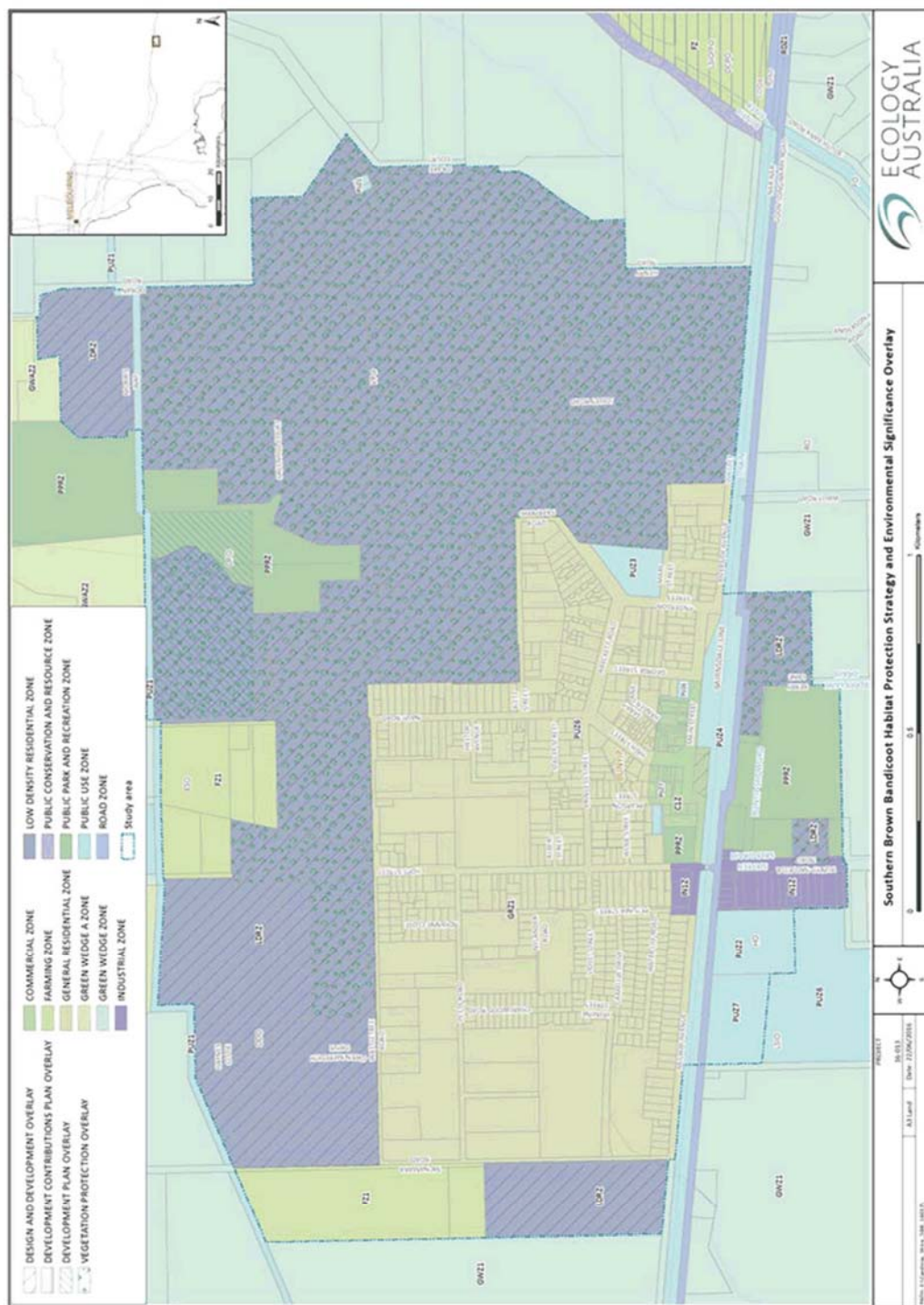


Figure 2 Zoning and overlays covering the township of Bunyip

Final

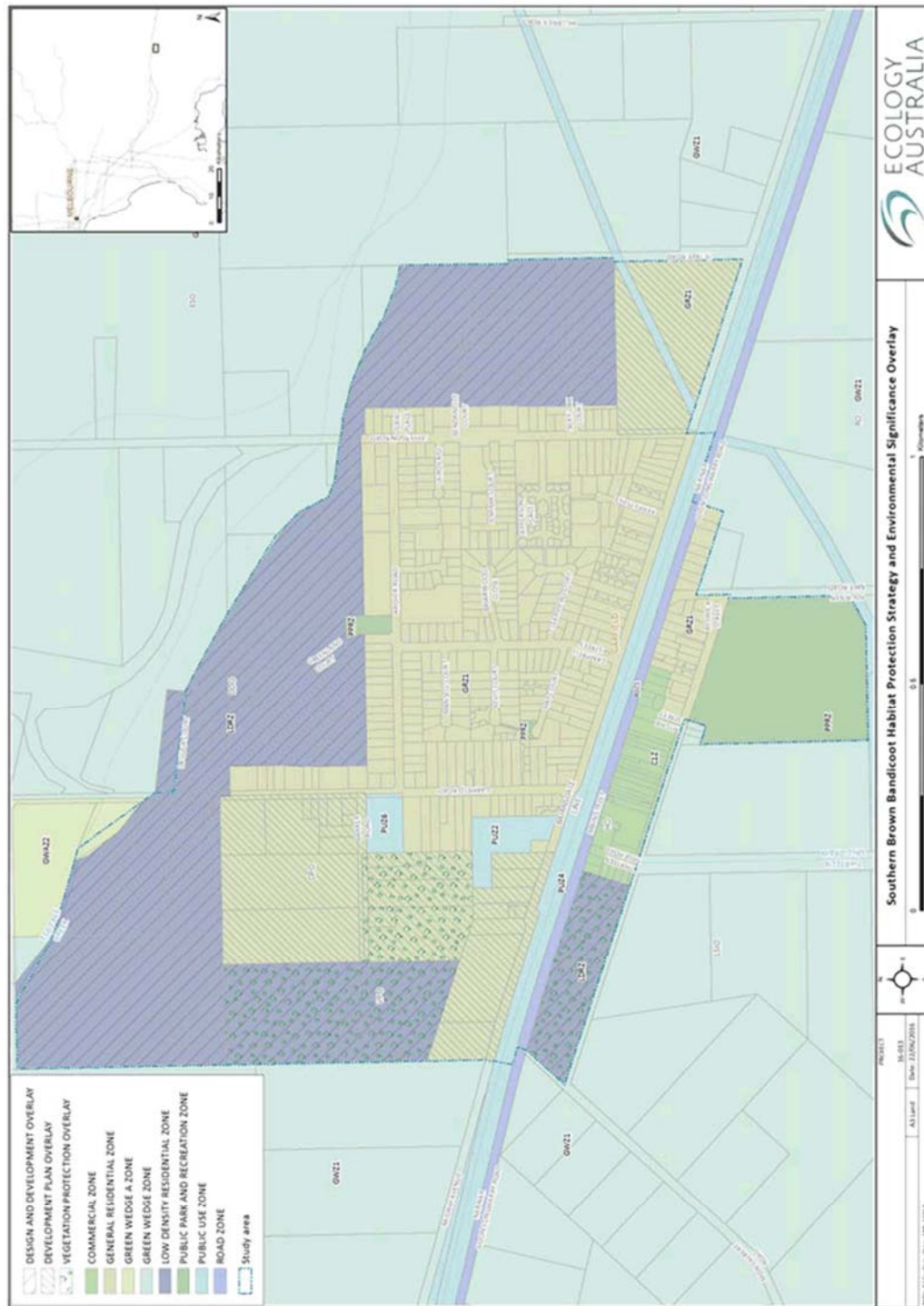


Figure 3 Zoning and overlays covering the township of Garfield

Final

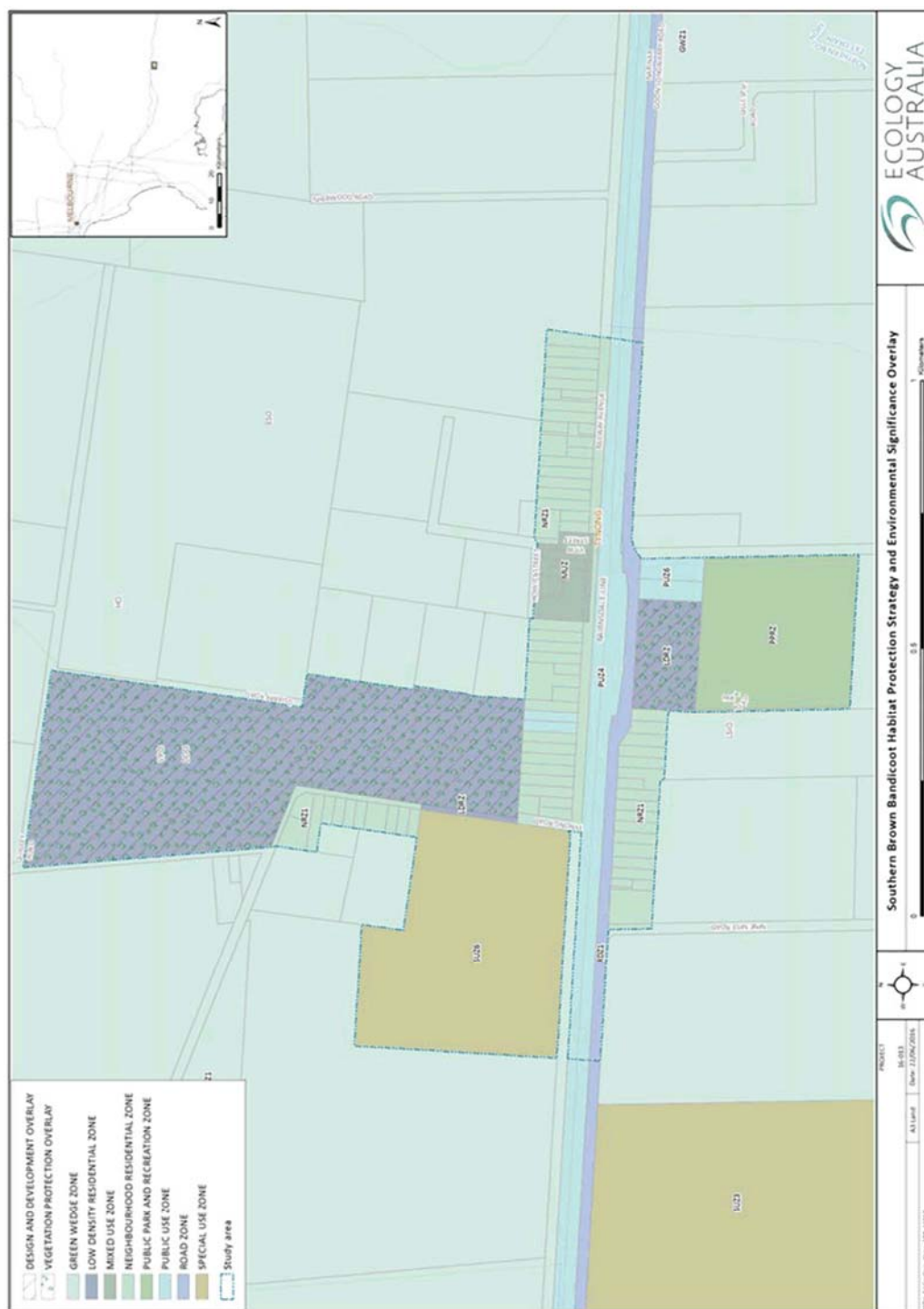


Figure 4 Zoning and overlays covering the township of Tynong

Final

6 Urban Conservation of Southern Brown Bandicoots

The Southern Brown Bandicoot is a relatively adaptable and opportunistic species which has been known to persist in some highly modified landscapes around Sydney, Adelaide, Perth and Melbourne, where it lives in close proximity to humans, making use of anthropogenic resources. Bandicoots are able to opportunistically exploit their environment through their wide choice of food, fast growth, rapid reproduction and short life span; these characteristics can also allow them to exploit novel resources and new opportunities provided by residential development.

6.1 Bunyip, Garfield and Tynong Populations

Southern Brown Bandicoots have been recorded on public and private land throughout the townships of Bunyip, Garfield and Tynong, including on residential blocks, public reserves, and along roadsides and waterways. Based on species records, Bunyip and Garfield appear to support the largest populations; there are few records from around Tynong (see Figures 5 – 7). However, these differences are likely to be influenced by survey effort and general awareness amongst the local community, reflecting biases in databases, rather than the actual size or distribution of resident populations.

To-date, there has been no systematic survey of private and public land within or around the three townships, to determine the local distribution of the species or its habitat. Current knowledge of their distribution has been derived through the collation of records from small-scale targeted surveys undertaken by researchers and consultants, incidental observations by experts and members of the public and indirect evidence (e.g. diggings), gathered over several decades (see Appendix 1). Thus, the records do not necessarily represent the current occupancy of habitat by bandicoots, but provide an indication of the suitability of habitat types used by bandicoots, locally.

Most records of Southern Brown Bandicoots are located within and around the Melbourne-Sale railway line (see Figures 5 – 7). The number of records along the railway line, and the consistency with which bandicoots have been recorded there, indicate that it is an important habitat for local populations, and habitat link that provides a vegetated connection between the three townships, and beyond to Longwarry. Within the townships, bandicoots have been largely recorded from private (residential) land, with records scattered throughout General Residential and Low Density Residential areas (Figures 5 – 7). However, the distribution of habitats within these areas, their use by bandicoots, and relative importance are not known.

The occurrence of bandicoots within the townships is primarily associated with remnants of Swamp Scrub, Swampy Riparian Woodland and Lowland Forest vegetation, which provide dense cover in the understorey and midstorey (see Plates 1 – 3). Some of these remnants remain relatively intact, with native species, such as Bracken (*Pteridium esculentum*) and Saw-sedge (*Gahnia sp.*) in the understorey and wattles (*Acacia spp.*) and Swamp Paperbark in the midstorey, while others have been degraded by past agricultural, or other, land uses (e.g. grazing), and are dominated by environmental weeds (e.g. see Plates 1 – 3). Woody weeds such as Broome (*Genista spp.*), Blackberry, and rank exotic pastures can replace native species to provide the dense structure required by bandicoots. Purely exotic vegetation (e.g. blackberry thickets) and garden plantings on suburban lots can also provide some habitat.

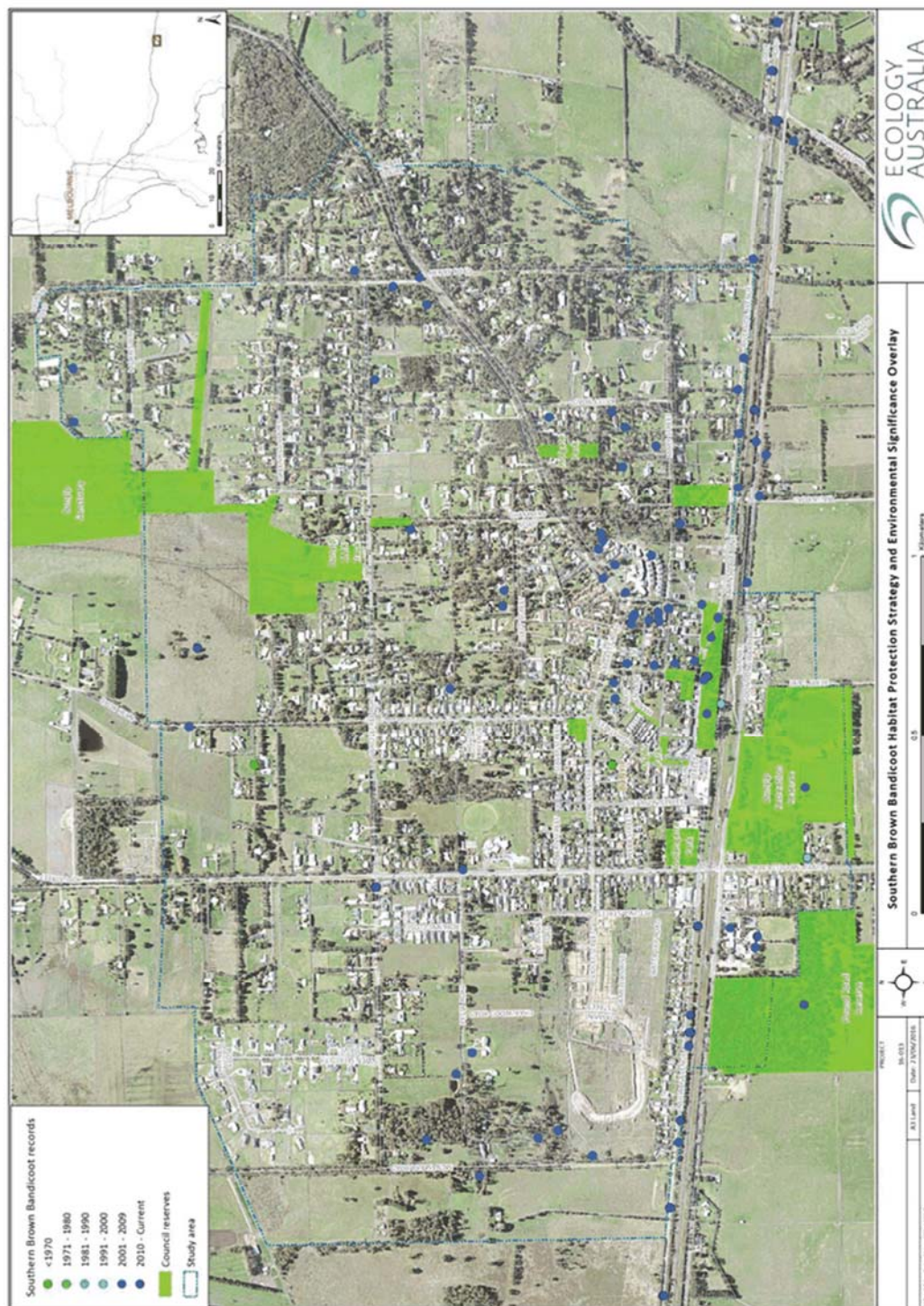


Figure 5 Southern Brown Bandicoot records at Bunyip

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Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay



Figure 6 Southern Brown Bandicoot records at Garfield



Figure 7 Southern Brown Bandicoot records at Tynong

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Plate 1 Remnant vegetation on private property in Bunyip, with a dense understorey dominated by native species



Plate 2 Remnant vegetation in Bunyip, with an understorey dominated by Blackberry



Plate 3 Remnant vegetation with a predominantly exotic understorey on private property at Barker Road, Garfield

6.2 Existing Township Characteristics

The particular characteristics of the townships which have enabled the bandicoot to survive within residential areas are not fully understood. However, it is likely that a combination of the existing land uses and development patterns in the townships, combined with the Southern Brown Bandicoot's ability to opportunistically exploit their environment, have enabled their persistence.

Bunyip, Garfield and Tynong are semi-rural townships within an agricultural landscape, which presently support relatively low densities of urban development and large areas of open space. The townships have the following characteristics, which provide a mosaic of dense vegetation and open areas:

- Residential areas currently support a wide range of property sizes, from small allotments in established residential areas, to larger landholdings in both the General Residential and Low Density Residential Zones, many of which retain patches of remnant native vegetation;
- Remnant vegetation with a dense understorey of native and exotic vegetation also occurs on public land, including within conservation and recreation reserves and along waterways, often interspersed with small clearings or open lawn areas; and
- Many roadsides throughout the townships are well vegetated and adjoin areas of vegetation on both public and private land (Plate 6).

These characteristics appear to offer bandicoots a relatively low resistance matrix to move through, compared with high intensity urban developments that are closer to metropolitan Melbourne. Linear remnants along the railway, roadsides and drains, in particular, are thought to facilitate the movement of bandicoots, by providing physical connectivity between habitats, within and between the townships and surrounding agricultural land (Coates et al. 2008, Ecology Australia 2009).

Residential areas also provide additional food and artificial sheltering resources:

- Within residential areas, exotic vegetation in the form of dense garden plantings on suburban lots, or landscaping around public buildings (e.g. schools), can provide shelter with more open foraging habitats provided by areas of lawn or vegetable patches;
- The townships support a significant number of older-style residences on larger lots, often including sheds and extensive gardens (see Plates 4 and 5). As in other peri-urban areas where bandicoots have persisted, Southern Brown Bandicoots have been found to use a range of natural and artificial structures, and have been reported living beneath houses and other buildings, under sheds and scrap woodpiles (Dufty 1994, Leary 2010, Dowle 2012); and
- Vegetable patches, human food scraps and food left out for domestic animals provide an additional food source. Southern Brown Bandicoots are opportunistic omnivores, consuming a wide variety of invertebrate and plant material (including seeds and fruits) and hypogeous fungi, components of which may shift according to seasonal availability (Heinsohn 1966, Quin 1992, 1985, 1988). However, they are also known to consume anthropogenic foods.

The Southern Brown Bandicoot's adaptations for the rapid and opportunistic exploitation of temporarily favourable habitats allow bandicoots to move into areas such as suburban backyards, with spatially heterogeneous and structurally complex habitats, to exploit various resources (Dowle 2012). However, as a ground-dwelling mammal, they remain vulnerable to the impacts of ongoing habitat loss or simplification, fragmentation and predation. As urban development expands, the ecological role of peri-urban and suburban areas, including yards becomes increasingly important for the persistence of native wildlife (Savard et al. 2000).



Plate 4 Property in the Low Density Residential Zone of Bunyip which supports artificial sheltering resources, including a shed and wood piles



Plate 5 Property frontage in the Low Density Residential Zone of Bunyip



Plate 6 Roadside vegetation along McNamara Road, Bunyip, where Southern Brown Bandicoots have been recorded in dense Swamp Scrub (left hand side)

6.3 Key Issues

The generalist habitats and broad, omnivorous diet have enabled bandicoots of a number of species to exploit modified or degraded habitat, supplementary food sources and artificial structures for shelter. However, while some residential areas such as Bunyip, Garfield and Tynong may provide increased opportunities for food and shelter, areas of intensive development typically lack sufficient dense habitats for nesting and refuge, and the mosaic of open foraging areas with peripheral cover. Intensive residential development can also reduce functional connectivity by increasing the number of barriers, and increasing the resistance to movement through the landscape.

There are a number of challenges relating to the long-term maintenance of Southern Brown Bandicoot Populations within the three townships, in the face of increased development. Namely:

- The existing zoning across the three townships allows for moderate levels of residential growth, with the townships of Bunyip and Garfield expected to undergo higher levels of growth as part of Melbourne's Urban Growth Area. Current planning provisions, including Native Vegetation Clearing Controls (C.52.17), do not adequately provide for the protection of potential habitat for Southern Brown Bandicoots within the townships, and guidelines under the EPBC Act do not provide a reliable trigger for implementing conservation requirements into new developments;
- Planning controls that may be introduced through an overlay can provide a trigger for the incorporation of conservation measures for the Southern Brown Bandicoot into new developments, but cannot limit the potential land uses permitted within the zoning;
- The distribution of bandicoots and their habitat within the townships has not been determined. The Southern Brown Bandicoot is a relatively cryptic and enigmatic species, which may use different habitats at different times, depending on local environmental conditions, and areas that are suitable for bandicoots are likely to change over time; and
- The critical elements which have enabled Southern Brown Bandicoots to persist within the townships have not been determined. These elements may include characteristics of the townships themselves, or surrounding areas. Furthermore, there are likely to be certain elements that contribute to the persistence of bandicoots, which cannot be addressed by planning controls.

6.4 Approach

The long-term persistence of bandicoot populations within the townships of Bunyip, Garfield and Tynong relies on maintaining a mixture of habitats within the townships, including dense sheltering and nesting habitats with adjacent foraging habitats, and on retaining permeability through the landscape to provide functional connectivity between habitats. The importance of conserving a mosaic of dense vegetation and open areas has been identified for other bandicoot species in urban landscapes (Scott et al. 1999, Chambers and Dickman 2002), while the maintenance of functional connectivity has been demonstrated to increase the likelihood of the persistence of bandicoots in fragmented habitats (FitzGibbon et al. 2007, Southwell et al. 2008).

This requires a strategic approach to each township that encourages the maintenance and strengthening of a network of habitat opportunities on public and private land, compatible with the ongoing development and use of the towns.

Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay

From a development perspective, planning controls have the potential to provide a consistent approach to protecting bandicoot habitat within the townships, and to ensure that the requirements for habitat conservation and enhancement are taken into account as appropriate, when decisions are made about new residential developments.

An Environmental Significance Overlay should be aimed at mitigating potential impacts of development, which may limit the long-term persistence of bandicoots within the townships, with a focus on those elements which can be feasibly preserved and where possible enhanced. This includes:

- Limiting incremental habitat loss through protection of existing vegetation that has the appropriate structure, location and accessibility as habitat for the bandicoot;
- Maintaining permeability of the landscape by limiting physical barriers to movement at ground level and enhancing habitat links;
- Identifying for each township any key habitat areas and/or linkages, as a basis for a network of habitat opportunities in the township environment, connected to the surrounding landscape; and
- Encouraging the replanting of habitat for bandicoots to offset vegetation removal (where losses are unavoidable, or alternative locations offer superior habitat potential in the longer term) or enhance habitat on the site or adjacent land.

It is also likely that the persistence of bandicoots in these townships relies not only on the maintenance of habitat on private land, but also within linear remnants of vegetation along roadside and waterways, which provide connectivity through the landscape. Other measures will also be required to support the implementation of the Overlay.

7 Strategic Habitat Links

A number of strategic habitat links have been identified for each of the townships. The strategic habitat links provide the overarching framework for the development of a network of habitat opportunities to be achieved by the strategy and associated Environmental Significance Overlay. Strategic habitat links are shown in Part B (Figures 12 – 14), and have been identified on the basis of the following characteristics:

- Linkages formed by natural landscape corridors (e.g. riparian corridors) or existing linear infrastructure (e.g. roadsides or railways);
- Habitats known to be important for supporting Southern Brown Bandicoots, based on the results of long term studies or research, which show that they consistently support bandicoots;
- Linkages which support existing vegetation along their alignment or are adjoined by properties which support areas of remnant vegetation; and/or
- Linkages which provide a connection to areas of identified habitat, Council reserves or land that has been set aside for Southern Brown Bandicoot conservation on private land, as part of requirements under the EPBC Act 1999.

The strategic habitat linkages and an outline of their characteristics are given below.

7.1 Township Linkages

Habitat Link	Features and Values
Melbourne-Sale Railway (and adjoining roads)	<ul style="list-style-type: none"> ▪ The Melbourne – Sale Railway is a landscape link that connects the townships of Tynong, Garfield, Bunyip and Longwarry, all of which are known to support Southern Brown Bandicoots. ▪ The railway line and adjoining roads provide a partly vegetated corridor which provides suitable habitat for bandicoots, comprising patches of remnant vegetation with a dense understorey of native and exotic species, interspersed with areas of rank exotic pastures. ▪ The number of records along the railway line, and consistency with which bandicoots are recorded there indicates that it provides important habitat for local populations. ▪ The vegetation along the railway line currently receives very little management.

7.2 Bunyip

Habitat Link	Features and Values
Bunyip River	<ul style="list-style-type: none"> The Bunyip River is a natural landscape linkage which has been channelized south of the Princes Freeway, and connects Southern Brown Bandicoot populations at Koo Wee Rup and Bunyip. The Bunyip Main Drain and drainage complex is considered to support important habitat for the Southern Brown Bandicoot, particularly between Koo Wee Rup and Cora Lyn, where recent research has shown that the vegetation along the drainage line supports a high density of individuals (S. Maclagan 2015, unpubl. data). The Bunyip River and drainage complex supports dense vegetation comprising patches of remnant vegetation and woody weeds which provide a dense sheltering and refuge habitat. Grassy levee banks between the drains within the drainage complex support foraging habitat, with peripheral cover. Southern Brown Bandicoots living within the drainage complex have been found to forage along the levee banks, and in adjoining residential properties around Koo Wee Rup (S. Maclagan 2015, unpubl. data).
Abeckett Road	<ul style="list-style-type: none"> Abeckett Road is a well-vegetated roadway which traverses the eastern half of the township, and provides a connection to the Bunyip River, just north of the township, and the Melbourne – Sale Railway line, via Anderson Street. Roadside vegetation along Abeckett Road is also connected to numerous patches of existing vegetation, on private property inside the township, and in Green Wedge land on the outskirts of the township. Holgate Park, a small Council Reserve, is located along Abeckett Road.
McNamara Road	<ul style="list-style-type: none"> McNamara Road is a well-vegetated roadway which extends from the railway line in the south of the township, to the northern extent of the township (loosely connected with Ti-Tree Creek). Southern Brown Bandicoots have been recorded along McNamara Road, and as a result, large-scale residential developments have been required to incorporate conservation areas for the Southern Brown Bandicoot adjoining McNamara Road, under the EPBC Act. McNamara Road supports remnant Swamp Scrub vegetation and Lowland Forest, particularly within the eastern road reserve.
Chambers Road	<ul style="list-style-type: none"> Chambers Road extends from Abeckett Road to the Bunyip Sanctuary in the north of the township, via Wattletree Road. Chambers road supports existing roadside vegetation and provides the most proximate connection to Bunyip Sanctuary, via the southern extension, which will include recreation facilities and areas which will be revegetated.
Doran Road and Henry Road	<ul style="list-style-type: none"> Doran Road and Henry Road intersect Abeckett Road, with Doran Road to the north and Henry Road to the south. Doran Road connects to the Bunyip Sanctuary, via a Council-reserved habitat link, while Henry Road connects to the Melbourne- Sale Railway line. Both roadsides are adjoined by private properties which support significant areas of remnant vegetation.
Sixteen Mile Drain	<ul style="list-style-type: none"> Well-vegetated drain along Bunyip-Modella Road adjoining remnant vegetation patches on private properties, in Green Wedge Zone.



Plate 7 Sixteen Mile Drain along Bunyip-Modella Road, Bunyip, supporting remnant vegetation with a dense understorey of native and exotic species, and a native mid storey and canopy



Plate 8 Bunyip River Main Drain at the Bunyip-Modella Road, south of the Bunyip township

7.3 Garfield

Habitat Link	Features and Values
Ti-Tree Creek	<ul style="list-style-type: none"> Ti-tree Creek is a natural landscape linkage which traverses the northern boundary of Garfield township and extends into Bunyip township. Sections of Ti-tree Creek remain vegetated, while other sections have been cleared of vegetation. Ti-tree Creek adjoins a number of large, undeveloped properties, some of which support relatively large areas of remnant vegetation.
Ti-Tree Road	<ul style="list-style-type: none"> Ti-tree Road extends from Ti-Tree Creek and Ti-Tree Creek Park in the north, to the Melbourne-Sale railway and adjoining Railway Avenue in the south. Ti-tree road supports small areas of roadside vegetation. Southern Brown Bandicoots have previously been recorded along Ti-tree Road, which has triggered the requirement for the Southern Brown Bandicoot offset areas to be incorporated into a large-scale development along Ti-Tree Road and Railway Avenue, under the EPBC Act.
Garfield Road	<ul style="list-style-type: none"> Garfield Road provides a connection to Ti-tree Creek in the north and Railway Avenue and the Melbourne-Sale Railway line in the south of the township. Garfield Road adjoins a number of well-vegetated properties and the Barker Road Reserve.

7.4 Tynong

Habitat Link	Features and Values
Tynong Road	<ul style="list-style-type: none"> Tynong road is an extensively vegetated roadway which extends from the Melbourne-Sale Railway line in the south to the Princes Hwy in the north. Tynong Road also connects to Quigley Road in the north of the township.
Quigley Road	<ul style="list-style-type: none"> Quigley Road is an extensively vegetated roadway which extends from Tynong Road to the eastern end of the township Quigley Road adjoins large undeveloped properties within the Low Density Residential Zone, which support remnant vegetation, and extends into heavily vegetated areas within the Green Wedge Zone.

8 Environmental Significance Overlay

The integration of conservation requirements for the Southern Brown Bandicoot into the planning scheme can provide a statutory mechanism that accounts for both small and large-scale developments, and provides a means of imposing appropriate conditions for the use or development of land that will protect, mitigate impacts on, or enhance habitat for the Southern Brown Bandicoot. To achieve this, the provisions of the Overlay must:

- Apply a strategic and consistent approach to the consideration and implementation of conservation requirements for the Southern Brown Bandicoot into new developments, which does not rely on determining the occupancy of bandicoots in any area at a given point in time;
- Recognise and understand the likely environmental changes and their potential impact on the long-term persistence of Southern Brown Bandicoots within the townships. Central to this is acknowledgement that the Overlay cannot take away from permitted land uses or enforce the management of biodiversity values. Therefore, controls imposed by the Overlay must support a strategy which will help sustain the bandicoot in the long-term, given the potential lack of management;
- Accommodate the ecological requirements of the Southern Brown Bandicoot, based on their population dynamics, use of habitats and natural and anthropogenic resources within the townships, using the best available scientific evidence; and
- Recognise the extent to which the protection and enhancement of bandicoot habitat can be achieved within the townships, given the prevailing permitted land uses, and likely development patterns.

8.1 Considerations

While the elements critical to the long-term survival of bandicoots in the townships are not known, it is likely that a combination of characteristics have contributed to the maintenance of these populations, as discussed in Section 5:

- Remnant vegetation and exotic vegetation (including weeds such as blackberry and broom) on private property provides habitat comprising of low dense vegetation, which is supplemented by linear remnants of vegetation along roadsides, drains and the railway line;
- Linear remnants provide habitat connectivity, and opportunities for dispersal. These remnants, especially the railway line, are considered to be important, not only for their intrinsic habitat value, but also as linkages within a highly modified landscape.
- Suburban gardens with dense native and exotic plantings have also been found to provide habitat in some cases, as well as providing foraging habitat; and
- Residential lots also offer a range of anthropogenic resources that may be exploited by bandicoots, for example, supplementary sources of food, and alternative sheltering sites beneath houses, sheds or scrap woodpiles.

The Environmental Significance Overlay is intended to help preserve some of these elements, having regard to the current evidence about the habitat requirements for the Southern Brown Bandicoot.

Consideration has been given to the likely feasibility of introducing such controls into the Planning Scheme, having regard to the limitations of current evidence and the need to balance the habitat objectives with reasonable expectations for development and use of land within the townships. Some of the elements which may help to support bandicoots in a township environment are inconsistent with contemporary planning and development practice. For example, modern construction methods and energy efficiency standards favour the construction of new houses on concrete slabs rather than stumps. In the absence of compelling scientific evidence that buildings constructed on stumps provide essential habitat for Southern Brown Bandicoots, it is unlikely that it would be feasible to include in the Planning Scheme, controls that mandate that construction specification.

The primary considerations and approach to developing planning controls for the ESO, in relation to the zoning, permitted land uses, and likely development patterns, are discussed below. Specific recommendations for the development and implementation of planning controls are provided in Part B.

8.1.1 General and Neighbourhood Residential Zones

The permitted density of development within the General Residential Zone provides very little scope for the retention of habitat for bandicoots, and there are few planning controls which can be reasonably imposed on these developments, particularly on smaller sub-divisions (i.e. of 2-10 lots). In addition, this density of development typically results in a significant increase in hard-surface area and physical barriers to movement, as well as an increase in domestic animal populations, which is likely to further reduce the likelihood of these areas supporting bandicoots in the long-term.

The objectives for Southern Brown Bandicoot populations in these zones are therefore, to retain (and where possible enhance) some level of permeability within the higher-density urban landscape, which allows bandicoots to forage and move through, and provides some refuge within the built-up areas.

Planning controls should therefore focus on maximising linear connectivity, by contributing to the established network of road reserves, and reducing the number of physical barriers to movement resulting from new developments. Consequently, the proposed controls focus on the provision of habitat areas for bandicoots within front yards, which enables connection with the road reserve. This approach provides residents with unencumbered use of their private open space (behind the front setback), including for keeping domestic animals in an area that can be segregated from the principal bandicoot habitat.

The planning controls proposed for subdivisions and development within the General Residential Zone and Neighbourhood Residential Zone, are uniform across the two Zones. They include requirements for:

- Front setbacks for buildings;
- Landscaping within front setbacks – to provide habitat and refuge areas for bandicoots; and
- Permeable front fencing – to limit the increase in physical barriers to movement at ground level.

8.1.2 Low Density Residential Zone

As in the General Residential and Neighbourhood Residential Zones, the recommended strategy is to develop a township-wide habitat network utilising roadsides and identified strategic habitat links (such as the rail lines and drainage lines). In most cases the main focus will be on the treatment of the front setbacks to enhance habitat connectivity and supplement vegetation within road reserves. However, there is more scope within this landscape to retain habitat elements for bandicoots, through

requirements which encourage the protection of vegetation and replanting or enhancement of vegetation to provide potential bandicoot habitat. The proposed controls for Low Density Residential areas include requirements for:

- Front setbacks for buildings and setbacks from waterways, consistent with the existing Design and Development Overlay;
- Retention of vegetation within setbacks and/or landscaping within setbacks for Southern Brown Bandicoots;
- Permeable fencing (to allow movement at ground level);
- Demonstrating the avoidance of vegetation loss where possible and/or minimisation; and
- Replacement of vegetation losses by replanting on-site to supplement existing habitat links or patches of vegetation (such (re)vegetation must conform to the specification for Southern Brown Bandicoot habitat as described).

8.1.3 Public Use Zone

The Melbourne – Sale Railway line is considered to provide important habitat for local bandicoot populations and is an important landscape link that provides functional connectivity for the movement and dispersal of bandicoots between the townships and surrounding land. The railway corridor is intermittently vegetated with remnant vegetation and dense woody weeds. Zoned as Public Use (Schedule 4), there is potential for maintenance works or transport-related development to result in the removal of Southern Brown Bandicoot habitat, reducing functional connectivity. Planning controls along the railway line should therefore, limit the removal of vegetation that provides potential habitat for bandicoots, and manage the removal of environmental weeds, through requirements to:

- Retain vegetation along the railway line wherever possible, or replace vegetation losses by replanting vegetation along the railway line to provide suitable habitat; and
- Stage weed removal works to ensure they are undertaken in a sensitive manner.

9 Supporting Measures and Incentives

The long-term persistence of Southern Brown Bandicoots within the townships will also depend upon support from the local community, and other measures implemented by Council, to mitigate the potential impacts of increased urban development, that cannot be addressed through the Planning Scheme.

9.1 Roadside Management

Records of Southern Brown Bandicoots within the townships indicate that they regularly use roadside reserves. The retention of vegetation within roadside reserves is not only valuable from an amenity and vegetation protection perspective, but also appears to perform an important function for bandicoots, in providing habitat and opportunities for bandicoots to disperse through the urban matrix. Roadside vegetation is most valuable when it comprises mostly native vegetation; however, weeds such as Blackberry or Gorse may also provide a suitable habitat structure for Southern Brown Bandicoots.

Roadsides form an integral part of the habitat framework that underpins the ESO, by helping to provide the network of habitat opportunities and maintain a level of functional connectivity through the landscape. However, some roadside management practices have the potential to remove habitat for the bandicoot by altering the habitat structure and removing critical elements. For example, weed removal, or slashing of roadsides for maintenance or fire prevention can reduce the complexity of the understorey, making the habitat temporarily unsuitable.

Sensitive management of roadsides to promote bandicoot habitat should be considered as part of a Roadside Vegetation Management Plan for the townships. This may include measures such as:

- Promoting the values of roadside vegetation (including weedy vegetation) and their potential to provide habitat for Southern Brown Bandicoots, through public engagement and education;
- Adopting a risk-based approach to maintenance activities such as slashing and fire prevention, and limiting those activities to the extent that is essential for public safety;
- Development of a management regime which gives consideration to maintaining some areas of refuge habitat for bandicoots at all times, to enable bandicoots to use other habitats if some are temporarily unsuitable;
- Encouraging the natural regeneration of vegetation along roadsides; and
- Habitat enhancement along roadsides identified as strategic links in the township Habitat Framework Plans, to improve the suitability and connectivity of habitat for Southern Brown Bandicoots.

9.2 Bandicoot Friendly Suburbs

The suitability of residential areas for Southern Brown Bandicoots may be enhanced by promoting 'Bandicoot friendly suburbs' within the townships, through public engagement and incentives programs developed by Council. This could include:

- Public education programs to improve the community's general awareness of Southern Brown Bandicoots, and promote living with bandicoots;

- Encouraging habitat enhancement on private land through public engagement and/or incentives, to help sustain bandicoots within residential areas of the townships;
- Domestic animal controls, to mitigate the potential risks of increased predation; and
- Implementing measures to reduce the risks of road mortality for bandicoots.

9.2.1 Public Education

Community perspectives and attitudes on the conservation of environmental values can be important determinants of the success of conservation actions; initiatives which do not have community support are unlikely to be successful (Balmford and Cowling 2006). Therefore, the success of the controls and other strategies in ensuring the persistence of Southern Brown Bandicoots will also rely on the support of the local community to implement conservation measures, and willingness to modify human behaviours.

A public education program to improve the community's general awareness of bandicoots may assist in increasing the willingness of landowners to help conserve the Southern Brown Bandicoot. The public education program should:

- Promote general awareness about bandicoots and provide information on their identification, biology and ecology, and major threats;
- Promote living with bandicoots and highlight the potential benefits of bandicoots in gardens (e.g. invertebrate pest control); and
- Outline ways in which landowners can make their gardens friendly for bandicoots, including:
 - Planting to enhance habitat for bandicoots (see Section 9.2.2, below);
 - Responsible pet ownership; and
 - Reducing or removing outdoor lighting, especially flood lighting in front yards.

9.2.2 Habitat Enhancement

As outlined in Section 5.4, planning controls cannot place requirements on landowners to maintain or enhance habitat for bandicoots, or enforce the management of habitat. Therefore, it is important that Council promote the management of habitat for bandicoots through a public engagement program. The program should encourage landowners to plant gardens which provide low, dense habitat for bandicoots; this does not necessarily need to comprise native species, so long as the suitable structure is provided. Open areas adjacent to dense cover are also important for maintaining the mosaic of dense refuge habitat and open foraging areas; areas of open lawn with relatively moist soil, can provide ideal foraging habitats in residential areas.

Guidelines for revegetation or plantings to enhance habitat for Southern Brown Bandicoots, including a list of recommended native species and suggested planting densities, are given in Section 10.2.

Landowners could also be encouraged to provide artificial shelters for bandicoots (see Section 10.2), particularly landowners which own domestic dogs or cats. Alternate forms of shelter such as rock piles or woodpiles may also be encouraged as part of garden landscaping.

9.2.3 Domestic Animal Control

An increase in residential development is highly likely to increase local populations of domestic animals. Until now, Southern Brown Bandicoots have persisted within these townships, in the presence of domestic animals. However, higher densities of domestic animals may reduce the long-term persistence of bandicoots either directly through predation (especially by cats), or through exclusion of bandicoots from residential properties which contain cats or dogs.

The levels and impacts of predation by domestic animals on Southern Brown Bandicoots are not known. Research, including dietary studies of domestic or uncontrolled (stray or feral) cats, risk analyses, and observational evidence from experts in the field, has shown that predation by domestic animals can have a significant impact on bandicoot populations. However, there has been no evaluation of the population level impacts from predation by domestic animals, in the local area.

The management of domestic animals can be achieved either through local planning instruments, or through mechanisms which focus on responsible ownership of cats and dogs. Planning instruments typically include exclusion zones, which prohibit residents from owning cats or dogs within particular areas, or confinement regulations which require owners to confine domestic animals to their property at all times. The feasibility of introducing exclusion zones into the townships retrospectively, is limited (Grayson et al. 2002, Metsers et al. 2010), and the inclusion of such controls into new developments within the townships is not worthwhile, given the likely levels of pet ownership in established residential areas.

A number of local councils within Australia have implemented cat confinement regulations (see McCarthy 2005). Casey City Council implemented such regulations in 1999, through an Order under Section 25 of the *Domestic (Feral and Nuisance) Animals Act 1994*, which makes it an offence for cats to be found outside of the owners premises at any time. However, these regulations require regular enforcement, which typically involves trapping, undertaken at the discretion of local council (Baker 2001).

Given these limitations, it is recommended that Cardinia Shire Council focus domestic animal management programs on responsible pet ownership, to raise awareness of the impacts of predation by domestic animals on the Southern Brown Bandicoot (and other native fauna), and the value of remaining bandicoot populations within the townships. As part of this program, Council should:

- Encourage pet owners to confine domestic animals to their property, and in particular, keep cats indoors;
- Promote the benefits of keeping cats indoors, including the benefits to Southern Brown Bandicoots, and improved welfare outcomes for cats which arise from the reduced likelihood of illness, injury or death (see McCarthy 2005);
- Encourage pet owners to de-sex cats and dogs; and
- Introduce incentives for owners to register domestic animals, such as providing subsidies for microchips.

9.2.4 Road Mortality

Urban growth is likely to result in increased traffic flows through the townships, and more extensive road networks. The impacts of roads on wildlife, arising from habitat fragmentation and isolation, their effects as physical barriers and filters to movement and road mortality, are well documented, and there is a large body of research on measures to mitigate the potential impacts of roads. The proposed planning controls may help to mitigate the potential loss and fragmentation of habitat associated with road construction. However, the Planning Scheme cannot address associated impacts of increased road mortality or barrier effects. To address these potential impacts, Council may consider other measures.

Measures to address the potential increase in road mortality require a strategic approach, which involves an understanding of the current level of road mortality in the population, and the routes and patterns of fauna movement. The current level of road mortality in the population, and patterns of movement throughout the township are not known. As such, Council may consider establishing and promoting a road mortality register for bandicoots within the townships, to determine whether or not road mortality is likely to be having a significant impact on bandicoot populations. The road mortality register may be used to identify potential movement corridors and identify sites where mitigation measures may be required, based on the frequency of road-kill reports or mortality patterns. Road mitigation measures, such as fencing, reduced speed limits or traffic calming devices can be introduced in 'hot-spot' areas identified from the register.

Council may also consider the benefits of introducing these measures into new subdivisional roads, as part of the permit approvals process, but this should be assessed on case-by-case basis. The major road networks within the townships of Bunyip, Garfield and Tynong are largely established, and the construction of new roads within the townships will most likely be associated with the subdivision of properties, to provide access to dwellings. It is anticipated that most of these roads will comprise minor (municipal) roads and driveways, and that the traffic speeds and volumes on these roads will be relatively low.

Measures to facilitate the movement of Southern Brown Bandicoots across roads must also be considered on a case-by-case basis. For most new subdivisional roads, the barrier effects on bandicoot movement are likely to be relatively low, given their small width and relatively low traffic volumes; thus, the anticipated benefit of incorporating wildlife crossing structures (e.g. underpasses/culverts) is likely to be minimal. However, the incorporation of crossing structures may be considered necessary for the construction of new arterial roads (e.g. Road Category 1), which are likely to present a greater barrier to movement, and higher risk of road mortality (see Section 9.5).

10 Standards and Guidelines

10.1 EPBC Act 1999 Referral Guidelines

The Commonwealth EPBC Act 1999 is Australia's premier environmental legislation, providing a legal framework for the protection and management of nationally and internationally significant environment and heritage values, listed under the Act (DoE 2013). Actions which are likely to have a significant impact on these values require assessment and approval by the federal environment minister. The requirements of the ESO do not remove a proponent's obligations to consider whether a referral to the federal environment minister may be required, under the Act. The EPBC referral guidelines for the Southern Brown Bandicoot can assist in determining whether a referral may be required (DSEWPC 2011, DoE 2013). However, proposed actions are assessed by the minister on individual basis, depending on the particular circumstances of the proposed action, including its precise location, potential direct and indirect impacts and details of proposed mitigation measures.

The guidelines outlined below are intended to be consistent with the EPBC Act guidelines and recommended mitigation measures, wherever possible. However, conditions imposed by the minister under the EPBC Act may be above those required by the ESO; whilst the ESO will assist in mitigating potential impacts of development, considerations under the EPBC Act may be broader.

10.2 Landscaping and Revegetation

10.2.1 Habitat Structure and Composition

Ideal bandicoot habitat comprises a mosaic of shrubby vegetation with a dense understory, and small open patches for foraging, within or adjacent to cover. In landscaping or revegetation, low vegetation, comprising of sedges, small shrubs and rushes should be used to create a dense understorey that provides bandicoots with shelter and nesting sites, and medium-sized shrubs, ideally growing up to 2 m tall (Paull et al. 2013), should be used to form a dense mid-storey that provides additional cover and reduces access by predators.

The understorey should form the dominant component of the habitat; more understorey species should be planted than medium-sized shrubs, and only a few trees should be planted. The understorey should provide at least 50% average foliage cover in the 0.2 – 1 m height range, in order to provide suitable shelter for bandicoots, as outlined in the proposed Schedule to the Overlay. A list of recommended species for planting, and the density at which they should be planted, is provided in Section 10.2.2, below.

The recommended planning controls for the ESO specify landscaping within front setbacks to provide habitat for Southern Brown Bandicoots that meets the specification for bandicoot habitat (see Section 7.2). The recommended planning controls specify a minimum of between 10% and 50% of the setback area, within which vegetation suitable for Southern Brown Bandicoots is to be retained and/or planted, to provide mixture of dense sheltering habitat with open areas (see Part B). This may be provided in the form of interspersed patches of vegetation, or as a single narrower, contiguous strip of vegetation; the requirement allows for flexibility in the layout of landscaping, provided that the plantings afford an appropriate level of cover. A diagram showing two residential subdivisions in the General Residential Zone, incorporating setbacks and landscaping, is given as an example in Figure 8.

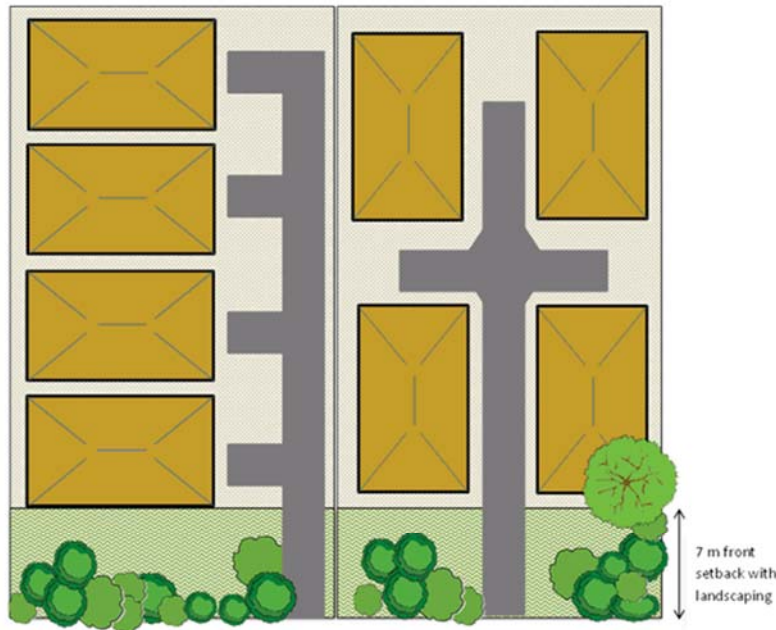


Figure 8 Example of subdivisions in the General Residential Zone, incorporating front setbacks and landscaping

10.2.2 Recommended Planting List

The selection of plant species recommended for landscaping or revegetation, are species which occur within the native vegetation types (EVCs), found within the townships that provide the structure required by Southern Brown Bandicoots. Species listed in Table 1 comprise understorey species that should form the basis of any habitat planting or enhancement for bandicoots. Species in Table 2 include mid-storey species which are specific to the three main vegetation types that occur within the townships, and suitable tree species.

All replanting must meet the habitat requirements of 50-80% foliage density in the 0.2-1 m range (as above). This may be achieved by adhering to the recommended planting densities given in Tables 1 and 2.

Table 1 Understorey species suitable for planting in landscaping or habitat restoration for the Southern Brown Bandicoot

Species Name	Common Name	Planting Density (plants/m ²)
<i>Carex appressa</i>	Tall Sedge	6
<i>Gahnia filum</i>	Chaffy Saw-sedge	6
<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge	6
<i>Juncus pallidus</i>	Pale Rush	6
<i>Lepidosperma laterale</i> var. <i>majus</i>	Variable Sword-sedge	6
<i>Lomandra longifolia</i> ssp. <i>longifolia</i>	Spiny-headed Mat-rush	6
<i>Poa labillardieri</i> var. <i>labillardierei</i>	Common Tussock-grass	6
<i>Goodenia ovata</i>	Swamp Goodenia	3
<i>Correa reflexa</i>	Common Correa	3

Table 2 Mid-storey and canopy species suitable for planting in landscaping or revegetation for Southern Brown Bandicoots within three major Ecological Vegetation Classes

Species Name	Common Name	Planting Density (plants/m ²)
Swamp Scrub		
<i>Medium Shrub</i>		
<i>Coprosma quadrifida</i>	Prickly Currant-bush	1/ 1 m ²
<i>Leptospermum continentale</i>	Prickly Tea-tree	1/ 1 m ²
<i>Leptospermum lanigerum</i>	Woolly Tea-tree	1/ 1 m ²
<i>Melaleuca ericifolia</i>	Swamp Paperbark	1/ 1 m ²
Swampy Riparian Woodland		
<i>Medium Shrub</i>		
<i>Acacia verticillata</i> var. <i>verticillata</i>	Prickly Moses	1/ 1 m ²
<i>Bursaria spinosa</i>	Sweet Bursaria	1/ 1 m ²
<i>Coprosma quadrifida</i>	Prickly Currant-bush	1/ 1 m ²
<i>Leptospermum continentale</i>	Prickly Tea-tree	1/ 1 m ²
<i>Leptospermum lanigerum</i>	Woolly Tea-tree	1/ 1 m ²
<i>Melaleuca ericifolia</i>	Swamp Paperbark	1/ 1 m ²
<i>Tree</i>		
<i>Acacia melanoxylon</i>	Blackwood	1/ 5 m ²
<i>Eucalyptus ovata</i>	Swamp Gum	1/ 5 m ²

Species Name	Common Name	Planting Density (plants/m ²)
<i>Eucalyptus radiata</i>	Narrow-leaf Peppermint	1/ 5 m ²
<i>Eucalyptus viminalis</i>	Manna Gum	1/ 5 m ²
Lowland Forest		
Medium Shrub		
<i>Acacia melanoxylon</i>	Blackwood	1/ 1 m ²
<i>Acacia paradoxa</i>	Hedge Wattle	1/ 1 m ²
<i>Banksia marginata</i>	Silver Banksia	1/ 1 m ²
<i>Leptospermum continentale</i>	Prickly Tea-tree	1/ 1 m ²
<i>Leptospermum myrsinoides</i>	Heath Tea-tree	1/ 1 m ²
Tree		
<i>Eucalyptus obliqua</i>	Messmate Stringybark	1/ 5 m ²
<i>Eucalyptus radiata</i>	Narrow-leaf Peppermint	1/ 5 m ²
<i>Eucalyptus viminalis</i>	Manna Gum	1/ 5 m ²

10.2.3 Staged Weed Control

Some weed management techniques have the potential to remove habitat or reduce suitability for bandicoots through the loss of dense cover and protection provided by the weeds. Where weed species provide suitable habitat for Southern Brown Bandicoots, broad-scale vegetation clearance can result in the complete loss of potential habitat. Following broad-scale clearance, it may be three to five years before native vegetation re-establishes and reaches a stage where it provides the same level of cover, and is once again suitable for bandicoots. In the interim, important habitat elements may have been removed, resulting in temporary habitat loss.

Staged weed control allows for some revegetation prior to total weed removal, so that the layer of cover is replaced without adversely impacting on habitat structure and suitability. Ideally, the level and extent of vegetation replacement will equal the level and extent of vegetation cover removed. However, the timing, staging and techniques for weed removal will depend on the site conditions and weed species requiring control. As an added measure, artificial shelters may be considered as a means of providing temporary refuge for bandicoots, while vegetation is establishing (see Section 10.4).

10.3 Fencing

Habitat that is retained or created for bandicoots must be accessible to bandicoots, in order to be of value in providing shelter and refuge, and contribute to the network of habitat to be developed as part of this strategy. In order for this to occur, front fencing erected as part of new developments must be permeable to bandicoots at ground level; fencing that extends to the ground level has the potential to create major physical barriers to the movement of Southern Brown Bandicoots, and reduces access to potential habitat.

There is no single fence design which is considered to be the best at facilitating the movement of bandicoots, so long as bandicoots are able to pass underneath the fences. The required gap is relatively small; gaps of approximately 10 cm are thought to be sufficient. A variety of fence designs may be acceptable, provided that the design meets the following specifications:

- There is a gap of at least 10 cm between the ground and the first strand/rail or bottom of the fence;
- The posts are spaced at least 20 cm apart; and
- At least 90% of the fence line is open at the ground level.

Fences may be constructed using a combination of materials; however, barbed wire should never be used. An example of one possible fence design, which conforms to the specified dimensions, is provided in the diagram below (Figure 9).

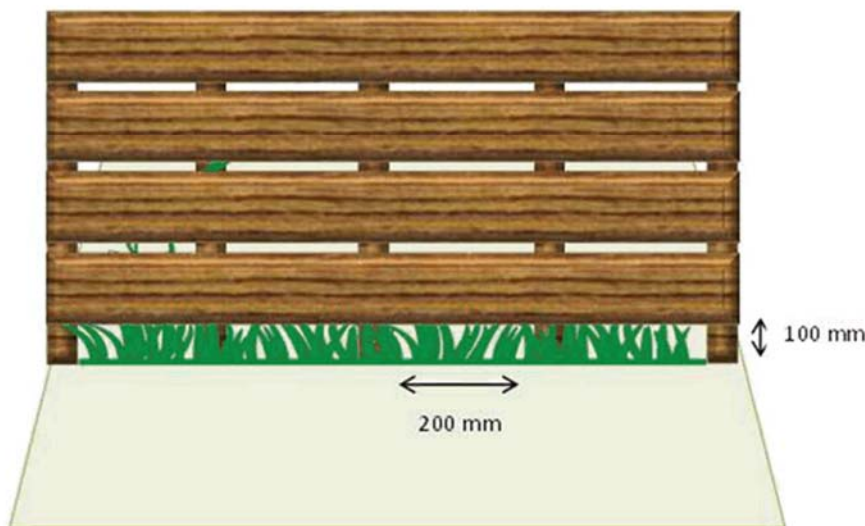


Figure 9 Example of a fence design that meets the required standard

10.4 Artificial Shelters

Southern Brown Bandicoots rely on dense vegetation cover and other structures such as woody debris (i.e. log piles) or disused animal burrows, to provide shelter and refuge from predation (Claridge 1988, Ecotone 2003, Long 2009). The availability of appropriate shelter and refuge sites is critical to reducing the predation pressure on Southern Brown Bandicoots, and enabling their persistence, especially in modified landscapes. Ideally, dense vegetation, with an average of 50-80% foliage cover in the 0.2-1 m height range, will provide shelter and protection from predators (DSEWPC 2011). However, artificial structures may be required to provide additional refuge sites and enhance the quality of habitat, particularly as vegetation is establishing or where vegetation patches are small and narrow.

Southern Brown Bandicoots have been known to use a range of artificial structures within the townships, including cavities beneath houses, sheds and scrap wood-piles, as sheltering and nesting sites. These structures not only supplement the availability of sheltering resources, but may provide a superior form of protection.

The intensification of residential development, which will involve reduction in lot sizes, reduction in yard size and loss of garden sheds, and construction of new houses on concrete slabs, is likely to reduce the availability of these resources. These changes cannot be dealt with in the Planning Scheme. However, alternative artificial shelters can be provided. Recommendations for these are given below.

10.4.1 Bandicoot Hides

Artificial shelters (i.e. bandicoot hides) are specifically designed wooden structures that provide access and cover for bandicoots, but exclude larger, predatory animals such as foxes, to provide shelter and refuge for bandicoots. They may be used to enhance habitat quality in residential areas, and may be particularly useful in providing temporary shelter while vegetation is establishing.

The use of bandicoot hides has been trialled in a number of locations, using several different designs. The trials have provided little direct evidence that these shelters are used; however, the use of other artificial structures by bandicoots, suggests that they may be effective. There is no evidence to-date of which designs are likely to be most effective.

Provided below are guidelines for the construction for a standard wooden shelter designed by ABZECO (see Figure 10; Plates 9 and 10). However, other shelters, including simpler wooden designs, wire and mesh constructions, and wood piles have all been trialled, and may be cheaper to construct.

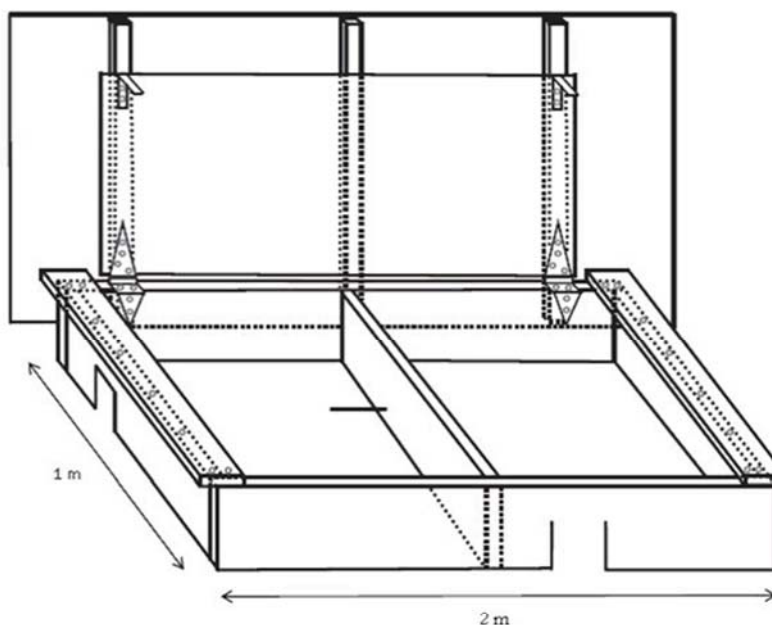


Figure 10 Design specifications for a standard bandicoot hide (ABZECO design)

Construction Guidelines

The following provides guidelines for the construction of bandicoot hides based on the ABZECO design:

- Bandicoot shelters should be constructed from untreated pine planks fastened into a rectangular frame (2 m X 1 m) with a partition in the middle to form two chambers (see Plates 9 and 10);
- A sheet of corrugated tin slightly larger than wooden frame should be screwed onto smaller sheet of ply to provide a roof. Sharp edges should be covered with rubber hose;
- The roof should be attached to the frame with hinges to allow access for inspections;
- An entrance hole, around 10 cm in diameter, should be provided at the base, at each end of the frame, one leading into each chamber; and
- Once in position, the shelter should be secured to the ground with short star pickets bolted to the inside of the frame in each corner.



Plate 9 Southern Brown Bandicoot hide with open roof (photo: ABZECO)



Plate 10 Southern Brown Bandicoot hide with closed roof, showing entrance (photo: ABZECO)

10.5 Fauna Underpasses

Fauna underpasses have been installed under a number of roads across Australia, to permit the movement of mammals, including bandicoot species, to mitigate potential impacts associated with roads, such as habitat fragmentation and isolation. A number of bandicoot species, including the south-western subspecies of the Southern Brown Bandicoot (*I. o. fusciventer*), have been recorded using these underpasses. However, evidence of their overall effectiveness in not only facilitating the regular and on-going movement of bandicoots under roads, but also in maintaining gene flow and other aspects of population ecology, is limited. As such, the construction of fauna underpasses beneath roads within the three townships must be carefully considered, on the basis of a detailed assessment of potential impacts on which to base design considerations.

Fauna underpasses may be considered as an appropriate mitigation measures for major new roads (e.g. Road Zone Category 1) to be constructed either within the townships, or on the outskirts of the townships. In these cases, consideration of underpasses must be made at the early planning phase. The location of the underpass must consider broader landscape factors, including its placement relative to the location and suitability of habitat or fauna movement patterns. In fragmented landscapes, in particular, where small patches of habitat remain in narrow linear remnants, animals may have limited opportunities for movement through the landscape. Therefore, to maximise the likelihood of bandicoots using underpasses:

- The location of the proposed crossing should be placed along known or likely movement routes or in areas identified as road-kill hot-spots; and
- Underpasses should connect areas of suitable or potential habitat.

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The specific design of the underpasses will be influenced by a number of site factors. However, several factors are considered to influence the success of fauna underpasses in general. To ensure that the design maximises the potential for movement by Southern Brown Bandicoots, the design should incorporate the following elements (see also Figure 11):

- Underpass entrances should be vegetated on both sides of the road to direct fauna beneath the road toward to the culverts. The vegetation should provide suitable cover for bandicoots, and may include other habitat elements that provide shelter (e.g. rock/log piles) at the entrances;
- Entrances should not be located beneath street lights or where there is likely to be significant human disturbance;
- Fauna furniture (sheltering structures) should be placed within the underpass, to maintain dry passage and reduce exposure to predation. Fauna furniture should be placed along the entire length of the underpass and have connection to the surrounding habitat;
- Underpass dimensions, including height, width, length and relative aperture should ensure that light penetrates the underpass;
- Drainage requirements should be assessed to ensure that the underpass provides dry passage — separate culverts should be considered for fauna passage and hydrology;
- The substrate should mirror surrounding substrates as far as possible — a concrete base should be covered with natural materials such as logs, soil or mulch; and
- Wildlife fencing should be used guide fauna into underpasses.

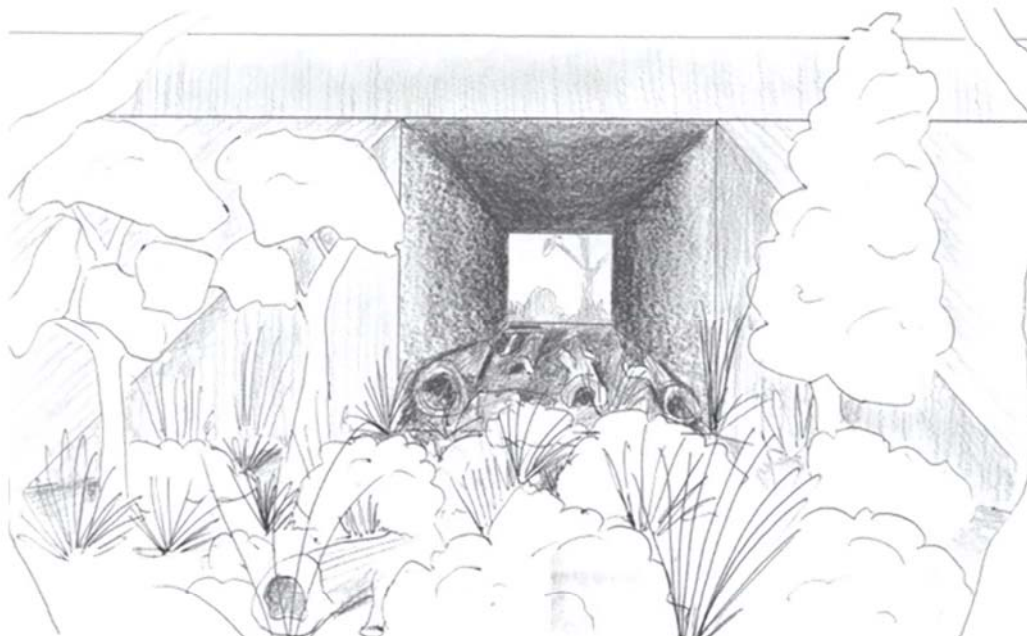


Figure 11 Example underpass for Southern Brown Bandicoots

PART B – Planning Recommendations

11 Recommended Planning Provisions

Application of an ESO over the townships would in the first instance create additional potential planning permit triggers for a development, except where exemptions are specified. To provide certainty to landholders and minimise the requirements for formal approvals, it is recommended that the ESO for the townships is drafted to exempt development that complies with standardised requirements that are specified in the schedule to the ESO.

The measures proposed here provide pathways for which formal permit applications are not required, provided that particular conditions are met and adhered to. The conditions focus on: minimising vegetation/habitat loss; reducing the number of potential barriers; increasing habitat connectivity through the landscape; and encouraging the replanting or enhancement of bandicoot habitat, in strategic areas to supplement habitat and habitat connectivity.

The recommended ESO is underpinned by a Habitat Framework Plan for each township (Figures 12 – 14). The plans show the strategic habitat network in each town that will be protected, and where possible enhanced, by the implementation of the ESO. Guidelines and standards for habitat and enhancement and other measures specified in the controls are detailed in Part A, Section 9, and as far as possible, are consistent with the Southern Brown Bandicoot EPBC Referral Guidelines (DSEWPC 2011).

11.1 Proposed Schedule to the Environmental Significance Overlay

Statement of Environmental Significance

The Southern Brown Bandicoot (*Isododon obesulus obesulus*) is a medium-sized ground dwelling marsupial which has declined significantly in abundance and distribution since European settlement. It is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*.

Formerly widespread across south-central Victoria it has disappeared from many urban and agricultural areas around Melbourne. Townships in Cardinia, including Bunyip, Garfield and Tynong, support some of the last remaining populations of Southern Brown Bandicoots in the region. The protection of habitat for this species is essential to provide for the long-term survival of bandicoots in the area.

The Southern Brown Bandicoot requires low, dense vegetation, with a ground cover of greater than 50% average foliage density within the 0.2-1m height range. This structure is important for providing protection from predators and local environmental conditions, whilst providing some room to move at ground level. The preferred structure may be provided by native or exotic vegetation, including weeds such as Blackberry, Gorse or Broom. These weeds can play an important role in facilitating the survival and dispersal of bandicoots in modified or degraded habitats.

Environmental objectives to be met

- To protect current and potential habitat for the Southern Brown Bandicoot
- To provide for the movement of Southern Brown Bandicoots through the landscape, by maintaining and enhancing local habitat links
- To encourage strategic regeneration and enhancement of Southern Brown Bandicoot habitat, using suitable species, to provide for the long-term maintenance of populations

- To ensure that subdivision and development proposals have proper regard to Southern Brown Bandicoots and Southern Brown Bandicoot habitat

General Residential Zone and Neighbourhood Residential Zone	
Permit Requirements	Subdivision of Land A permit is not required for subdivision, provided that: <ul style="list-style-type: none"> ▪ a building exclusion zone at least 7m deep is provided along the frontage of any lot abutting a road or strategic habitat link identified in the relevant township habitat framework plan; and ▪ the building exclusion zone is included as a restriction on the plan of subdivision; and ▪ the owner of the land enters into an agreement under section 173 of the <i>Planning & Environment Act 1987</i> that requires: <ul style="list-style-type: none"> ○ prior to the commencement of development of a dwelling on a lot the preparation of a landscape plan that shows landscaping that conforms to the standard for habitat for the Southern Brown Bandicoot and covers a minimum of 50% of the front setback area of the lot; and ○ that the landscaping must be completed prior to the occupation of the dwelling, except with the written approval of the Responsible Authority; and ○ that the habitat must be maintained to the satisfaction of the Responsible Authority.
	Buildings and Works A permit is not required to construct a building or carry out works, provided that all of the following conditions are met: <ul style="list-style-type: none"> ▪ Any building has a minimum setback of 7m from the lot frontage; and ▪ Prior to the commencement of the use of any permanent building on the lot, landscaping is provided that conforms to the standard for habitat for the Southern Brown Bandicoot and covers a minimum of 50% of the front setback area, in accordance with a landscape plan prepared to the satisfaction of the Responsible Authority; ▪ Any fence along or within 7m of the lot frontage is permeable to a height of at least 100 mm above ground level; and ▪ Building access and driveways are located to avoid or minimise loss of roadside vegetation and have a maximum width of 6 m or 20% of the frontage, whichever is greater, to the satisfaction of the Responsible

General Residential Zone and Neighbourhood Residential Zone	
Information Requirements for Permit Applications	<p>Authority.</p> <p>A permit is not required for extension to an existing dwelling or outbuilding, provided that no part of the building is closer than 7 m to the lot frontage</p>
	<p>Vegetation Removal</p> <p>A permit is required to remove vegetation which meets the specifications for potential bandicoot habitat, if:</p> <ul style="list-style-type: none"> ▪ The vegetation is located within the front setback; or ▪ Is located in or adjacent to a habitat area identified on the relevant township habitat framework plan
	<p>Subdivision of Land</p> <ul style="list-style-type: none"> ▪ A plan demonstrating how the habitat zone required along each lot frontage together with the associated Southern Brown Bandicoot habitat plantings can be accommodated within the land. ▪ A statement describing the reasons for varying the front setback from the standard and how the proposed alternative front setback can satisfy the objectives of the Environmental Significance Overlay
	<p>Buildings and Works</p> <ul style="list-style-type: none"> ▪ A development plan showing: <ul style="list-style-type: none"> – Existing vegetation within the site – Building envelope and driveway to the building envelope – Building setbacks ▪ A landscape plan for land in the front setback and within 10m of any waterway or habitat link shown in the township habitat plan, showing the location, area and species of existing and proposed planting, and a maintenance program to ensure successful establishment of the habitat ▪ Details of proposed fencing, including location, design and materials ▪ A statement describing the reasons for varying the front setback from the standard and how the proposed alternative front setback can satisfy the objectives of the Environmental Significance Overlay
	<p>Vegetation Removal</p> <ul style="list-style-type: none"> ▪ A description of the location, extent and type of vegetation to be removed (including the understorey), accompanied by photographs ▪ Demonstration of steps taken to:

General Residential Zone and Neighbourhood Residential Zone	
	<ul style="list-style-type: none"> – Avoid vegetation removal where possible – Minimise the removal of vegetation – Appropriately replace the loss of vegetation <ul style="list-style-type: none"> ▪ A landscape plan showing the location, area and species of replacement planting, and a maintenance program to ensure successful establishment of the habitat
Decision Guidelines	<p>Subdivision of Land</p> <ul style="list-style-type: none"> ▪ Whether the proposed building exclusion zone on each lot is of sufficient dimensions and area to accommodate existing and proposed vegetation required for Southern Brown Bandicoot habitat, is consistent with the township habitat framework plan, and will meet the objectives of the Environmental Significance Overlay. <p>Buildings and Works</p> <ul style="list-style-type: none"> ▪ Whether the dimensions and area of land within the proposed front setback are sufficient to accommodate Southern Brown Bandicoot habitat ▪ Whether the proposed removal of existing vegetation within the front setback (that meets Southern Brown Bandicoot habitat criteria) is appropriate and can be adequately compensated for ▪ Whether the proposed landscaping will provide appropriate habitat, including with respect to the location of the planting in relation to roadside areas and other adjacent land, the suitability of plant species, planting densities and proposed maintenance of the landscaping ▪ Fence design and permeability at ground level ▪ Whether driveway crossings and pedestrian access are located to avoid or minimise vegetation loss within the road reserve <p>Vegetation removal</p> <ul style="list-style-type: none"> ▪ Whether the removal or loss of any vegetation that is suitable for Southern Brown Bandicoots could be avoided ▪ Whether adequate provision has been made to maintain or establish vegetation elsewhere on the property ▪ The benefit of replanting to replace vegetation losses ▪ Whether the proposal is consistent with the maintenance or creation/enhancement of a habitat link or area shown in the township habitat plan

Low Density Residential Zone	
Permit Requirements	<p>Subdivision of Land</p> <p>No permit is required for subdivision, provided that:</p> <ul style="list-style-type: none"> ▪ A building exclusion zone at least 30 m deep is provided along the frontage of any lot abutting a Road Zone Category 1; and ▪ A building exclusion zone at least 20 m deep is provided along the frontage of any lot abutting a Road Zone Category 2; and ▪ A building exclusion zone at least 10 m deep is provided along the frontage of any lot abutting any other road or strategic habitat link identified in the relevant township habitat framework plan; and ▪ A building exclusion zone at least 30 m deep is provided along any property boundary abutting a waterway; and ▪ Any building exclusion zone is included as a restriction on the plan of subdivision; and ▪ the owner of the land enters into an agreement under section 173 of the <i>Planning & Environment Act 1987</i> that requires: <ul style="list-style-type: none"> ○ prior to the commencement of development of a dwelling on a lot the preparation of a landscape plan that shows landscaping that conforms to the standard for habitat for the Southern Brown Bandicoot and achieves the minimum site coverage specified for setbacks from lot frontages and waterways; and ○ that the landscaping must be completed prior to the occupation of the dwelling, except with the written approval of the Responsible Authority; and ○ that the habitat must be maintained to the satisfaction of the Responsible Authority. <p>Buildings and Works</p> <p>A permit is not required to construct a building or undertake works, provided that all of the following conditions are met:</p> <ul style="list-style-type: none"> ▪ All buildings are set back at least: <ul style="list-style-type: none"> – 30 m for Road Zone Category 1 – 20 m from Road Zone Category 2 – 10 m from any other road – 30 m from a waterway ▪ Existing vegetation on the lot that meets the criteria for Southern Brown Bandicoot habitat is retained, or replaced with an equivalent area of

Low Density Residential Zone	
	<p>Southern Brown Bandicoot habitat plantings located adjacent to areas of existing habitat or the habitat zone in the front setback</p> <ul style="list-style-type: none"> ▪ Landscaping to a standard suitable for Southern Brown Bandicoots is provided within the front setback, covering: <ul style="list-style-type: none"> – At least 50% of the area of a 10 m deep setback – At least 30% of the area of a 20 m deep setback – At least 25% of the area of a 30 m deep setback ▪ Landscaping to a standard suitable for Southern Brown Bandicoots is provided to at least 50% of the area within 10 m of a waterway ▪ Fencing to a road frontage, waterway or habitat link shown on the township habitat plan is permeable to a height of at least 100 mm above ground level ▪ Existing vegetation within the property proposed for removal is replaced through replanting of an area equivalent to the loss elsewhere on the property ▪ All replacement vegetation is of a standard suitable for Southern Brown Bandicoots, and is connected to an area of existing vegetation within or adjoining the property: <ul style="list-style-type: none"> – Replanted areas connect with the front setback or to a habitat area or link or waterway setback identified on the relevant township habitat plan – Where the property adjoins a habitat area, link or waterway, as shown on the associated plan, replanting should contribute to the continuity and integrity of the link or habitat area. ▪ Building access and driveways are located to avoid or minimise loss of roadside vegetation and have a maximum width of 6 m or 20% of the frontage, whichever is greater, to satisfaction of the responsible authority ▪ No extension to an existing dwelling or outbuilding is constructed within the designated road or waterway setbacks
	<p>Vegetation Removal</p> <p>A permit is required to remove vegetation. This does not apply to vegetation that does not meet the specifications for bandicoot habitat</p>
Information Requirements for Permit Applications	<p>Subdivision of Land</p> <ul style="list-style-type: none"> ▪ A plan demonstrating how the habitat zone along each lot frontage together with the associated Southern Brown Bandicoot habitat plantings can be accommodated within the land ▪ A statement describing the reasons for varying the dimensions or area of

Low Density Residential Zone	
	<p>Southern Brown Bandicoot habitat from the standard, and explaining how the proposed alternative can satisfy the objectives of the ESO</p>
	<p>Buildings and Works</p> <ul style="list-style-type: none"> ▪ A site plan, drawn to scale, showing: <ul style="list-style-type: none"> – Building envelope and driveway to the building envelope – Setbacks to property boundaries – The location, type and extent of existing vegetation on the property, including photographs ▪ A landscape plan for land in the front setback and within 10m of any waterway or habitat link shown in the township habitat plan, showing the location, area and species of existing and proposed planting, and a maintenance program to ensure successful establishment of the habitat ▪ Details of proposed fencing, including location, design and materials ▪ A statement describing the reasons for varying from the standard the front setback of any building and how the proposed alternative front setback can satisfy the objectives of the Environmental Significance Overlay
	<p>Vegetation Removal</p> <ul style="list-style-type: none"> ▪ A description of the location, extent and type of vegetation to be removed (including the understorey), accompanied by photographs ▪ Demonstration of steps taken to: <ul style="list-style-type: none"> – Avoid vegetation removal where possible – Minimise the removal of vegetation – Appropriately replace the loss of vegetation ▪ A landscape plan showing the location, area and species of replacement planting, and a maintenance program to ensure successful establishment of the habitat
Decision Requirements	<p>Subdivision of Land</p> <ul style="list-style-type: none"> ▪ Whether the proposed building exclusion zone(s) on each lot is of sufficient dimensions and area to accommodate existing and proposed vegetation required for Southern Brown Bandicoot habitat, is consistent with the township habitat framework, and will meet the objectives of the ESO
	<p>Buildings and Works</p> <ul style="list-style-type: none"> ▪ Incorporation of appropriate boundary setbacks ▪ Proposed landscaping, including the suitability of plant species and planting densities ▪ Fence location and design

Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay

**Low Density Residential Zone****Vegetation Removal**

- Whether the removal or loss of any vegetation that is suitable for Southern Brown Bandicoot habitat could be avoided
- Whether adequate provision has been made to maintain or establish vegetation elsewhere on the property
- The benefit of replanting to replace vegetation losses
- Whether the proposal is consistent with the maintenance or creation/enhancement of a habitat link or area shown in the township habitat plan

Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay



Public Use Zone 4 – Transport	
Permit Requirements	<p>Vegetation Removal</p> <p>A permit is required to remove vegetation. This does not apply if:</p> <ul style="list-style-type: none"> ▪ The vegetation does not support habitat elements suitable for the Southern Brown Bandicoot, or ▪ The area of vegetation to be removed is replaced by replanting of an equivalent area that conforms to the specification for Southern Brown Bandicoot habitat and is located within or adjacent to the railway corridor, or ▪ The vegetation removal involves the staged removal of environmental weeds, and a management plan is prepared to the satisfaction of the Responsible Authority demonstrating that appropriate Southern Brown Bandicoot habitat will be maintained during the weed removal works and the area will be revegetated using indigenous species with a suitable habitat structure for bandicoots
Information Requirements for Permit Applications	<p>Vegetation Removal</p> <ul style="list-style-type: none"> ▪ A description of the location, extent and type of vegetation to be removed (including the understorey), accompanied by photographs ▪ Demonstration of steps taken to: <ul style="list-style-type: none"> – Avoid vegetation removal where possible – Minimise the removal of vegetation – Appropriately replace the loss of vegetation ▪ A landscape plan showing the location, area and species of replacement planting, and a maintenance program, to ensure successful establishment of the habitat.
Decision Guidelines	<p>Vegetation Removal</p> <ul style="list-style-type: none"> ▪ Whether the removal or loss of any vegetation that is suitable for Southern Brown Bandicoots could be avoided ▪ Whether adequate provision has been made to maintain or establish vegetation elsewhere on the property ▪ The benefit of replanting to replace vegetation losses ▪ Whether the proposal is consistent with the maintenance or creation/enhancement of a habitat link or area shown in the township habitat plan

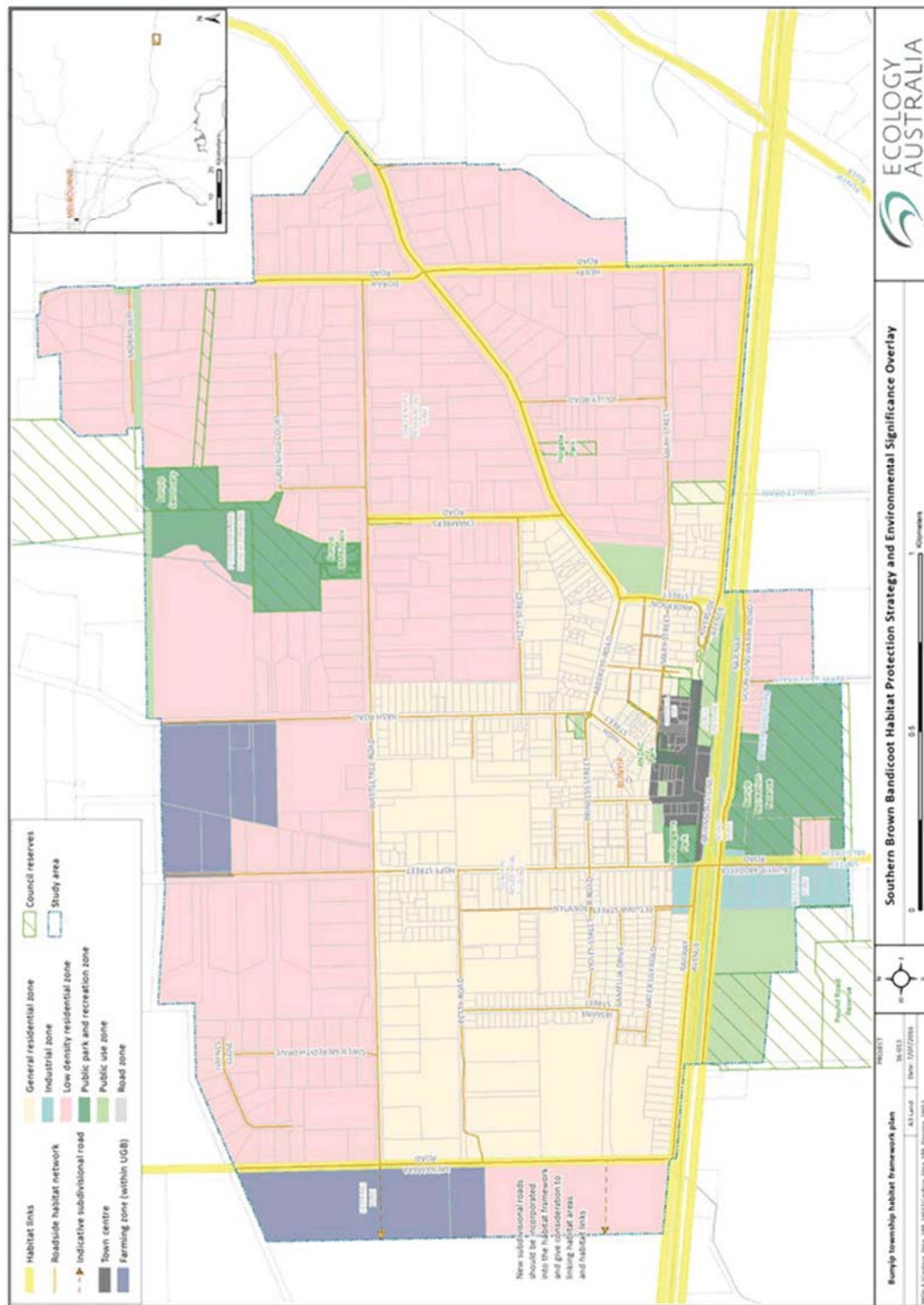


Figure 12 Bunyip township habitat framework plan

Final

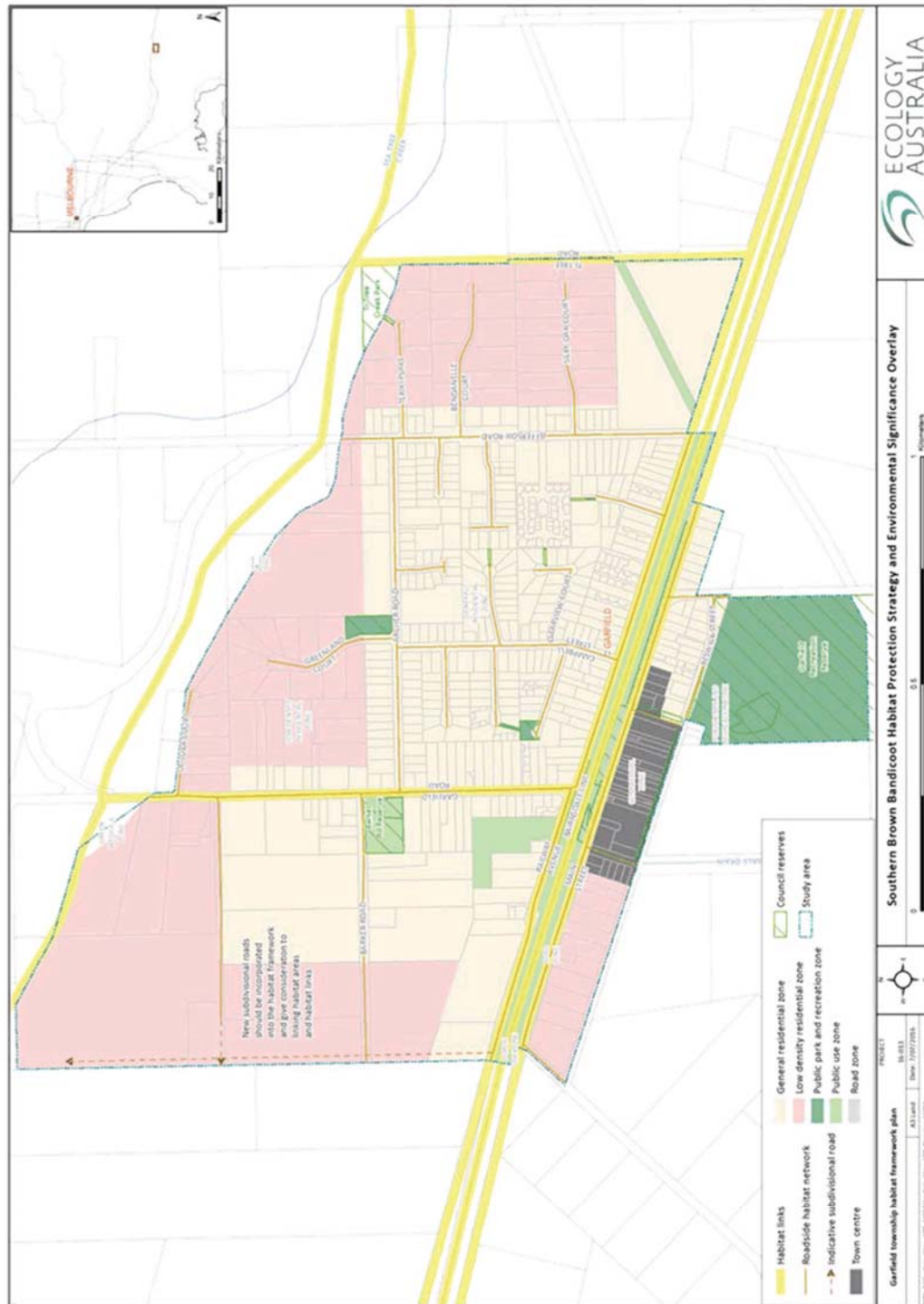


Figure 13 Garfield township habitat framework plan



Figure 14 Tynong township habitat framework plan

Final

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13 Glossary

Biodiversity	The variety of all life-forms, plants, animals, fungi, protists (including algae) and bacteria, their encoded genes, and the ecosystems of which they form a part
Bioregion	Defined geographical regions of Australia with similar climatic and geophysical characteristics, and which generally contain a suite of distinct ecosystems and species
Dispersal	Movement away from an existing population or area of habitat, to another.
Ecological Vegetation Class (EVC)	A vegetation classification described through a combination of its floristic composition, life form and ecological characteristics, and its association with particular environmental attributes. EVCs may include one or more floristic communities that occur across a biogeographic range, and have similar habitat and ecological processes operating
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
Exotic	Plants, animals, fungi and other organisms that have been introduced (deliberately or accidentally) to Australia or a given area after European settlement
Exotic vegetation	Vegetation comprised wholly or substantially of exotic species
FFG Act	Victorian <i>Flora and Fauna Guarantee Act 1988</i>
Floristic	Of or pertaining to plant species, i.e. flora
Gestation	The period of development between conception and birth
Indigenous	Plant and animal species found naturally in pre-European Australia
Introduced	Deliberately or accidentally brought to Australia or part of Australia, usually by human agency
Native vegetation	Species occurring naturally in Australia as part of the pre-European flora or fauna
Vegetation community	Term for interacting plant populations forming vegetation. A vegetation community in formal classifications may have characteristic plant species, composition and structure

Appendix 1 Southern Brown Bandicoot Distribution Records

Records of Southern Brown Bandicoot presented in this report have been combined from three sources, to present the most up-to date information available. They comprise records from:

1. Department of Environment, Land, Water and Planning (2016, unpubl. data) — Records provided in this report are primarily from the database developed to undertake modelling of Southern Brown Bandicoots across the state. This database is consistent with the Victorian Biodiversity Atlas, a web-based information system that provides the primary platform for recording and managing information about wildlife in Victoria (DELWP 2016). However, the data has been vetted using data filters to remove unreliable records based on spatial accuracy and observer reliability.
2. Cardinia Shire Council — Additional records were provided for the three townships from Cardinia Shire Council's database, which includes records from various sources.
3. Biosis (2013) — Surveys around Tynong were undertaken by Biosis (2013), to inform development of the Sub-regional Strategy for Southern Brown Bandicoots as part of the strategic assessment for Melbourne's Growth Areas. Records are taken from the mapping provided in the accompanying report.

CARDINIA PLANNING SCHEME

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C229**SCHEDULE 7 TO 42.01 ENVIRONMENTAL SIGNIFICANCE OVERLAY**Shown on the planning scheme map as **ES07**.**SOUTHERN BROWN BANDICOOT CONSERVATION AREA****1.0 Statement of environmental significance**--/20--
C229

The Southern Brown Bandicoot Conservation Area comprises the townships of Bunyip, Garfield and Tynong and the key conservation links between them. These towns and their linkages are important habitat for the endangered Southern Brown Bandicoot (*Isoodon obesulus obesulus*).

2.0 Environmental objective to be achieved--/20--
C229

To minimise adverse impacts resulting from the use and development of land on the Southern Brown Bandicoot by maintaining, enhancing and connecting key habitat linkages.

3.0 Permit requirement--/20--
C229

A permit is not required to:

- Construct a building or carry out works within an approved building envelopes or located outside the setback listed in table 1. This applies to crossovers where it is the single crossover for the property and is 3 metres or less in width or 20% of the frontage of the lot whichever is lesser.
- To remove native or non-native vegetation:
 - Below 11 square metres in area (this includes environmental weeds) unless it is within a designated landscape area shown on permit, subdivision or title plan or within a designated habitat corridor (see figures 1, 2 and 3).
- Carry out works undertaken by a public agency in accordance with an approved Southern Brown Bandicoot Management Plan.
- For a fence within the front setback with a 100mm gap along the bottom for a minimum 50% of the width of the frontage.

Table 1. Setbacks and vegetation requirements

Zone	Front Setback	Road Zone Category 1 or waterway	Road Zone Category 2	Minimum Landscaping Requirements
Low Density Residential	10m	30m	20m	50% of 10m setback, 30% of 20m setback and 25% of 30m setback.
General Residential Zone	7m	N/A	N/A	50% of setback.
Neighbourhood Residential Zone	7m	N/A	N/A	50% of setback.

CARDINIA PLANNING SCHEME

Application requirements

An application must be accompanied by the following information:

- The location of any existing buildings and works, existing vegetation, waterways and the status of the road fronting the development.
- Details of the location and extent of any earthworks.
- The location of any existing vegetation, including understorey, proposed to be removed or adjacent to the property
- A photograph or site plan (drawn to scale) showing the boundaries of the site, existing vegetation and the vegetation to be removed.
- A description of the vegetation to be removed, including the species, extent, number and size (diameter at 1.3 metres above natural ground level) of any trees to be removed and the Ecological Vegetation Class of native vegetation.
- A written explanation of the steps that have been taken to:
 - Avoid the removal of vegetation, where possible.
 - Minimise the removal of vegetation.
 - Appropriately replace, and or/compensate for the loss of vegetation, if required
- A copy of any property vegetation plan or similar requirement that applies to the site.
- Where a permit is required as a consequence of the front setback requirements of this schedule a plan demonstrating landscaping within the front setback must be provided.
- Where the removal, destruction or lopping of vegetation is to create defendable space, a statement explaining why removal, destruction or lopping of vegetation is required having regard to other available bushfire risk mitigation measures. This does not apply to the creation of defendable space in conjunction with an application under the Bushfire Management Overlay.
- A Section 173 Agreement or similar will generally be required to accurately ensure areas and measures to protect bandicoots are identified and protected into the future.

The application requirements may be waived or reduced to the satisfaction of the responsible authority.

4.0**Decision guidelines**

--(20--
C229

The following decision guidelines apply to an application for a permit under Clause 42.01, in addition to those specified in Clause 42.01 and elsewhere in the scheme which must be considered, as appropriate, by the responsible authority:

- Consistency with the objectives of the overlay and the key habitat corridors outlined in figures 1, 2 and 3.
- The primacy of maintaining, enhancing and connecting habitat corridors (outlined in figures 1, 2 and 3) by minimising development within or through these areas.
- The ability to provide suitable planting for bandicoot habitat adjacent to identified habitat corridors to provide additional buffers to these areas. The maximum desirable width is 40m for habitat corridors containing roads or railway lines and 30 metres either side of a waterways.
- The ability to provide roads or pathways with adjacent habitat plantings on the edge of the urban growth boundary to provide habitat corridors to offset loss and fragmentation of habitat.
- The ability to provide suitable bandicoot habitat within road reserves.
- The ability to minimise the impacts of vehicles access through identified key habitat corridors by using service roads, shared crossovers or alternative road connections.

CARDINIA PLANNING SCHEME

- The ability to minimise fragmentation of habitat by road networks by:
 - Constructing roads with a maximum width of 7.6m including kerbing if within habitat links.
 - Planting native vegetation to connect bandicoot habitat within road reserves.
 - Using vegetated swale drains.
 - Providing appropriate bandicoot crossings for roads and crossovers
 - Utilising combined pedestrian and vehicle accessways with a carriageway width of 5.5m in appropriate locations.
 - 2.5m wide shared path or 1.5m footpaths on one side of roads only:
- Whether the impacts of the proposal within setbacks can be compensated for either on site or in adjacent land including road reserves.
- Whether proposed landscaping will provide appropriate habitat, including with respect to the location of the planting in adjacent areas, suitability of plant species, planting densities and proposed maintenance.
- The impact on native flora and fauna habitats.
- The extent of any proposed removal or replacement of vegetation, and the location of any buildings and works, in particular:
 - The desirability of retaining or establishing a buffer of native vegetation adjoining waterways, natural drainage lines, along roads and any existing vegetation along roads and property boundaries.
 - Whether the vegetation has been identified as being of environmental significance.
- Whether the ecological values and environmental characteristics will be enhanced.
- Measures to prevent environmental degradation by noxious and environmental weeds and pest animals.
- Consistency of landscaping with the requirements of table 1 and the reference document.

Reference Document

- Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay (Part A) February 2017 (Ecology Australia)

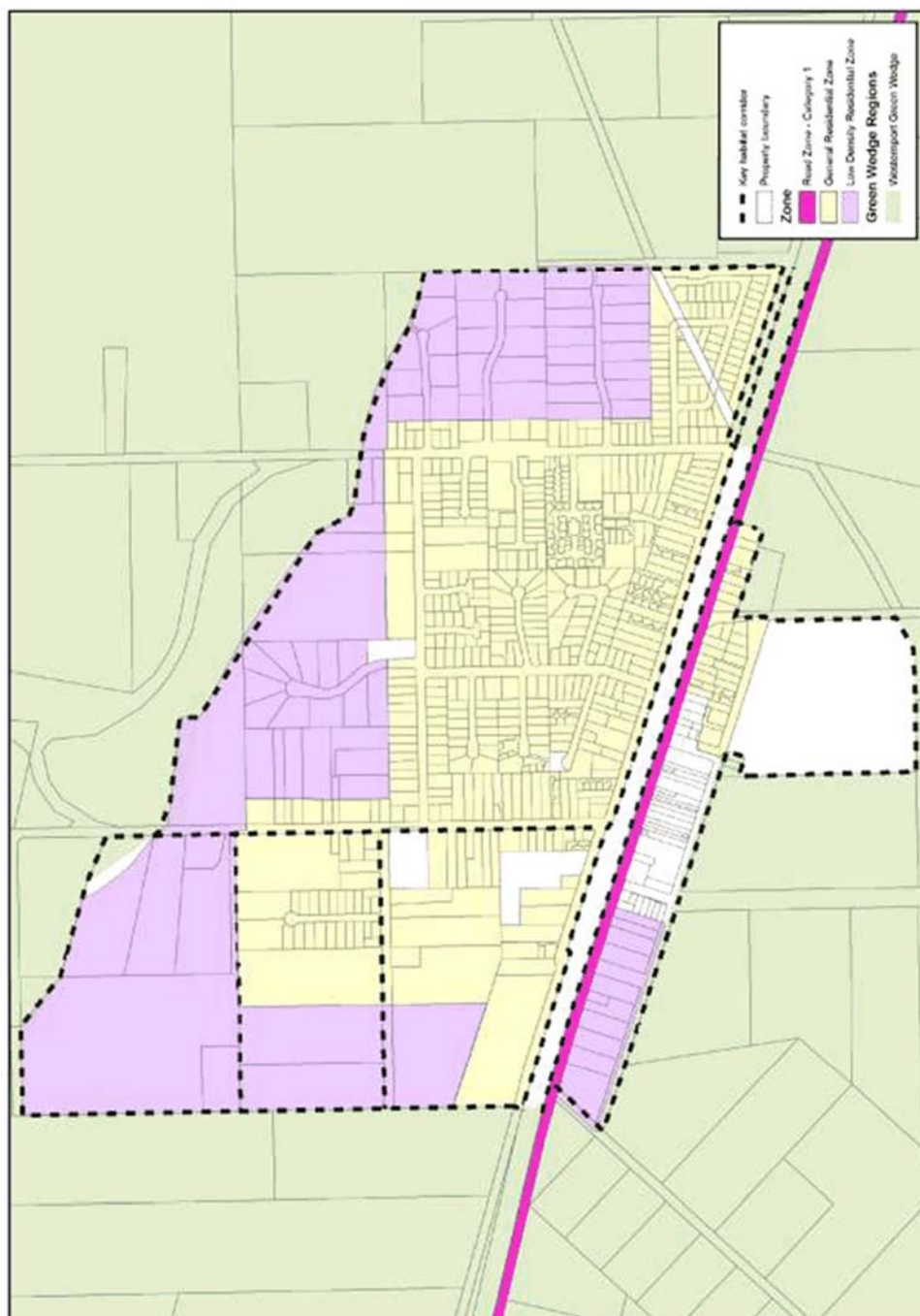
CARDINIA PLANNING SCHEME

Figure 1. Key habitat corridors Tynong



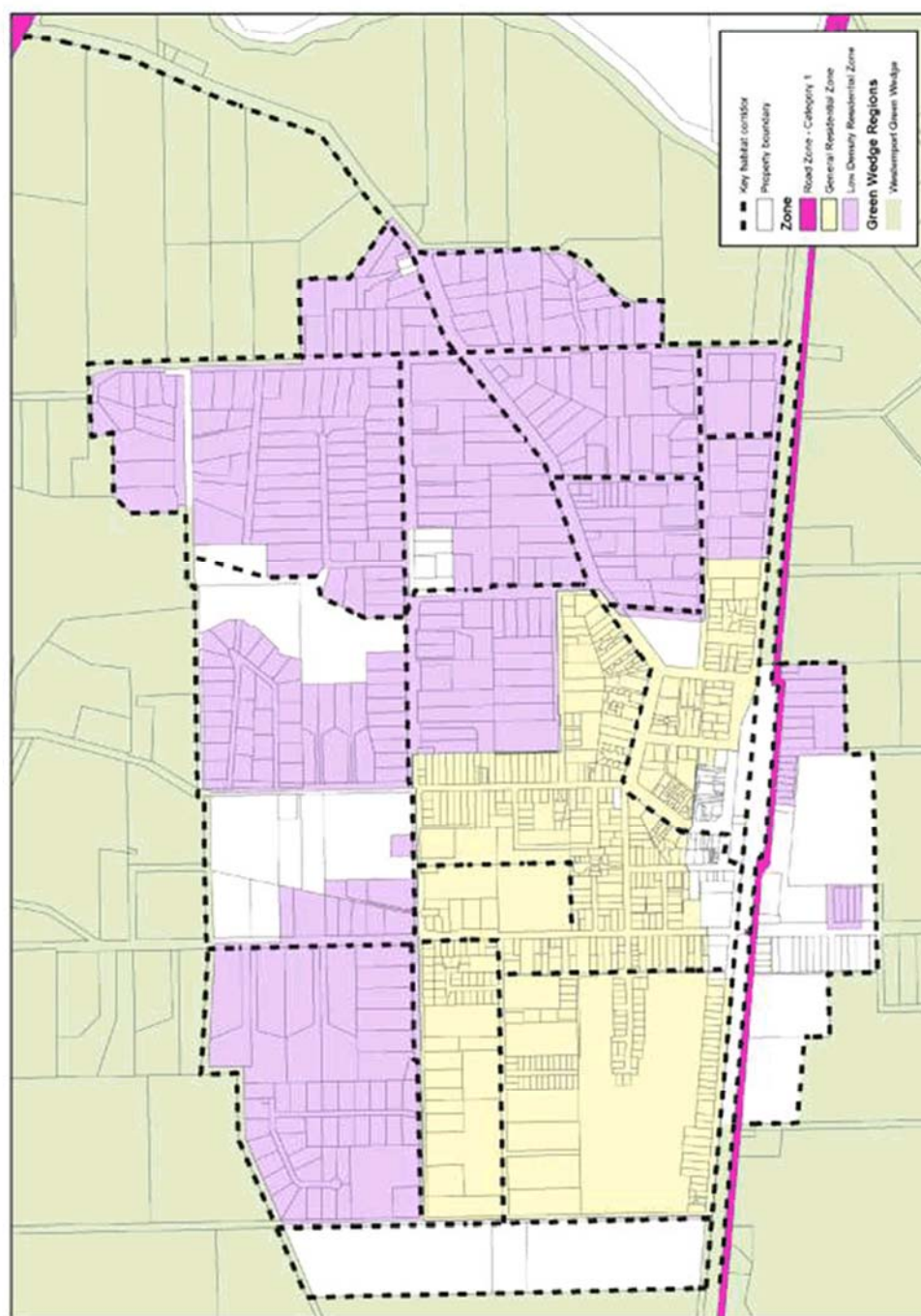
CARDINIA PLANNING SCHEME

Figure 2. Key habitat corridors Garfield



CARDINIA PLANNING SCHEME

Figure 3: Key habitat corridors Bunyip



CARDINIA PLANNING SCHEME

AMENDMENT C229

EXPLANATORY REPORT

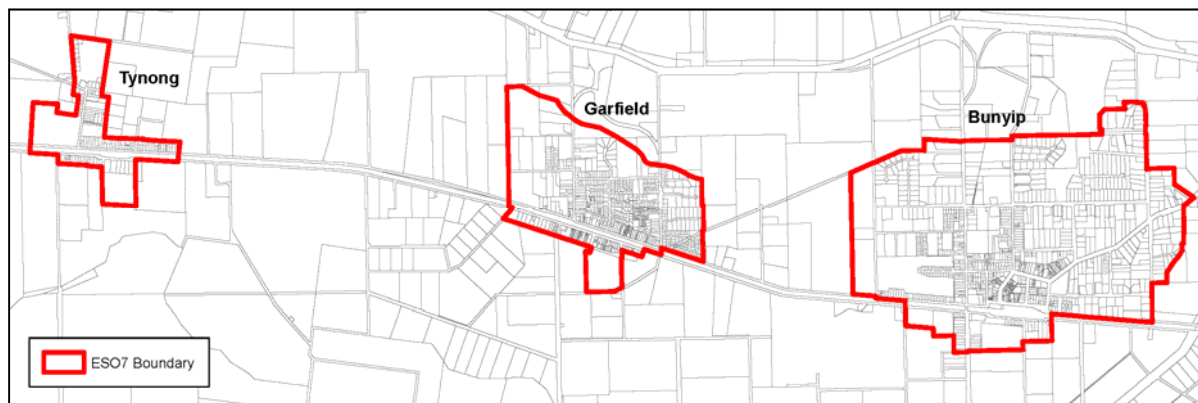
Who is the planning authority?

This amendment has been prepared by the Cardinia Shire Council, who is the planning authority for this amendment.

Land affected by the Amendment

The Amendment applies to the townships of Tynong, Garfield and Bunyip.

Figure 1. Land affected by the Amendment



What the amendment does

The Amendment applies Schedule 7 to the Environmental Significance Overlay to all land within the Urban Growth Boundary (UGB) of Garfield and Bunyip and all land zoned for urban purposes within Tynong.

Strategic assessment of the Amendment

Why is the Amendment required?

The Southern Brown Bandicoot (SBB), *Isoodon obesulus obesulus* is an endangered marsupial under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* and is also protected by the Victorian Government *Flora and Fauna Guarantee Act 1988 (FFG Act)*.

Ecology Australia was engaged by Council to assist in the development of an overlay to protect and enhance the habitat of the SBB.

Cardinia Shire is home to a large and distinctive SBB population cluster within the former Koo Wee Rup Swamp area which comprises four smaller sub-populations in Dalmore-Koo Wee Rup, Bayles, Cardinia-Rythdale, and Garfield-Longwarry.

The SBB live in dense understorey vegetation including native vegetation, exotic long grass and prickly dense weeds (including blackberries) as it protects them from predators such as cats and foxes. Known threats to the SBB include predation, increasing number of road fatalities, loss of habitat and corridor

fragmentation (through the clearing of native and exotic vegetation) and new urban infrastructure such as solid fences blocking their movements between habitat areas.

Recent developments in the townships of Bunyip, Garfield and Tynong have resulted in inconsistent planning permit requirements and outcomes to protect the SBB. A number of developers have cleared all Bandicoot habitat on a site by site basis, therefore creating gaps in the SBB movement corridors, others have been required to provide 10 - 50 metre wide corridors with onerous management requirements for Council. These inconsistent outcomes have led to additional costs for developers and Council and is likely to lead to the extinction of the SBB within these townships.

The current ad hoc pattern of subdivisions has led to some properties having no or inadequate provision of habitat for the species, where other properties have variable width corridors and inconsistent management requirements. Without a holistic approach to create and preserve SBB habitat the cumulative impacts of development will likely result in the local extinction of the SBB within these townships.

Ecology Australia was engaged by Council to assist in the development of statutory planning tools to better manage development outcomes to ensure a consistent approach for developers and to protect and enhance habitat for the SBB. The amendment implements the findings of the report developed by Ecology Australia: Southern Brown Bandicoot Habitat Protection Strategy and Environmental Significance Overlay, February 2017 (the Strategy).

How does the Amendment implement the objectives of planning in Victoria?

The amendment implements the following objectives under Section 4 of the *Planning and Environment Act 1987*:

- (a) to provide for the fair, orderly, economic and sustainable use, and development of land;
- (b) to provide for the protection of natural and man-made resources and the maintenance of ecological processes and genetic diversity;
- (g) to balance the present and future interests of all Victorians.

How does the Amendment address any environmental, social and economic effects?

The amendment seeks to provide positive environmental effects by ensuring that adequate habitat is preserved and improved to ensure the ongoing protection of the SBB. The SBB is currently listed as endangered under the EPBC Act, and the application of the Environmental Significance Overlay – Schedule 7 (ESO7) will ensure that consideration is given to impacts of any development on the habitat of the SBB.

The amendment will have limited social effects, but will support ongoing work undertaken by environmental groups within the Tynong, Garfield and Bunyip communities.

The economic effects of the amendment will be positive as the application of the ESO7 will provide increased certainty for developers as they will be aware of the requirements in relation to the SBB and be able to deal with these as part of the planning process, rather than further down the track as a result of referral under the EPBC Act.

Does the Amendment address relevant bushfire risk?

Land within the amendment is not affected by the Bushfire Management Overlay. The amendment protects and enhancing existing vegetation, however, given the low bushfire risk of this area, it is not considered to increase bushfire risk in this area.

Does the Amendment comply with the requirements of any Minister's Direction applicable to the amendment?*Ministerial Direction No. 9 – Metropolitan Strategy.*

The Amendment is consistent with the principles, outcomes, directions and policies of Plan Melbourne 2017 – 2050.

Direction 6.5 of Plan Melbourne seeks to protect and restore natural habitats. It notes that habitat loss and waterway degradation can pose a significant threat to native flora and fauna populations. The critical need to maintain and improve the overall extent condition of natural habitats is also recognised. The amendment directly responds to this policy.

Ministerial Direction No. 11 - Strategic Assessment of Amendments.

It is considered that the amendment is consistent with this Ministerial Direction.

How does the Amendment support or implement the State Planning Policy Framework and any adopted State policy?

The amendment supports the following sections of State Planning Policy Framework:

Clause 12.01- Biodiversity, seeks to assist the protection and conservation of Victoria's biodiversity including important habitat for Victoria's flora and fauna and other strategically valuable biodiversity sites. This includes ensuring that strategic planning avoids and minimises significant impacts, including cumulative impacts of land use and development on biodiversity, assists in the protection and management of sites containing high value biodiversity and assists in the reestablishment of links between isolated habitat remnants that contain high value biodiversity.

Clause 12.01-2- Native vegetation management, seeks to ensure that permitted clearing of native vegetation results in no net loss in the contribution made by native vegetation to Victoria's biodiversity. This includes avoiding the removal of native vegetation that makes a significant contribution to Victoria's biodiversity and minimise impacts on that biodiversity.

How does the Amendment support or implement the Local Planning Policy Framework, and specifically the Municipal Strategic Statement?

The following sections of the Local Planning Policy are relevant to this amendment as follows:

Clause 21.01-3 Key issues, nominates five strategic themes, the first of which is environment. Specifically, it seeks to protect and manage biodiversity.

Clause 21.02-3 Biodiversity, recognises that the municipality contains State and Nationally significant rare and threatened species including the Southern Brown Bandicoot, and that declining and fragmenting of habitats is resulting in the loss of biodiversity. Key issues under this section include recognising that native vegetation provides habitat for key fauna species, maintaining biodiversity in areas of significance, maintaining and re-establishing wildlife corridors.

This clause contains an objective "to maintain and enhance the diversity of indigenous habitats and species". Strategies to achieve his objective include avoiding the fragmentation of land in areas of biodiversity significance and create new habitat corridors/biolinks, protecting and enhancing the environmental and landscape values of the land and protect and enhance the habitat including the Growling Grass Frog and Southern Brown Bandicoot.

Under further strategic work listed in this section, identifying and mapping areas of significant flora, fauna or biodiversity value for potential inclusion into the Environmental Significance Overlay or Vegetation Protection Overlay.

The amendment implements the strategic work undertaken in regards to the SBB and therefore supports the Local Planning Policy Framework.

Does the Amendment make proper use of the Victoria Planning Provisions?

The amendment uses the Environmental Significance Overlay to implement the findings of the Strategy.

This Overlay is the appropriate tool because it addresses an issue related to the natural environment.

The purposes of the ESO are

- To identify areas where the development of land may be affected by environmental constraints, and;
- To ensure that development is compatible with identified environmental values.

In this instance, it was considered that the Vegetation Protection Overlay was not the most suitable too because it relates more specifically to existing vegetation. It is considered that the ESO is a more appropriate tool as it can address matters beyond vegetation such as fencing and setbacks.

The use of the ESO will ensure that landowners and future purchasers are aware of the requirements in relation to the protection of the SBB, and that the requirements are consistently applied.

How does the Amendment address the views of any relevant agency?

The Department of the Environment within the Australian Federal Government have been consulted in relation to the Amendment and have raised no issues with it.

Additional agencies will be consulted as part of the amendment process.

Does the Amendment address relevant requirements of the Transport Integration Act 2010?

This amendment will have no impact on the relevant requirements of the *Transport Integration Act 2010*.

Resource and administrative costs

- **What impact will the new planning provisions have on the resource and administrative costs of the responsible authority?**

The amendment will result in the need for additional permits to be sought for development on the land affected by the Environmental Significance Overlay. This will have some impact on the resource and administrative costs of Council, however, it will prevent applicants having to come back after the issue of their planning permit to amend their plans to meet the requirement of the Environment Department of the Federal Government.

Where you may inspect this Amendment

The Amendment is available for public inspection, free of charge, during office hours at the following places:

Cardinia Shire Council Offices
20 Siding Avenue
Officer

On Council's website at www.cardinia.vic.gov.au

The Amendment can also be inspected free of charge at the Department of Environment, Land, Water and Planning website at www.delwp.vic.gov.au/public-inspection.

Submissions

Any person who may be affected by the Amendment may make a submission to the planning authority. Submissions about the Amendment [and/or planning permit] must be received by [insert date].

:

Electronic submissions are preferred and should be sent to mail@cardinia.vic.gov.au

Or mail to:

Cardinia Shire Council Strategic Planning Department
PO Box 7 Pakenham
3810 VIC

Panel hearing dates

In accordance with clause 4(2) of Ministerial Direction No.15 the following panel hearing dates have been set for this amendment:

- directions hearing: [insert directions hearing date]
- panel hearing: [insert panel hearing date]]

[Delete this section if not applicable]

ATTACHMENT X - Mapping reference table

Location	Land /Area Affected	Mapping Reference
Bunyip, Garfield and Tynong	Land within the township boundary	Cardinia C229 001esoMaps20-24 Exhibition

