5 EXISTING ENVIRONMENT

5.1 COMPONENTS OF BIODIVERSITY, ECOLOGICAL AND PHYSICAL ENVIRONMENTAL PROCESSES

The study area (Figure 1) includes predominantly agricultural land adjacent to highly urbanised areas. Most land within the study area can be considered highly altered from its 'natural state', with consequent impacts on biodiversity and ecological processes, due to its land-use history.

The changed ecological processes resulting from land-use change reported by numerous authors (see Pickett et al. 2001, Whitford et al. 2001, Dale et al. 2005 and Theobald et al. 2005) have historically occurred over much of the study area. Those with significant effects on biodiversity include changes in vegetation structure and composition; local species extinctions and fragmentation of habitat; changes in species abundances including the introduction of new species; and the alteration of disturbance regimes.

The surrounding catchments have been highly modified. Water quality into Westernport Bay is often poor because of extreme modification to catchment hydrology and the establishment of intensive agriculture. There is very little connectivity of habitat within the current Urban Growth Boundary.

The Port Phillip and Westernport catchment, within which Melbourne is located, scored poorly for four out of five biodiversity indicators in the Catchment Condition report (PPWCMA 2006).

5.2 LISTED AND NOMINATED COMMUNITIES UNDER THE EPBC ACT

Five ecological communities listed, or nominated for listing, under the EPBC Act were identified from the Commonwealth's Protected Matters Search Tool as potentially occurring within the study area. These are:

- Natural Temperate Grassland of the Victorian Volcanic Plain;
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain;
- Temperate Lowland Plains Grassy Wetland;
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland; and
- Gippsland Red Gum Grassy Woodland and Associated Native Grassland.

This assessment determined that White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland and Gippsland Red Gum Grassy Woodland and Associated Native Grassland do not occur within the study area.

Natural Temperate Grassland on the Victorian Volcanic Plain, Grassy Eucalypt Woodland of the Victorian Volcanic Plain and Temperate Lowland Plains Grassy Wetland are considered to have a moderate or high likelihood of occurring within the study area. These communities are described in more detail below.

5.2.1 NATURAL TEMPERATE GRASSLAND OF THE VICTORIAN VOLCANIC PLAIN

Natural Temperate Grassland of the Victorian Volcanic Plain is native grassland of Kangaroo Grass (*Themeda triandra*), Wallaby-grass (*Danthonia* spp.) and other perennial tussock-forming grasses interspersed with an array of native herbs and sub-shrubs.

Natural Temperate Grassland covered the vast majority of the Victorian Volcanic Plain, stretching from the Yarra River in Melbourne almost to the South Australian border. At least 95 per cent of its original extent has now been cleared or patches have been severely degraded, primarily for agriculture, but also for urban development. As a result it is listed as a critically endangered ecological community under the EPBC Act. The original, pre-European and current extents of around 870,000ha and 65,000ha respectively are shown in Figures 2 and 3. More information about this type of grassland can be found in Department of the Environment, Water, Heritage and the Arts (2008).

The EPBC-listed grassland community 'Natural Temperate Grassland of the Victorian Volcanic Plain' is essentially identical to Victoria's Western Basalt Plains Grassland listed as a threatened community under the Victorian *Flora and Fauna Guarantee Act 1988* (FFG Act). It also corresponds to Plains Grassland and Creekline Tussock Grassland ecological vegetation classes, which have a conservation status of endangered within the Victorian Volcanic Plains bioregion.

Refined maps of native grassland and other native vegetation within and to the west of the study area, including the OMR/E6 Transport Corridor and Regional Rail Link are shown in Figures 5 and 6. Remnants of native grassland persist in the study area, mostly in the Melbourne West Investigation Area, but also in smaller areas within the Melbourne North Investigation Area (Figures 7 and 8). Scattered remnants of this ecological community also occur within the OMR/E6 Transport Corridor and the Regional Rail Link. The final ground-truthed maps (Figures 5–8) are considered very reliable maps of the extent of Natural Temperate Grassland in the study area.

Apart from being a critically endangered ecological community, Natural Temperate Grassland provides habitat for several species of plant and animal threatened at a national (and state) level. Several of these are discussed in this report, including Golden Sun Moth (critically endangered), Striped Legless Lizard (vulnerable), Grassland Earless Dragon (endangered), Spiny Rice-flower (critically endangered) and Plains-wanderer (vulnerable).

5.2.2 GRASSY EUCALYPT WOODLAND OF THE VICTORIAN VOLCANIC PLAIN

Grassy Eucalypt Woodland of the Victorian Volcanic Plain is an open eucalypt woodland with a predominantly grassy understorey. The ecological community exhibits a degree of natural variation in appearance and composition across its range, due to variations in rainfall and landscape features such as changes in elevation, drainage patterns and the presence of rocky outcrops. It is most commonly dominated by River Red Gum (*Eucalyptus camaldulensis*), but this can become Grey Box (*E. microcarpa*) or Yellow box (*E. melliodora*) on drier sites, and Manna Gum (*E. viminalis*) or Swamp Gum (*E. ovata*) on damper sites. In some areas, this community can have an association with or include stony knolls.

Grassy Eucalypt Woodland of the Victorian Volcanic Plain is an ecological community that was listed under the EPBC Act on 25 June 2009 as critically endangered.

Grassy Eucalypt Woodland of the Victorian Volcanic Plain has a similar former range to the Natural Temperate Grassland of the Victorian Volcanic Plain and is likely to have extended from Melbourne to near Hamilton in south-west Victoria. It was always somewhat more restricted than Natural Temperate Grasslands of the Victorian Volcanic Plain, being confined to more friable soils on the basalt plains and rarely occurring on the true cracking clays.

The EPBC-listed community 'Grassy Eucalypt Woodland of the Victorian Volcanic Plain' incorporates Victoria's Volcanic Plains (River Red Gum) Grassy Woodland, which is listed as threatened under the FFG Act (Scientific Advisory Committee, 2004). This also correlates with Plains Grassy Woodland, the relevant ecological vegetation class which has a conservation status of endangered within the Victorian Volcanic Plains bioregion.

The Commonwealth Department of Environment, Water, Heritage and the Arts has drafted advice that defines eligible stands of this vegetation type based on condition of the vegetation. In essence, for a stand to qualify as the listed community, it must be at least 0.5ha in size and have at least 50 per cent of its perennial ground layer made up of native species; or if it is more degraded, it must have a density of at least three large (>70cm diameter at breast height) trees per hectare.

Department of Sustainability and Environment mapping, revised following the formal listing of Grassy Eucalypt Woodland, almost certainly represents an overestimate of the extent of the listed community. Following an additional program of ground-truthing this vegetation type, it was clear that some of the area mapped includes areas with very poor understorey condition. Without additional access to private property to determine

this precisely, a precautionary approach was taken where all areas with suitable tree cover and considered potentially able to support the necessary understorey component were included. However, where areas were confirmed not to be the listed community (generally due to absence of any native understorey), these were excluded from the mapping. There were only relatively small areas where this was the case.

Using Department of Sustainability and Environment's modelled vegetation mapping, the original (pre-European) extent of Grassy Eucalypt Woodland is shown in Figure 10. The current extent of Grassy Eucalypt Woodland is shown in Figures 7 and 8.

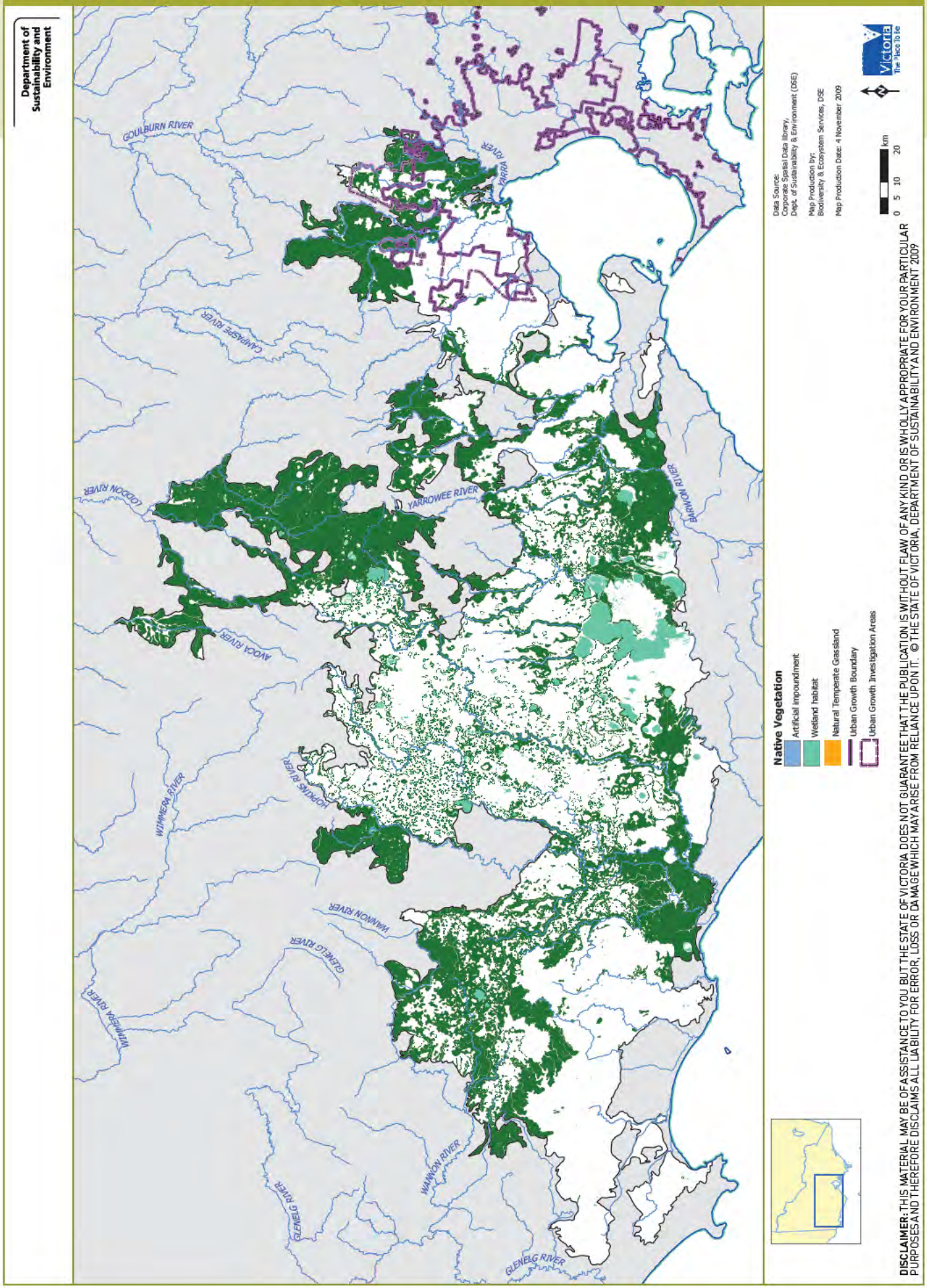
Within the study area, grassy woodlands of the Victorian Volcanic Plain are found scattered through the Melbourne North Investigation Area and adjoining precincts inside the existing Urban Growth Boundary, and including in the Sunbury area. The largest concentration of remnants is found in the south-east of the Melbourne North Investigation Area, with some more consolidated patches in the south-west and along Merri Creek, where there are many adjoining stony knolls. The ecological community also occurs within the OMR/E6 Transport Corridor. Generally the quality of the understorey appears similar throughout the Investigation Area, however this will be the subject of further detailed investigation. Beyond the Investigation Area, the community occurs more extensively to the east towards Whittlesea and to the west (generally as discrete stands) toward Gisborne. The red gum dominated woodlands within the Melbourne North Investigation Area and adjoining areas comprise the FFG-listed Western Basalt Plains (River Red Gum) grassy woodland, grading to a Grey Box (*Eucalyptus microcarpa*)-dominated grassy woodland alliance in the north-west of the Investigation Area.

Grassy woodlands of the Victorian Volcanic Plain provide habitat to several threatened flora and fauna species. Within or near the study area, these include Swift Parrot, Golden Sun Moth and Matted Flax-lily, and potentially Striped Legless Lizard.

5.2.3 TEMPERATE LOWLAND PLAINS GRASSY WETLAND

Temperate Lowland Plains Grassy Wetland occurs in seasonally wet depressions on fertile soils of volcanic or sedimentary plain (Department of the Environment, Water, Heritage and the Arts, unpublished). It consists of grassland and associated sedges and other herbaceous vegetation in ephemeral and seasonal wetlands. The wetlands are sometimes fringed by or interspersed with eucalypts (typically Red Gum) or lignum shrubs. The herbaceous ground-layer comprises some aquatic species as well as those tolerant of intermittent to seasonal inundation. The community was previously widespread and common in suitable habitat but has now been largely cleared and most remnants are under threat.

FIGURE 10. MODELLED MAP OF PRE 1750 GRASSY EUCALYPT WOODLAND EXTENT WITHIN VICTORIAN VOLCANIC PLAIN BIOREGION



Temperate Lowland Plains Grassy Wetland has been nominated to the EPBC Act as a threatened ecological community. The Commonwealth assessment for this ecological community and determination of listing is due to be completed by 30 September 2010. In Victoria, it is broadly referred to as Ecological Vegetation Class no.125 Plains Grassy Wetland. It includes the Victorian FFG Act listed floristic community Herb-rich Plains Grassy Wetland (West Gippsland) (Department of the Environment, Water, Heritage and the Arts, unpublished).

5.3 LISTED AND NOMINATED THREATENED SPECIES UNDER EPBC ACT

A total of 25 fauna species and 32 flora species that are listed or nominated for listing under the EPBC Act have been identified as potentially occurring within the study area (see Section 3.6.1). However, most of these (15 fauna and 21 flora species) are considered to have a low or negligible likelihood of occurrence within the study area. Species with only a low or negligible likelihood of occurrence are listed in Tables 1 and 2, with reasons for this determination.

Species with a moderate or high likelihood of occurrence are described in more detail below.

5.3.1 SPECIES THAT INHABIT GRASSLANDS AND GRASSY WOODLANDS

Native Temperate Grasslands and Grassy Woodlands of the Victorian Volcanic Plain provide habitat for several species of plant and animal threatened at the State and national level.

Threatened fauna species that utilise grasslands or grassy woodlands and have a low–moderate to high likelihood of occurrence within the study area are:

- Plains-wanderer;
- Striped Legless Lizard;
- Grassland Earless Dragon; and
- Golden Sun Moth.

Threatened flora species that utilise grasslands or grassy woodlands and have a low–moderate to high likelihood of occurrence within the study area are:

- Adamsons Blown-grass;
- Button Wrinklewort;
- Clover Glycine;
- Curly Sedge;

- Large-fruit Groundsel;
- Matted Flax-lily;
- Small Golden Moths;
- Spiny Rice-flower; and
- Swamp Fireweed.

PLAINS-WANDERER

The Plains-wanderer (*Pedionomus torquatus*) is a small quail-like bird standing about 10cm tall and weighing 40–95g (Marchant and Higgins 1993). It is listed as vulnerable under the EPBC Act and as threatened under the FFG Act.

Plains-wanderer inhabits sparse, lowland native grasslands in which the vegetation structure is a more important habitat attribute than the species composition (Baker-Gabb 2002). In Victoria, over 70 per cent of recent sightings of Plains-wanderers have come from the Mitiamo district around Terrick Terrick National Park in the State's north-west (Maher and Baker-Gabb 1993, Webster 1996a). There have been previous records of this species in the Melbourne West and Melbourne North Investigation Areas. A confirmed record from 2008 of Plains-wanderer exists from the area immediately west of the Melbourne West Investigation Area. Habitat in this area has been altered little over the past 20 years, when Plains-wanderer was regularly recorded in the area (Birds Australia 2009). Historical records of the Plains-wanderer are shown in Figure 11.

GRASSLAND EARLESS DRAGON

The Grassland Earless Dragon (*Tympanocryptis pinguicolla*) is a small lizard with a head to tail length generally less than 150 mm, small rough scales and well-developed limbs (Robertson and Evans 2008). It is listed as endangered under the EPBC Act and threatened under the FFG Act.

In Victoria, five sightings believed to be this species were reported between 1988 and 1990 (including from the upper reaches of Merri Creek and west of Werribee), but intensive trapping at these locations since 1994 have failed to confirm the sightings. Many other potential grassland sites to the north and west of Melbourne were also surveyed during this period, and no earless dragons were located (Robertson and Evans 2004). One further reported sighting near Craigieburn in 1990 requires further investigation (Robertson and Evans 2004). The last confirmed sightings of this species in Victoria were from the Rockbank area in 1968 and the Geelong area in 1969 (Robertson and Cooper 2000). While there are no recent confirmed records, Grassland Earless Dragon is a highly cryptic species and there is a small possibility it may still occur, particularly immediately west of the Melbourne West Investigation Area. Figure 12 shows historical records of the Grassland Earless Dragon.

FIGURE 11. SURVEY RECORDS OF PLAINS-WANDERER *(Pedionomus torquatus)*

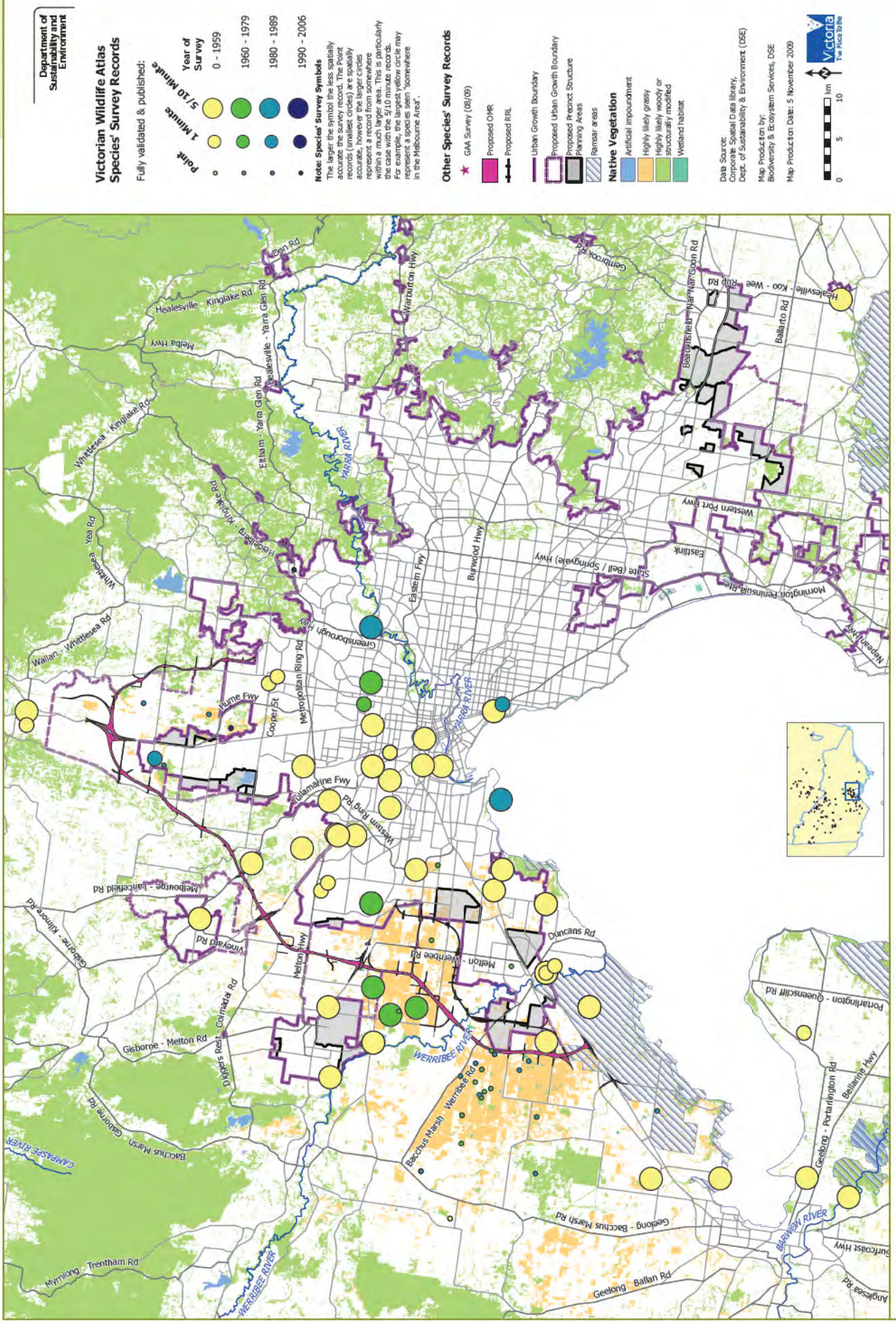
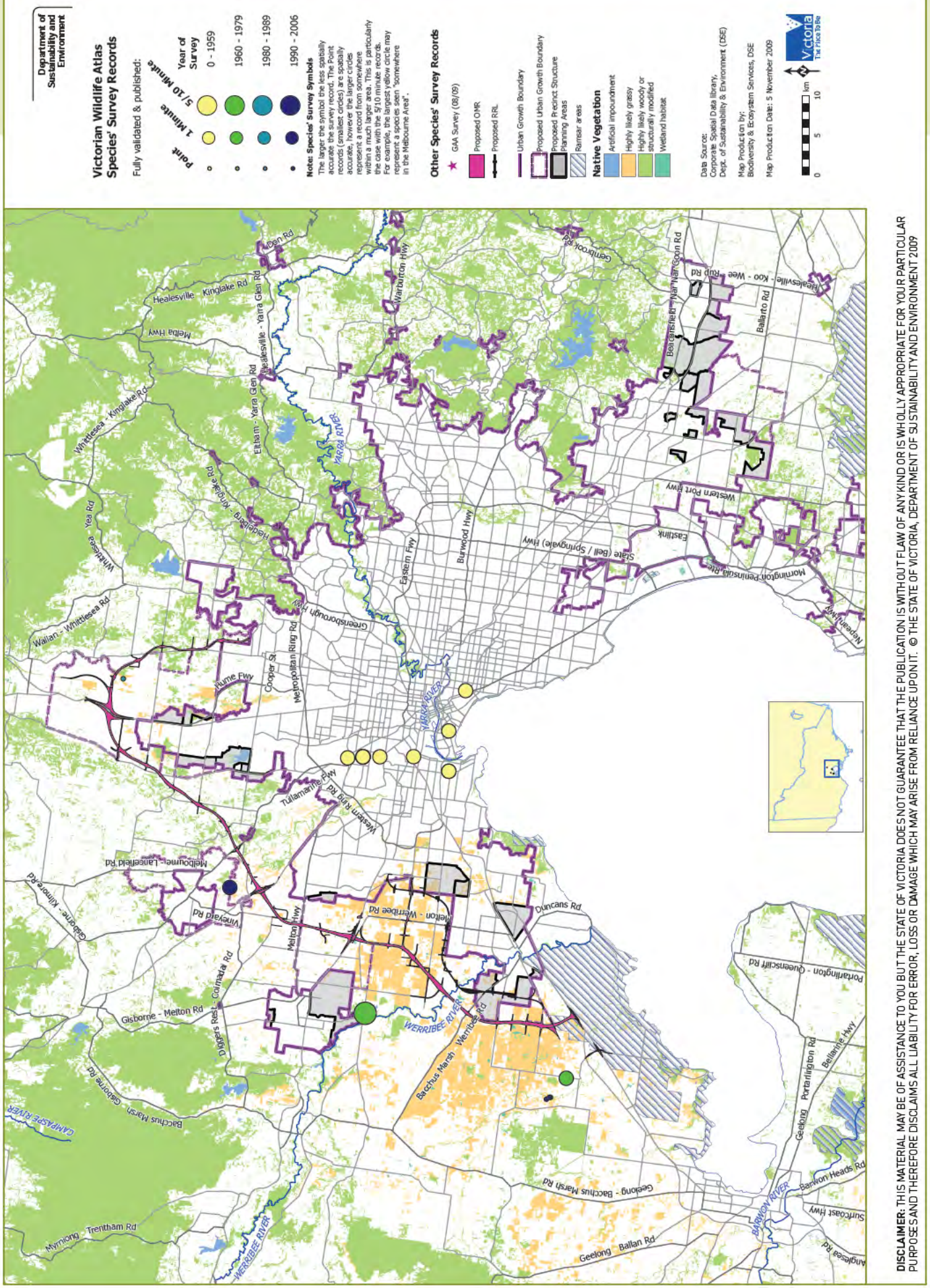


FIGURE 12. SURVEY RECORDS OF GRASSLAND EARLESS DRAGON *(Tympanocryptis pinguicolla)*



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STRIPED LEGLESS LIZARD

The Striped Legless Lizard (*Delma impar*) is a pale grey-brown lizard with a long thin body and long tail, growing to a total length of about 300mm. Legless Lizards lack forelimbs and have hind limbs reduced to tiny flaps (Smith and Robertson 1999). It was listed as vulnerable under the EPBC Act in July 2000, and a national recovery plan has been prepared (Smith and Robertson 1999). It is also listed as threatened under the FFG Act and an action statement has been prepared (Department of Sustainability and Environment 2003).

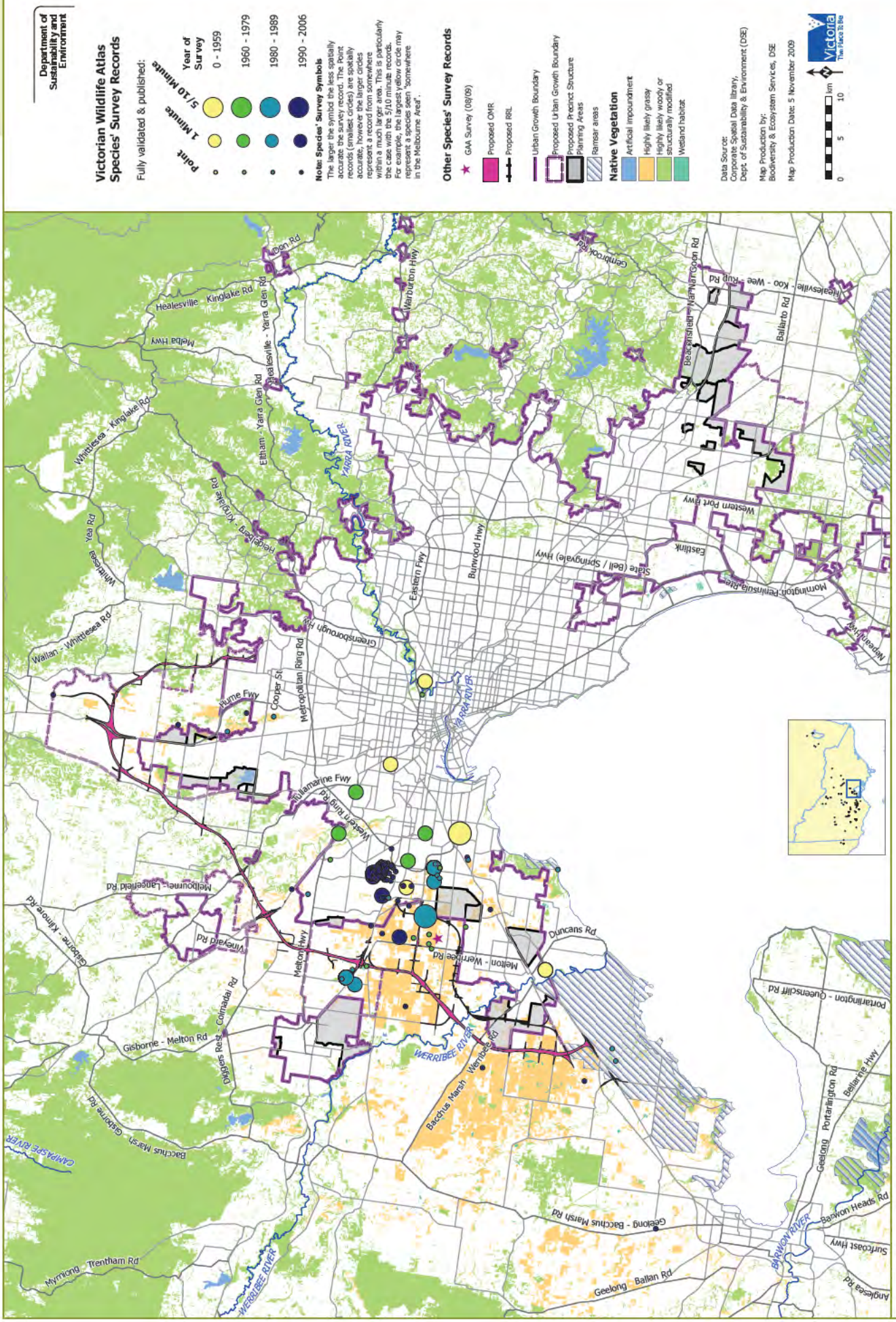
The Striped Legless Lizard inhabits lowland native grasslands and sometimes grassy woodlands in Victoria, the Australian Capital Territory, and the south-eastern parts of New South Wales and South Australia.

Although primarily found in native grasslands with relatively low levels of disturbance and dense tussock structure, Striped Legless Lizard has also been recorded in nearby exotic grasslands. This suggests that the grassland structure rather than the floristic composition is the important habitat characteristic. It is unknown, however, whether non-native habitats would support a population over the long term. More information about the biology and ecology of the species can be found in Smith and Robertson (1999) and Department of Sustainability and Environment (2003). The Striped Legless Lizard has more recently been recorded in grassy woodland habitat in the Yea area of Victoria. Figure 13 shows survey records of the Striped Legless Lizard.

There are currently four conservation reserves containing suitable grassland habitat in the state, and three of these are known to support the Striped Legless Lizard: Derrimut Grassland Reserve in the western suburbs of Melbourne; Craigieburn Grassland and Cooper Street Grasslands reserves just north of Melbourne; and Terrick Terrick National Park in northern Victoria.

Within the study area, the Striped Legless Lizard is known to occur at scattered locations in the Melbourne West Investigation Area and also at Craigieburn Grasslands in the Melbourne North Investigation Area. A cluster of records occur close to the Victoria University at St Albans, an area that has been intensively studied. Experience shows that the Striped Legless Lizard can be difficult detect during surveys and that they are often present in suitable habitat. It is highly likely that additional populations will be located, particularly within the Melbourne West Investigation Area, either through targeted surveys or, more likely, during the actual physical construction process. The approach adopted therefore will be to use habitat as a surrogate for extant populations and assume the species is present in suitable habitat. However, surveys will still be undertaken as part of planning for urban and transport infrastructure.

FIGURE 13. SURVEY RECORDS OF STRIPED LEGLESS LIZARD *(Delma impar)*



GOLDEN SUN MOTH

The Golden Sun Moth (*Synemon plana*) is a medium-sized (wingspan 3.1–3.4cm) day-flying moth restricted to Victoria, the Australian Capital Territory and adjacent areas of southern New South Wales. It was listed as critically endangered under the EPBC Act in December 2002 and as threatened under the FFG Act. An FFG action statement has been prepared for this species (Department of Sustainability and Environment 2003).

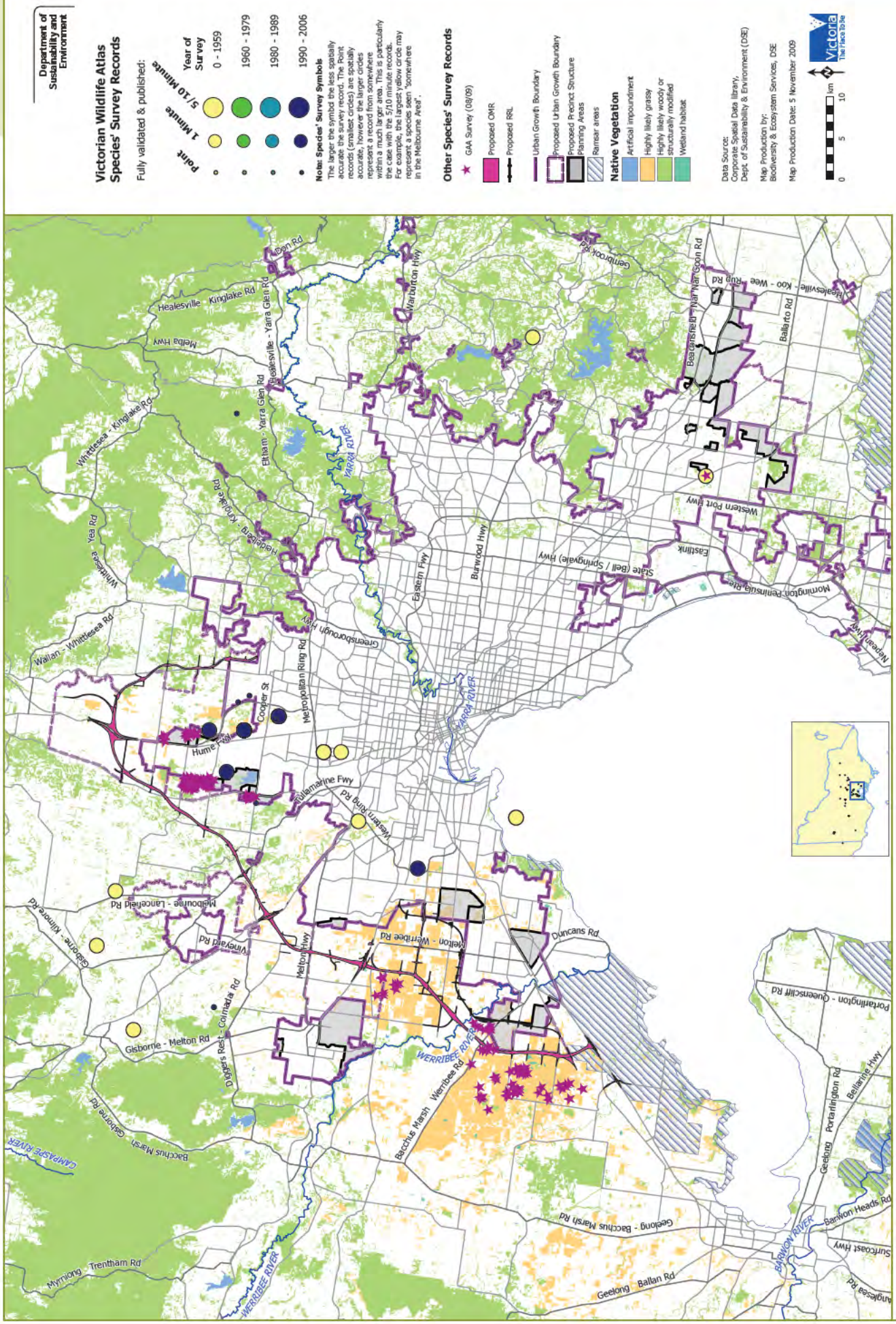
The Golden Sun Moth inhabits grassy areas, including native grasslands and grassy woodlands as well as areas of introduced (non-native) grasses and weeds. An open tussock structure with sparse inter-tussock spaces and/or much bare ground appears to be an important attribute of sites supporting the species (DEC 2006). The species has been thought to be associated with presence of Wallaby-grasses (*Austrodanthonia* spp.) in the ground layer at typical proportions of more than 40 per cent (DEC 2006, Department of the Environment, Water, Heritage and the Arts 2009), so such areas have been targeted for survey. However, this conclusion has not been borne out in recent surveys around Melbourne, which did not target native grasslands specifically but nonetheless found Golden Sun Moth at 19 of 24 sites searched (Biosis 2008). Sites where the species was recorded often had very low cover of Wallaby-grass and most sites were very weedy (Biosis 2008).

There have been no widespread targeted surveys undertaken for the Golden Sun Moth across its Victorian range. The most effective survey method is a number of repeatable site visits on suitable days during the active flight season, as per survey protocols developed by the Department of Sustainability and Environment, and the Department of the Environment, Water, Heritage and the Arts at the Golden Sun Moth Policy Workshop in 2008.

Targeted, opportunistic or pre-development surveys are responsible for most of the recent data about the Golden Sun Moth. These have increased the number of known sites in Victoria to around 60 from the six recorded when the FFG action statement was prepared in 2003 (Figure 14). The targeted Port Phillip Golden Sun Moth surveys occurred over two seasons (2006/07 and 2007/08), due to an EPBC controlled action requirement. It is highly likely that systematic surveys across the historic range of the species would locate many "new" populations, as the surveys around Melbourne (50 sites), Australian Capital Territory (32 sites), and New South Wales (42 sites) have demonstrated (National Recovery Plan and ACT Grassland Conservation Strategy 2005).

The lack of widespread surveying and recent survey results indicate that the true state of the species is more likely to be endangered or vulnerable rather than critically endangered. As surveys proceed, it is likely that the large number of sites around Melbourne will link up and become fewer but larger in area as the Golden Sun Moth distribution becomes known across its range. In addition, proposed regional surveys will add greatly to the information regarding distribution of this species in rural parts of Victoria.

FIGURE 14. SURVEY RECORDS OF GOLDEN SUN MOTH *(Synemon plana)*



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ADAMSONS BLOWN-GRASS

Adamson's Blown-grass (*Lachnagrostis adamsonii* formerly known as *Agrostis adamsonii*) is a tufted, short-lived perennial grass that may behave as an annual under some conditions (Murphy 2007). It is listed as endangered under the EPBC Act and threatened under the FFG Act.

Since its rediscovery in 1987, 68 populations of Adamson's Blown-grass have been found in saline shallow wetlands from Clifton Springs near Geelong to Melville Forest, east of Coleraine in south west Victoria (Murphy 2007) (Figure 15). Adamson's Blown-grass is unlikely to, but may occur, within the Melbourne West Investigation Area.

BUTTON WRINKLEWORT

The Button Wrinklewort (*Rutidosis leptorrhynchoides*) is a perennial multi-stemmed semi-shrub in the daisy family (DCE 1992). It was listed as endangered under the EPBC Act in 2000 and as threatened under the FFG Act.

The species was formerly widespread in grasslands and grassy woodlands in Victoria but is now restricted to 11 populations in south-west Victoria and the western suburbs of Melbourne (DCE 1992) Figure 16. The species is known to occur in roadsides, rail reserves and cemeteries within the study area, but is unlikely to occur on private land because of incompatible management regimes: the species is intolerant of grazing, is palatable to stock and requires frequent burning to ensure that it is not out-competed by grasses (DCE 1992).

CLOVER GLYCINE

Clover Glycine (*Glycine latrobeana*) is a small, prostrate, perennial herb in the pea family, with purple flowers (Carter and Sutter unpublished). It is listed as vulnerable under the EPBC Act and threatened under the FFG Act.

Clover Glycine occurs mainly in grassland and grassy woodland habitats, less often in dry forests, and only rarely in heathland (Carter and Sutter unpublished). There are approximately 65 recorded populations of Clover Glycine in Victoria, but there are likely to be many more scattered populations, particularly on private land (Carter and Sutter unpublished). There are records of this species from the Melbourne West Investigation Area (Figure 17); however as it is not known whether the species persists in the area, it is considered to have a moderate likelihood of regular occurrence (Table 2).

FIGURE 15. SURVEY RECORDS OF ADAMSON'S BLOWN-GRASS *(Lachnagrostis adamsonii)*

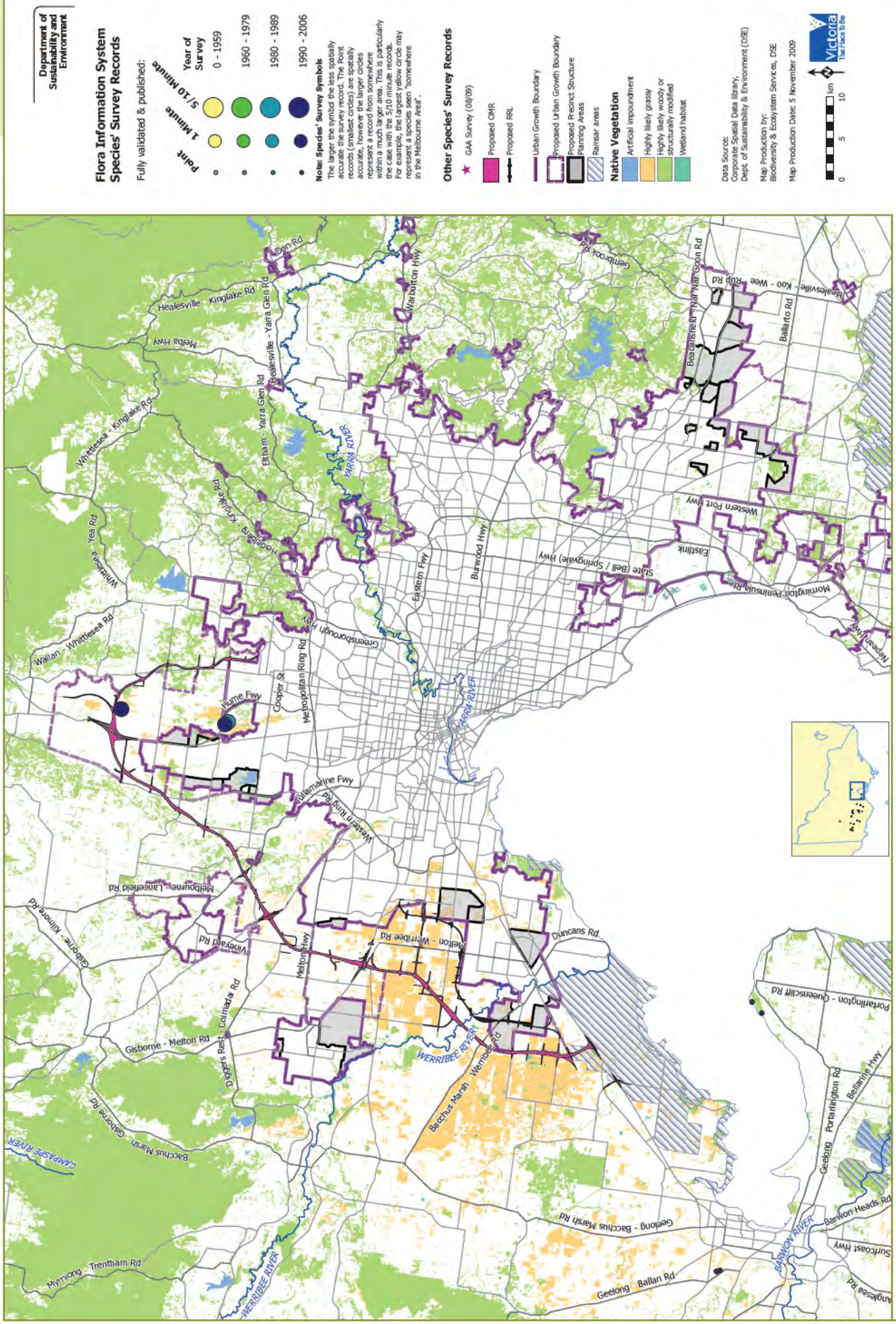

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FIGURE 16. SURVEY RECORDS OF BUTTON WRINKLEWORT *(Rutidosis leptorrhynchoides)*

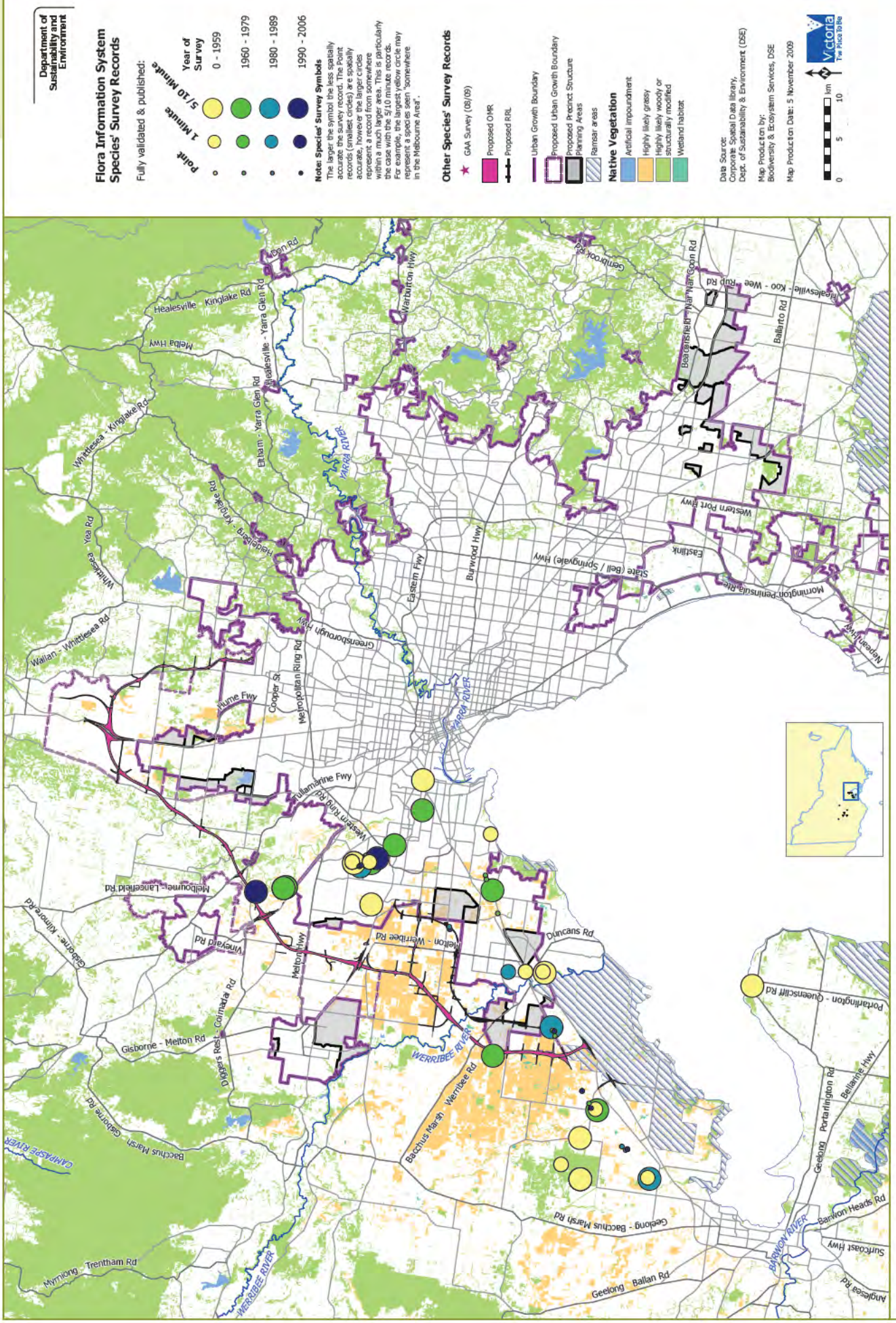

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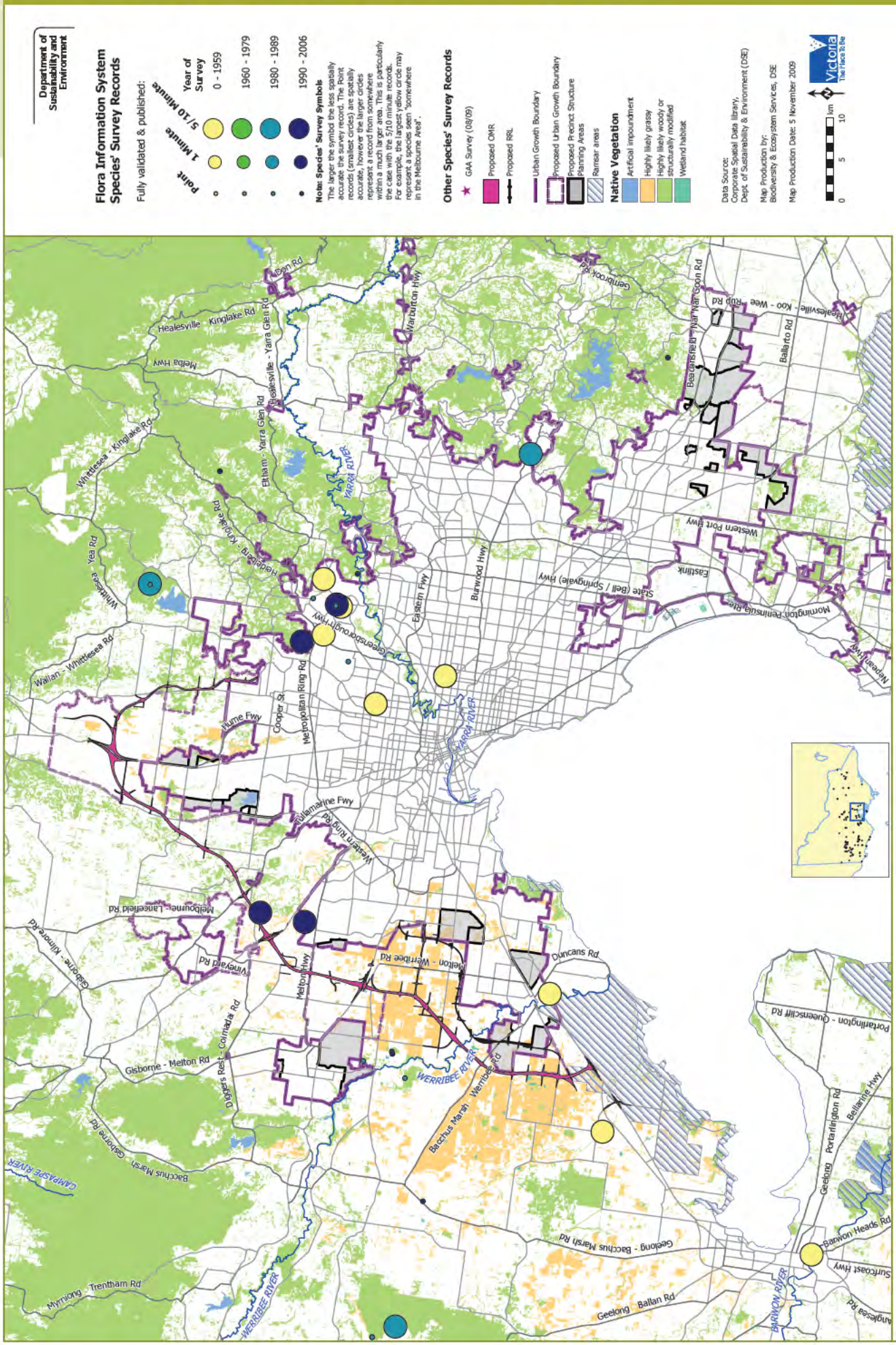
FIGURE 17. SURVEY RECORDS OF CLOVER GLYCINE *(Glycine latrobeana)*



CURLY SEDGE

Curly Sedge (*Carex tasmanica*) is wiry, clumped, perennial sedge to 50cm high (Department of Sustainability and Environment 2004a). It was listed under the EPBC Act in 2000 as vulnerable and is listed as threatened under the FFG Act.

Curly Sedge grows in seasonally damp sites in grassland or grassy woodland (Department of Sustainability and Environment 2004a). In Victoria Curly Sedge is now known in around 20 sites (Carter, unpublished). Important populations are predominantly recorded in south-west Victoria, but two occur within the Greater Melbourne area (Figure 18). Both are along Curly Sedge Creek: one within Craigieburn Nature Conservation Reserve; and the other on private land south of the reserve (Carter, unpublished).

LARGE-FRUIT GROUNDSEL

Large-fruit Groundsel (*Senecio macrocarpus*) is a bushy, upright herb up to 40cm high, belonging to the daisy family (DCE 1996). It was listed as vulnerable under the EPBC Act in 2000 and is listed as threatened under the FFG Act.

Large-fruit Groundsel predominantly occurs in plains grassland (where it is a subdominant species with Button Wrinklewort), but it is also found in grassy woodlands (Department of Sustainability and Environment 1996). The species was formerly widespread in western Victoria, but now only 13 populations are recorded at 11 locations (DCE 1996). The species is known to occur in roadsides, rail reserves and cemeteries within the study area, but rarely on private land because of incompatible management regimes: the species does not tolerate heavy grazing or mechanical disturbance (DCE 1996) (Figure 19). It also occurs in railway reserves outside but close to the Melbourne West Investigation Area, and near Werribee station in the existing urban area. The species is known to occur at one private land site within the study area at Rockbank, where plants have persisted amongst native grassland with abundant surface rock.

MATTED FLAX-LILY

Matted Flax-lily (*Dianella amoena*) is a tufted, mat–forming perennial lily. Its leaves typically have small, irregularly spaced teeth and may be shed in summer if stressed by lack of water (Carter 2005). It is listed as endangered under the EPBC Act and threatened under the FFG Act.

The species occurs on fertile soils in grassland and grassy woodland habitats (Carr & Horsfall 1995). There are estimated to be around 1,400 Matted Flax-lily plants remaining in approximately 120 wild populations (Carter 2005). Many sites where this species is found are in the Melbourne metropolitan area: around Bundoora; Eltham; Craigieburn; Reservoir; Epping; and South Morang. Other populations are found on the Victorian Volcanic Plains between Sunbury and Bacchus Marsh (Figure 20). The majority of populations comprise just a few plants (Carter 2005).

FIGURE 18. SURVEY RECORDS OF CURLY SEDGE *(Carex tasmanica)*

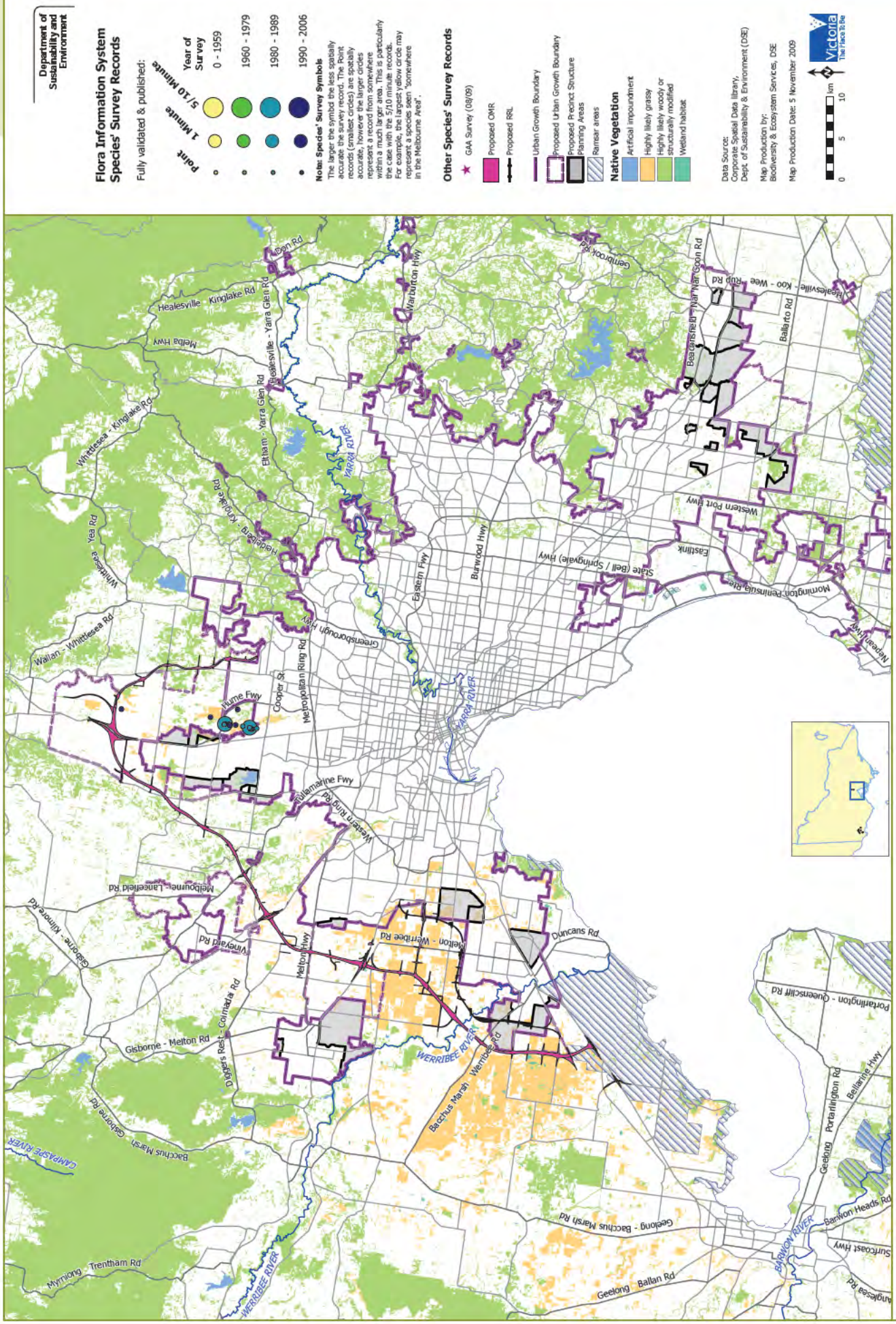


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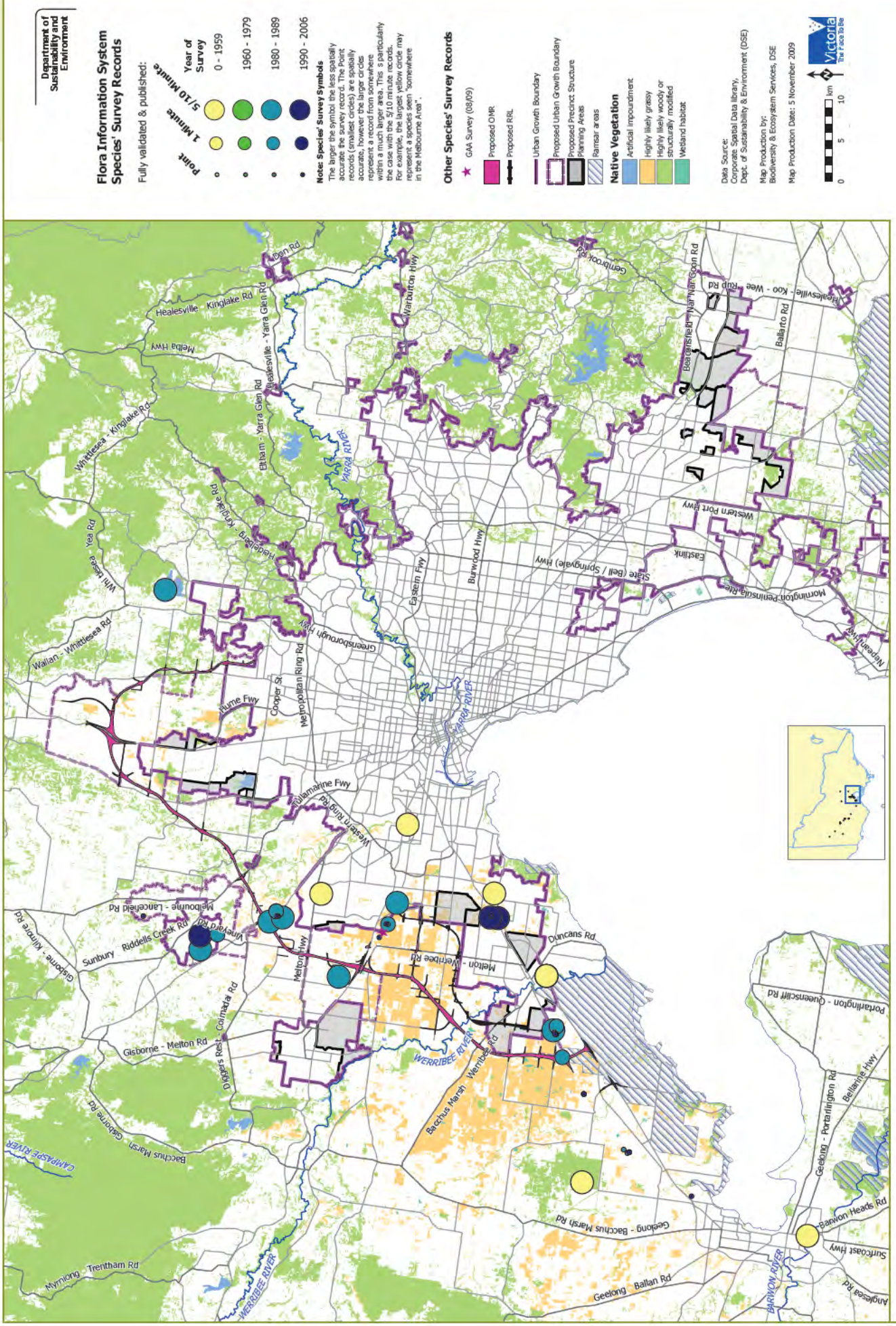
FIGURE 19. SURVEY RECORDS OF LARGE-FRUIT GROUNDSEL *(Senecio macrocarpus)*



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SMALL GOLDEN MOTHS

Small Golden Moths (*Diuris basaltica*) is a terrestrial orchid with grass-like green leaves and barely opening, golden orange flowers. It is most similar to the Golden Moths Orchid (*Diuris chryseopsis*) and the Golden Cowslips Orchid (*Diuris behrii*), but differs from both by its diminutive stature, smaller and poorly opening flowers, and highly restricted distribution (Backhouse and Webster 1999). It was listed as endangered under the EPBC Act in 2000 and is listed as threatened under the FFG Act.

Small Golden Moths is known in only two populations; with the largest on private land near Clarke Road near Caroline Springs within the Melbourne West Investigation Area (G. Backhouse pers. comm.). The smaller population is located at Laverton Airbase, outside the study area.

SPINY RICE-FLOWER

The Spiny Rice-flower (*Pimelea spinescens ssp. spinescens*) is a small spreading shrub to 30cm in height with spine-tipped stems (Carter and Walsh 2006). It is endemic to Victoria, occurring in the central west of the state from the Victorian Volcanic Plain to the Riverina (Figure 21). It has a very large tap-root and is thought to live for up to 100 years (Mueck 2000). Plants are either male or female so both types are required for reproduction. More information about the biology of the species can be found in Carter and Walsh (2006) and Department of the Environment, Water, Heritage and the Arts (2009).

The species inhabits native grasslands or other open grassy areas on volcanic soils of low relief (Walsh and Entwisle 1996). It has been severely depleted across its range and was listed as critically endangered under the EPBC Act in May 2003. A recovery plan has been published (Carter and Walsh 2006).

Carter and Walsh (2006) estimate that there are approximately 12,000 Spiny Rice-flower plants in 20 populations. Most of these are in roadsides or rail reserves, although the largest known population occurs on private land in northern Victoria. Since 2006, several more populations have been located, but these are all relatively small and have generally been recorded as part of development applications on private land, as a result of which many plants have been translocated. According to the Pimelea spinescens Recovery Team there were 184 known locations of Spiny Rice-flower across Victoria in October 2008 (Walsh and Thomas 2009). It should be noted that while many Spiny Rice-flower plants have been translocated previously, and lived for many years post-translocation, no reproduction has occurred in plants translocated recently (S. Mueck pers. Comm. 2008 in Department of the Environment, Water, Heritage and the Arts 2009).

Spiny Rice-flower is known to occur within the Melbourne West Investigation Area and also within both of the proposed Western Grassland Reserves (Figure 21).

FIGURE 20. SURVEY RECORDS OF MATTED FLAX-LILY *(Dianella amoena)*

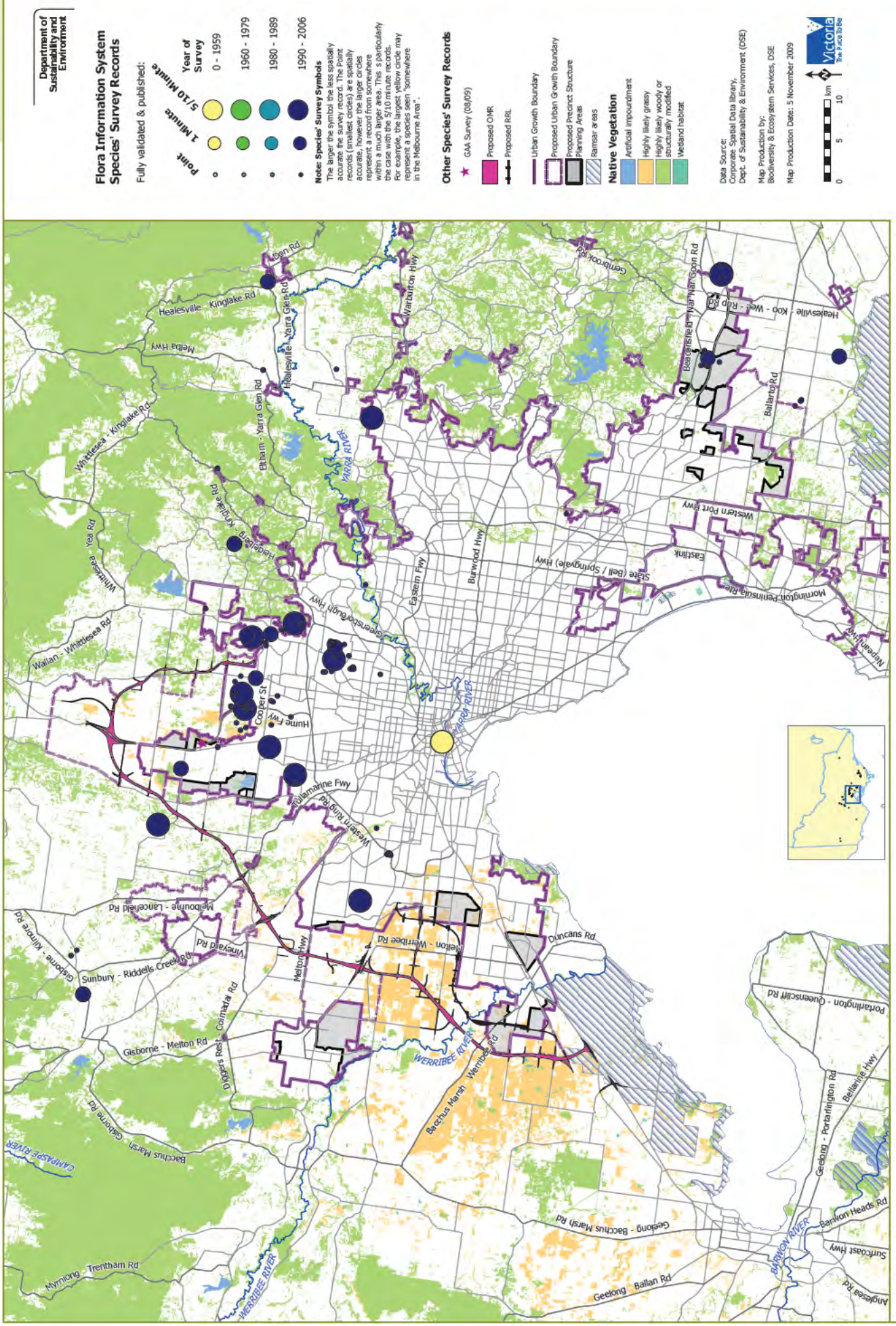
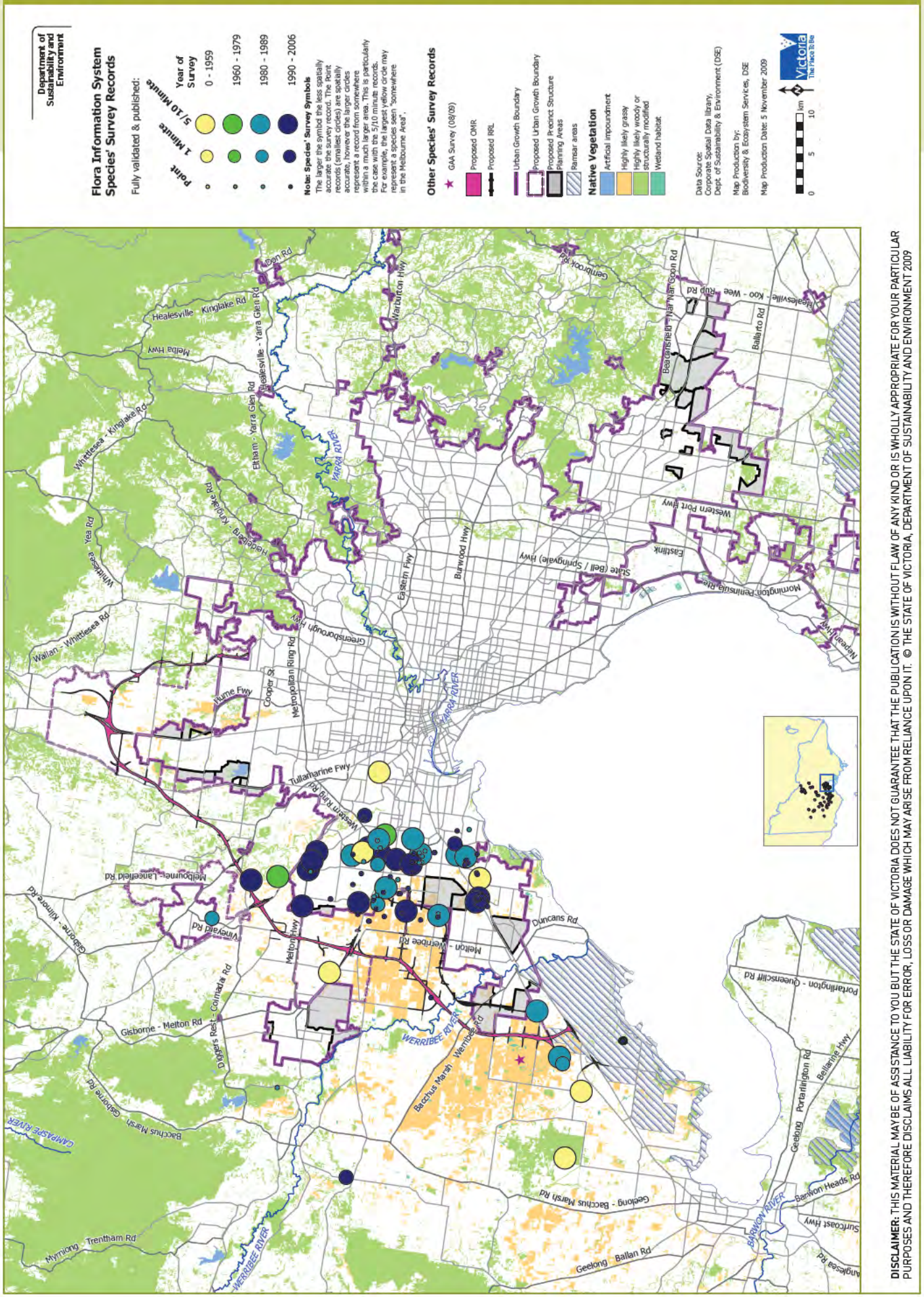


FIGURE 21. SURVEY RECORDS OF SPINY RICE-FLOWER *(Pimelea spinescens* subsp. *spinescens)*



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SWAMP FIREWEED

The Swamp Fireweed (*Senecio psilocarpus*) is a tall slender herb occurring in shallow wetlands and seasonally wet areas. It is listed as vulnerable under the Commonwealth EPBC Act. Scattered populations occur across western Victoria, including approximately 10 sites between Wallan (north of Melbourne) and Honans Scrub in south-east South Australia (Threatened Species Scientific Committee 2008b). It has also been recorded in Tasmania.

Within the study area it occurs in on private land at Hearne Swamp, just north-east of Beveridge, in the Melbourne North Investigation Area (Figure 22). There are several tens of records of the species at this site (Brett Lane, ecological consultant, pers. comm.). According to the National Herbarium in Melbourne it has also been recorded in the south-east of Melbourne as recently as 2005, with a potential location within the Melbourne South East Investigation Area at Clyde.

5.3.2 SPECIES THAT PREDOMINANTLY INHABIT NON-GRASSY ENVIRONMENTS

A variety of other threatened species that inhabit non-grassy environments or are not grassland specialists have a moderate or high likelihood of occurrence within the study area. Many of these species utilise wetland environments.

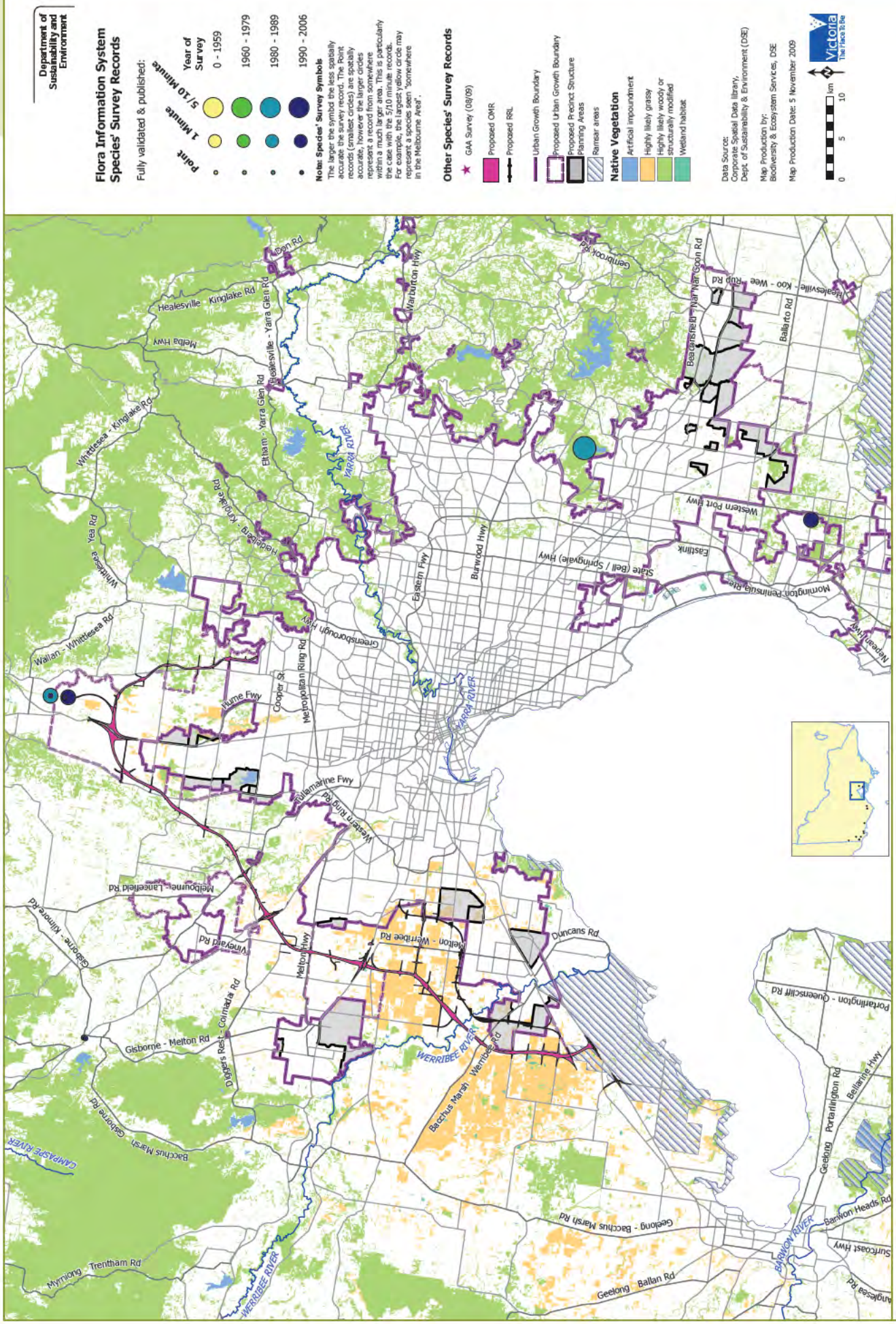
Threatened fauna species that utilise non-grassy environments and have a moderate to high likelihood of occurrence within the study area are:

- Grey-headed Flying-fox;
- Southern Brown Bandicoot;
- Australian Painted Snipe;
- Swift Parrot;
- Growling Grass Frog;
- Australian Grayling; and
- Dwarf Galaxias.

Threatened flora species that utilise non-grassy environments and have a moderate to high likelihood of occurrence within the study area are:

- Maroon Leek-orchid;
- River Swamp Wallaby-grass; and
- Swamp Everlasting.

FIGURE 22. SURVEY RECORDS OF SWAMP FIREWEED *(Senecio psilocarpus)*



GREY-HEADED FLYING-FOX

Grey-headed Flying-fox (*Pteropus poliocephalus*) is one of the largest bats in the world, ranging in weight from 600g to 1000g and ranging between 230cm and 289cm in head and body length (Eby and Lunney 2002). It was listed as vulnerable under the EPBC Act in December 2001.

The population of the Grey-headed Flying-fox is spatially structured into colonies (Parry-Jones and Wardle 2004). Within Victoria, the main colony is located at Yarra Bend Park near Fairfield and the smaller colony at Geelong (Figure 23).

The Grey-headed Flying-fox forages up to 50km per night in search of nectar, pollen and fruit, which they collect from suburban gardens, parks, orchards and forests from the Brisbane Ranges to the west of Melbourne around to the eastern and northern suburbs.

SOUTHERN BROWN BANDICOOT

There are five sub-species of Southern Brown Bandicoot (*Isoodon obesulus obesulus*) across southern Australia and on Cape York. The sub-species discussed here is Isoodon obesulus obesulus, a medium sized ground-dwelling marsupial up to around 1.5 kg in weight. It is similar to but generally a little smaller than the Long-nosed Bandicoot, with which it sometimes co-exists.

The Southern Brown Bandicoot is a nationally threatened subspecies that was listed as endangered under the EPBC Act in April 2001.

The Southern Brown Bandicoot is endemic to mainland south-eastern Australia, where it occurs in New South Wales, Victoria and South Australia. Historically, it occupied a more or less continuous coastal band from Eyre Peninsula in South Australia to Sydney. It has contracted significantly in range, and in Victoria, now occurs in five essentially isolated "populations", including one from south-east of Melbourne to Wilsons Promontory (Schmidt et al. 2008).

The Southern Brown Bandicoot utilises a range of native and exotic vegetation types with a densely vegetated ground-layer, and generally occurs within 50km of the coast, although it extends further inland in south-west Victoria. Individuals tend to be solitary and generally nocturnal, with a home range of between 0.5ha to 9ha reported (Schmidt et al. 2008). The minimum area required to support an individual or a population is not known.

The Southern Brown Bandicoot is well known in the south-east of Melbourne and has been recorded in the Melbourne South-East Investigation Area and adjacent precincts (Figure 24). An important population occurs at the Royal Botanic Gardens Cranbourne, where it is protected by a predator-proof fence. This is the largest population known within the Melbourne area. The species does not occur in the Melbourne North or Melbourne West Investigation Areas.

FIGURE 23. SURVEY RECORDS OF GREY-HEADED FLYING-FOX *(Pteropus poliocephalus)*

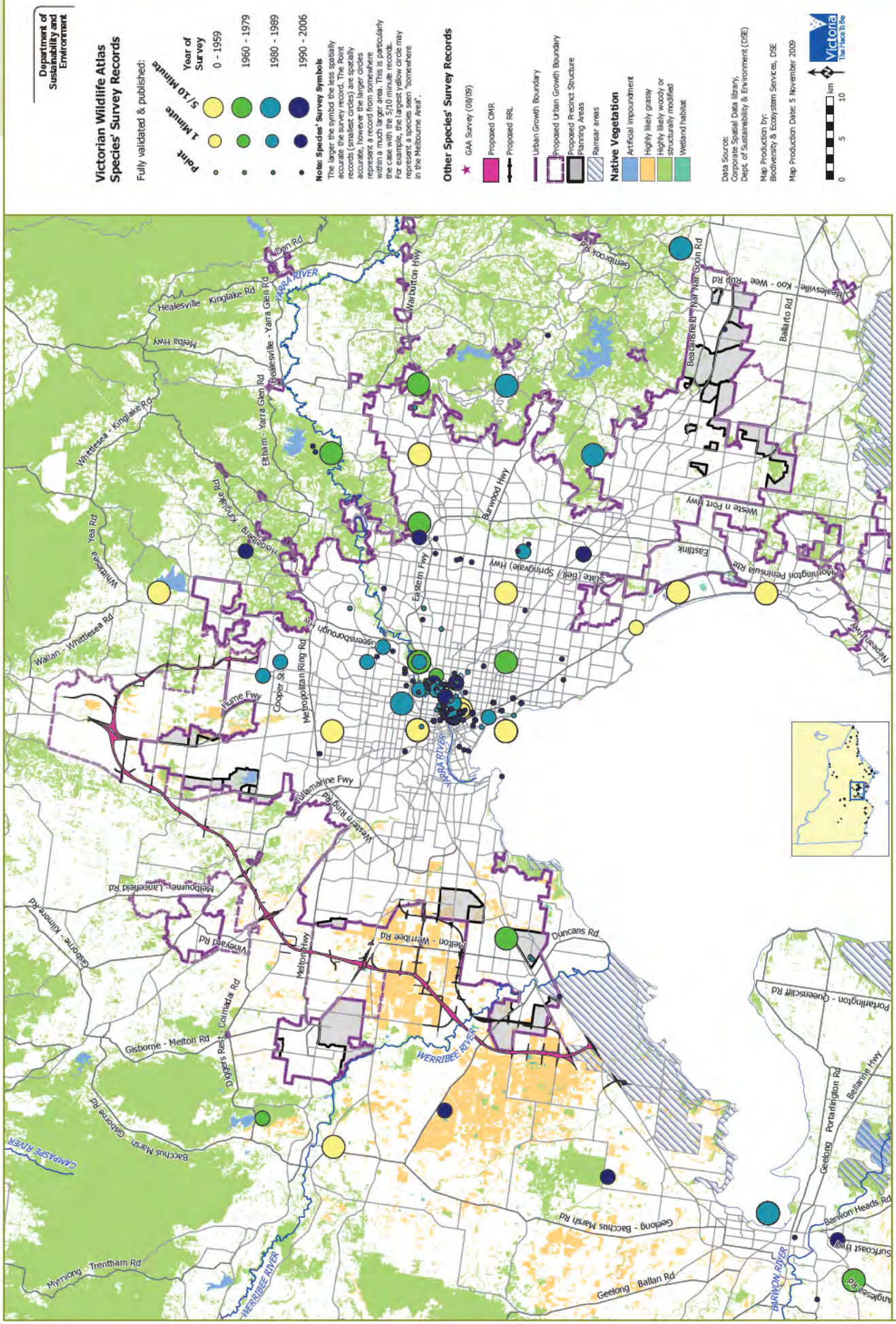
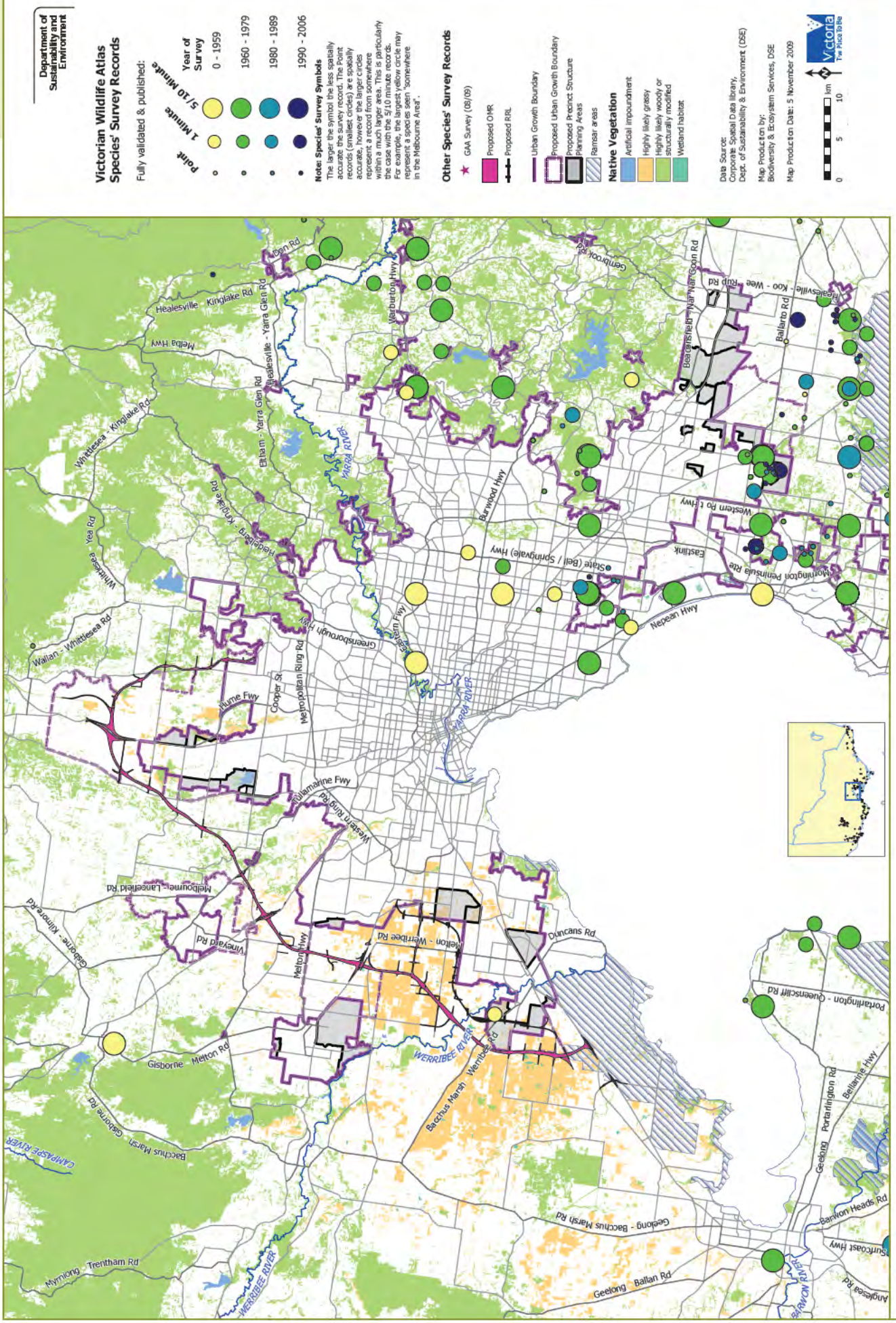


FIGURE 24. SURVEY RECORDS OF SOUTHERN BROWN BANDICOOT *(Isoodon obesulus obesulus)*



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AUSTRALIAN PAINTED SNIPE

The Australian Painted Snipe (*Rostratula australis*) is a stocky wading bird around 25cm in length (Department of the Environment, Water, Heritage and the Arts 2009f). It is listed as vulnerable, migratory and marine under the EPBC Act.

Australian Painted Snipe is usually found in shallow inland wetlands, either freshwater or brackish, which are either permanently or temporarily filled (Department of the Environment, Water, Heritage and the Arts 2009f). It is a cryptic bird that is hard to see and often overlooked (Department of the Environment, Water, Heritage and the Arts 2003). It has been recorded in two locations in the south-west of the Melbourne West Investigation Area (Birds Australia 2009) (Figure 25).

SWIFT PARROT

The Swift Parrot (*Lathamus discolor*) is a small, fast-flying parrot found in eucalypt forests in south eastern Australia (Swift Parrot Recovery Team 2001). It was listed as endangered under the EPBC Act in July 2000.

Swift Parrots breed in Tasmania and migrate to mainland Australia in autumn. During winter it is semi-nomadic, foraging for lerps or nectar in flowering eucalypts, mainly in the Box-Ironbark Forests and woodlands inland of the Great Dividing Range in Victoria and New South Wales (Swift Parrot Recovery Team 2001) (Figure 26). However, there are a few records each year from suburban Melbourne, and in the dry forests and woodlands of the Melbourne and Geelong districts (Swift Parrot Recovery Team 2001). Within the Greater Melbourne area, its favoured forage trees are Grey Box (*Eucalyptus microcarpa*). However, during poor flowering seasons, Swift Parrots may forage for lerps on Red Gums (*Eucalyptus camaldulensis*).

GROWLING GRASS FROG

The Growling Grass Frog or Southern Bell Frog (*Litoria raniformis*) is a large frog up to 10cm in length, varying from dull olive to bright emerald-green with irregular golden-bronze blotches (Clemann and Gillespie 2007). It occurs in south-eastern Australia, including South Australia, Victoria, Tasmania, New South Wales and the Australian Capital Territory. It was listed as vulnerable under the EPBC Act in July 2000.

The Growling Grass Frog's habitat is permanent or seasonally flooded slow moving waterbodies for breeding, aquatic vegetation for shelter and foraging, and logs and debris for over-wintering. The species is known to utilise artificial habitat such as farm dams, flooded quarries and constructed wetlands. Adults are known to travel two kilometers between waterbodies, sometimes travelling up to one kilometer in 24 hours using vegetated areas, such as paddocks and drainage lines, for movement (Clemann and Gillespie 2007). Viable populations rely on a matrix of aquatic and terrestrial habitat across the landscape (Department of the Environment, Water, Heritage and the Arts 2008).

FIGURE 25. SURVEY RECORDS OF AUSTRALIAN PAINTED SNIPE *(Rostratula australis)*

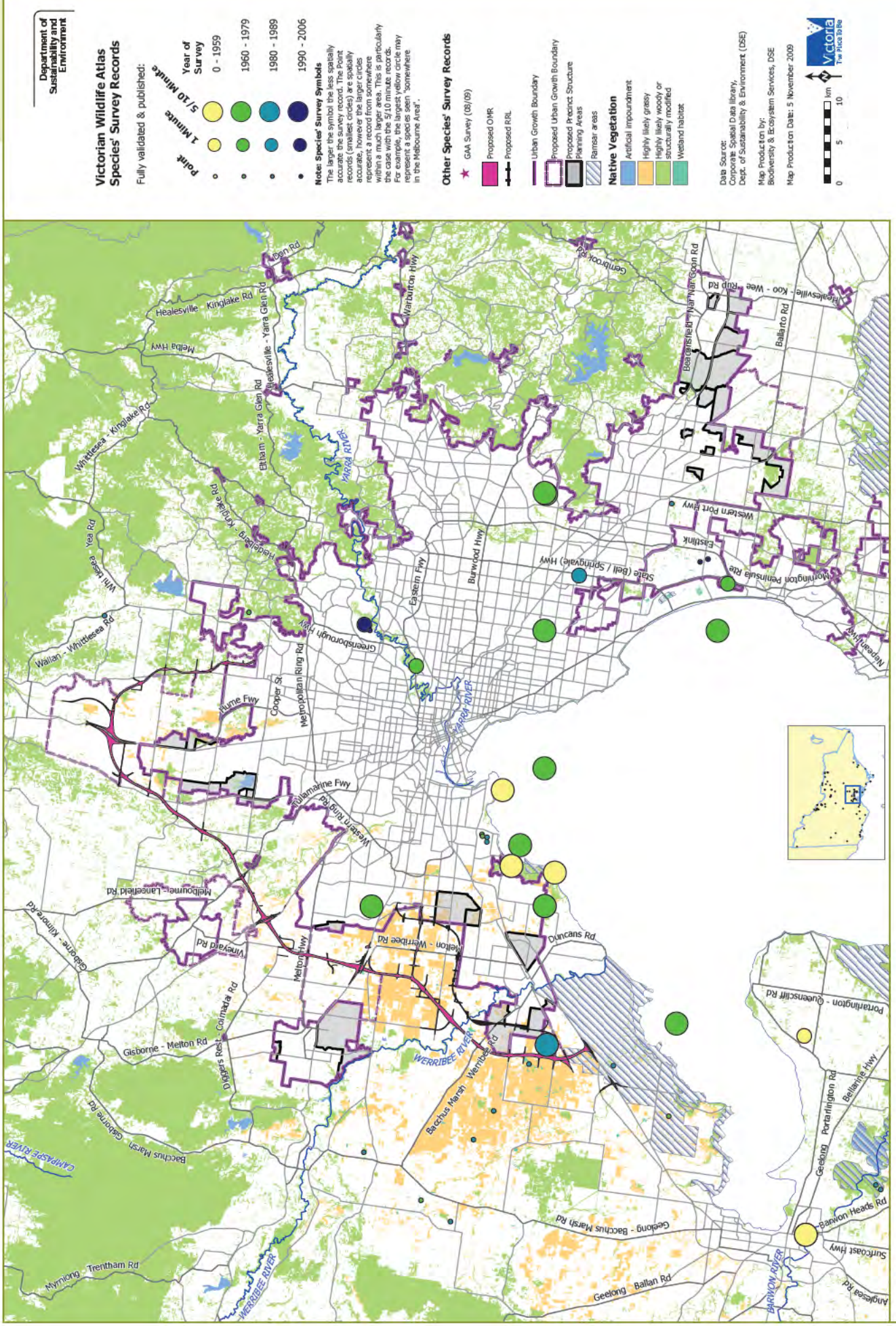

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FIGURE 26. SURVEY RECORDS OF SWIFT PARROT *(Lathamus discolour)*

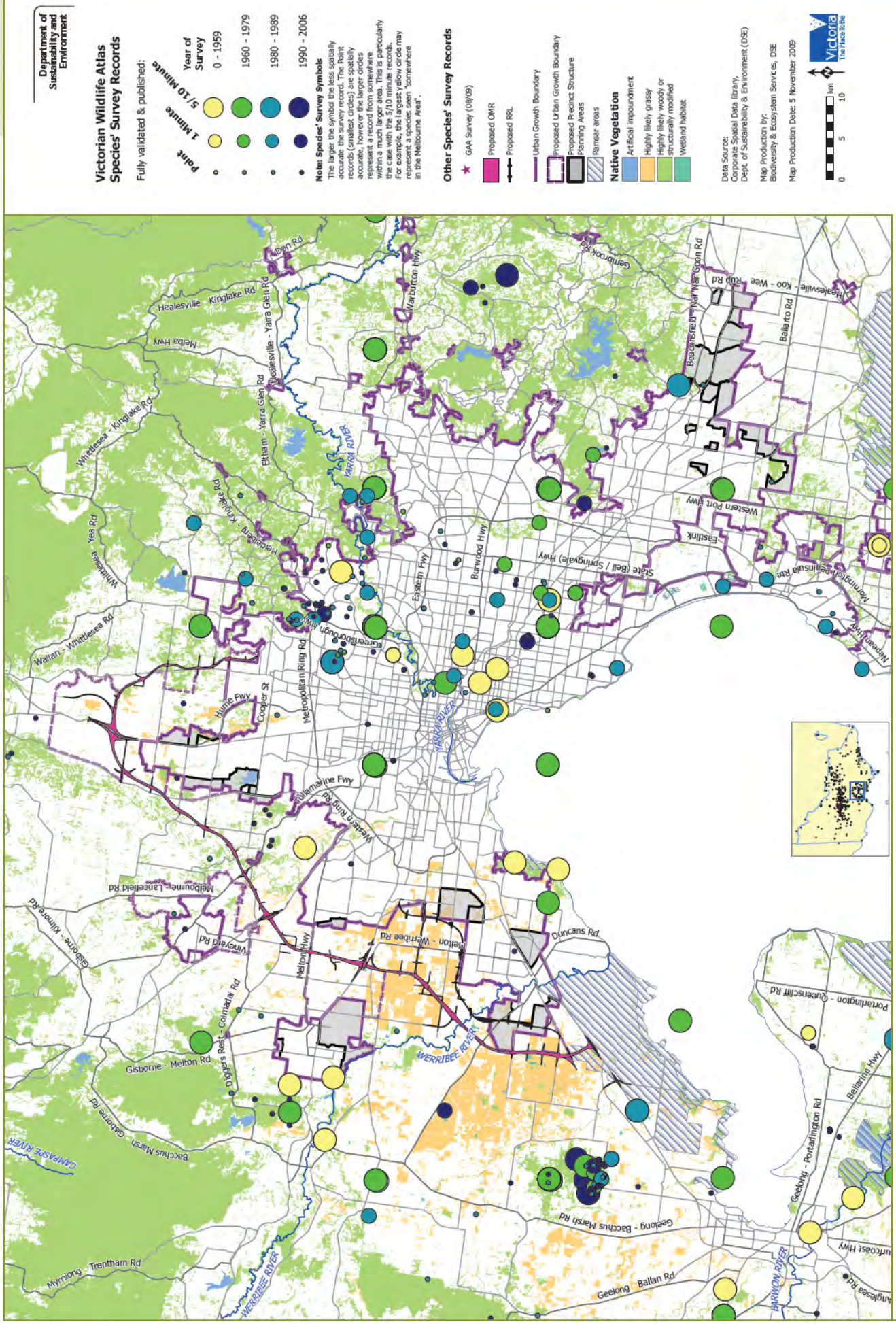
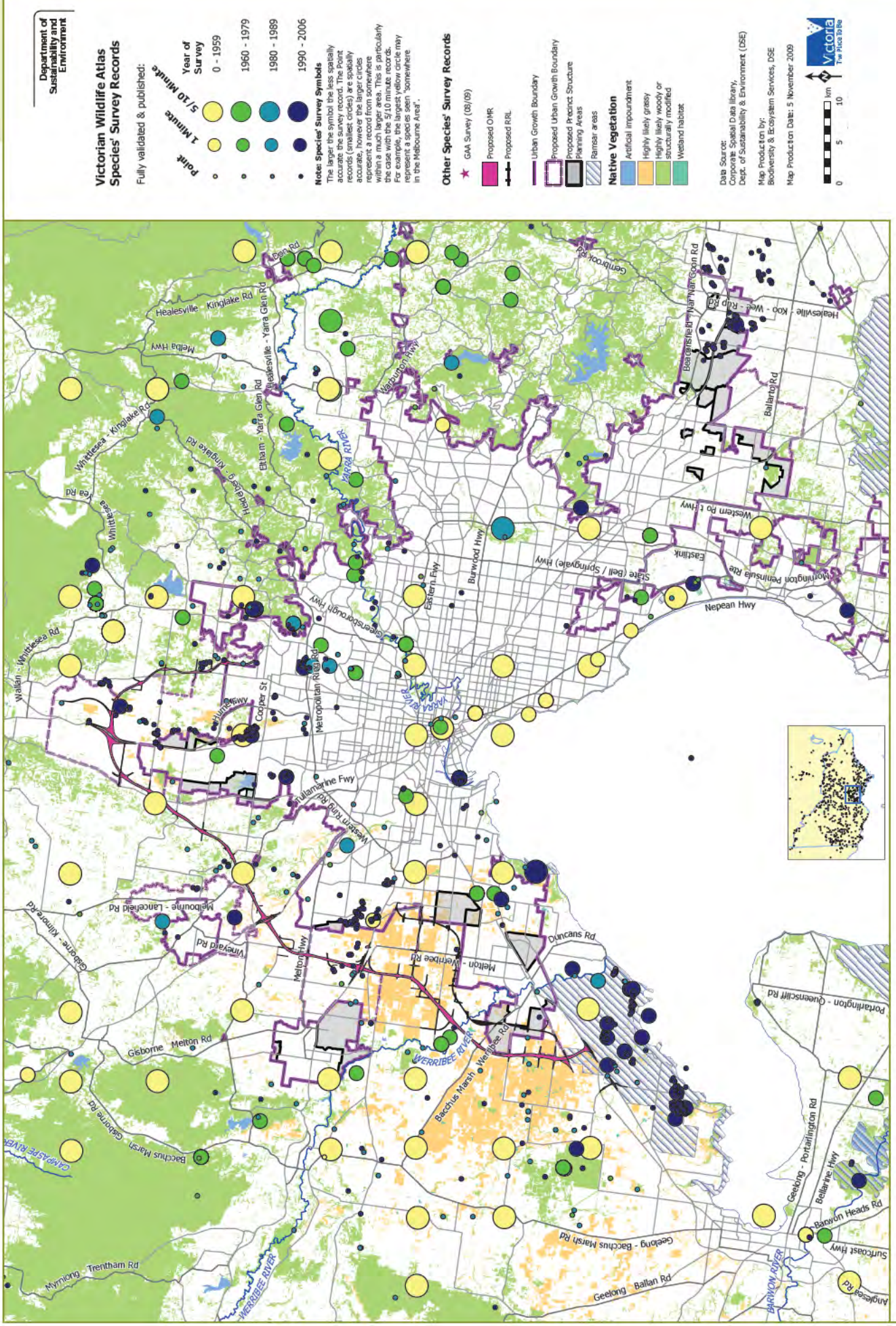


FIGURE 27. SURVEY RECORDS OF GROWLING GRASS FROG *(Litoria raniformis)*



There are currently many sites in Victoria where the Growling Grass Frog is known to occur, including many in the Greater Melbourne area (Figure 27). Within the study area, an important population occurs along the Merri Creek within the Melbourne North Investigation Area and also along the nearby Darebin Creek. The species has also been recorded sporadically in the Melbourne West Investigation Area and in the area proposed for the Western Grassland Reserves, generally in association with key waterways. It is well known in the south-east of Melbourne. It has been recorded within proposed precincts immediately east of the Melbourne South-East Investigation Area and there are extensive populations in the Pakenham area to the immediate north-east, within the existing Urban Growth Boundary (Figure 27). These Pakenham populations probably meet the criteria for an important population (Department of the Environment, Water, Heritage and the Arts 2008). Despite not being recorded within the Melbourne South-East Investigation Area, there is suitable habitat (natural and artificial) and the species is assumed to be present.

AUSTRALIAN GRAYLING

The Australian Grayling (*Prototroctes mareana*) is small to medium-sized, slender fish endemic to south-eastern Australia (Backhouse et al. 2008). The species is listed as vulnerable under the EPBC Act.

Australian Grayling migrate between rivers, their estuaries and coastal seas, so rely on free access to a range of habitat for survival (Backhouse et al. 2008). This species has been recorded within Cardinia Creek, which flows through the Melbourne South-East Investigation Area and adjacent proposed precincts (Backhouse et al. 2008) (Figure 28).

DWARF GALAXIAS

The Dwarf Galaxias (*Galaxiella pusilla*) is a tiny freshwater fish endemic to south-east Australia (Saddlier et al. 2008) (Figure 3). The species is listed as vulnerable under the EPBC Act, and as threatened under the FFG Act.

The Dwarf Galaxias typically occurs in slow flowing and still, shallow, freshwater habitats such as swamps, drains and the backwaters of streams and creeks (Cadwallader & Backhouse 1983; McDowall 1996; Hammer 2002 in Saddlier et al. 2008). Some wetlands where it occurs may partially or completely dry up during summer (Humphries 1986 in Saddlier et al. 2008). Such wetlands rely on seasonal flooding and linkages to other sites where the species occurs for habitat and population replenishment. The degree of wetland connectivity to a more permanent waterbody (such as river or creek) may be vital to the long term survival of this species, particularly during extended dry conditions (Saddlier et al. 2008).

The Dwarf Galaxias is still widely distributed, but populations are fragmented and patchy across the landscape within the Greater Melbourne area (Figure 29).

FIGURE 28. SURVEY RECORDS OF AUSTRALIAN GRAYLING *(Prototroctes maraena)*

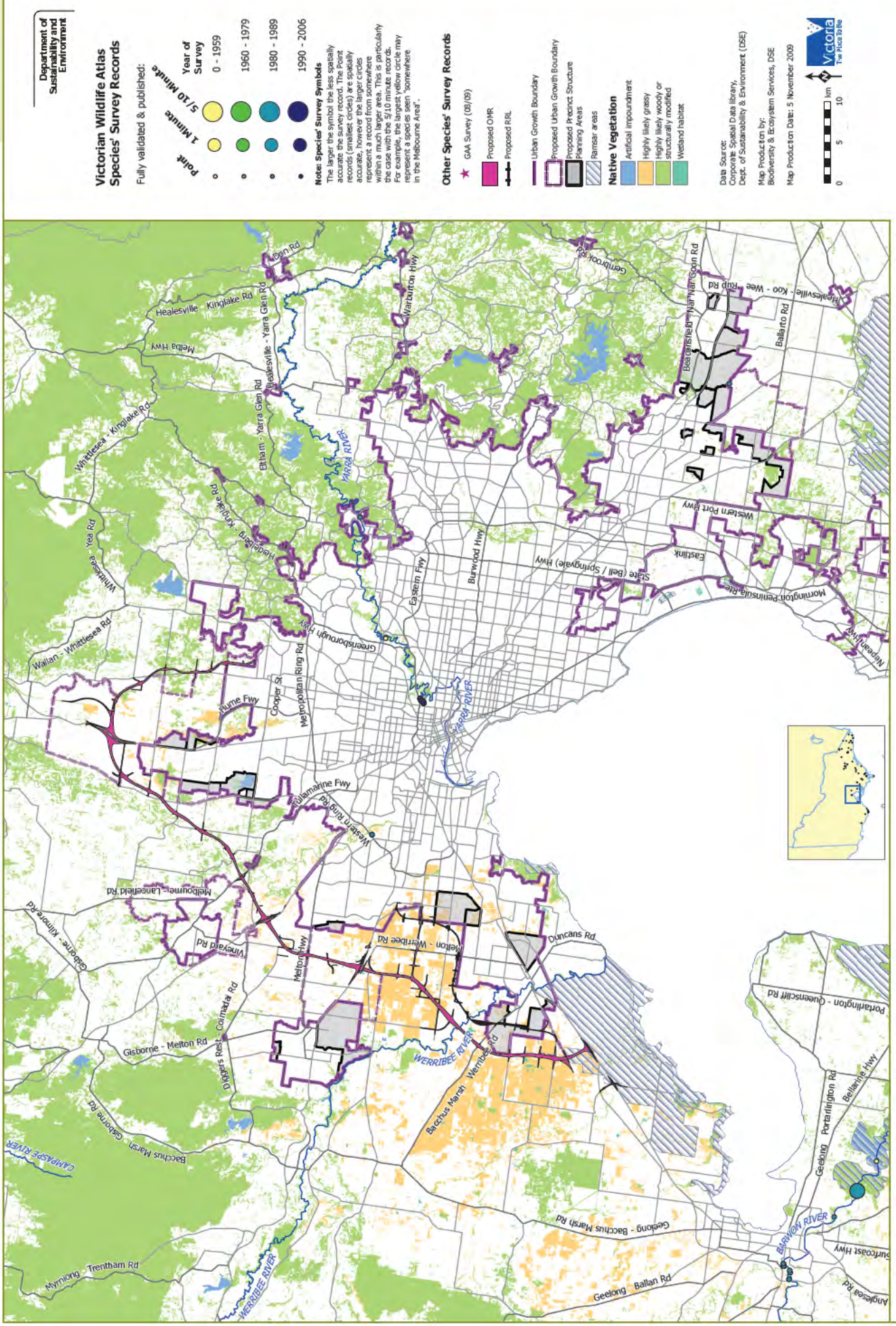


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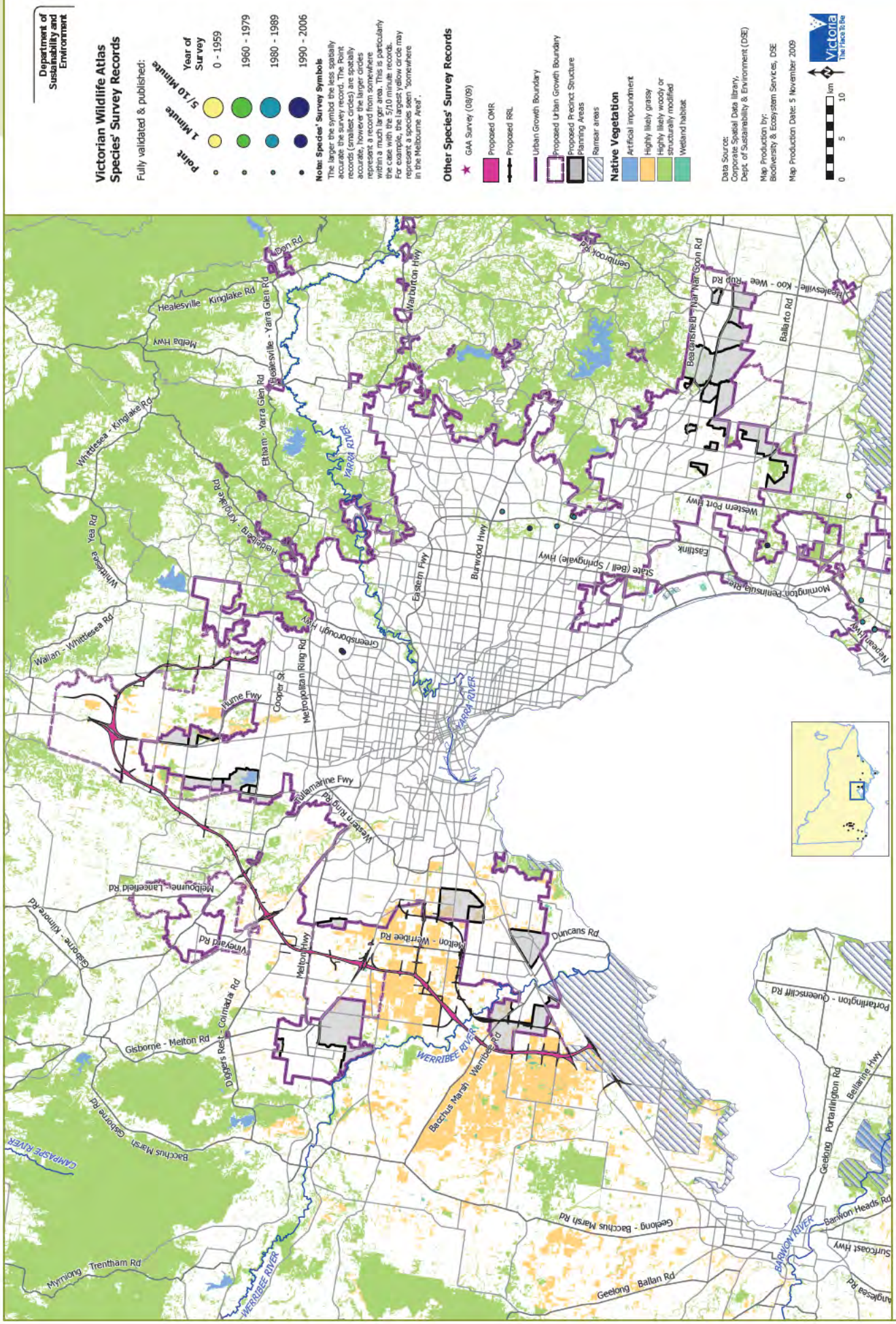
FIGURE 29. SURVEY RECORDS OF DWARF GALAXIAS *(Galaxiella pusilla)*



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MAROON LEEK-ORCHID

Maroon Leek-orchid (*Prasophyllum frenchii*) is a tall, slender, deciduous terrestrial orchid endemic to south-eastern Australia (Duncan *unpublished*). Although not a grassland specialist, grasslands and grassy woodlands are important habitats for the species (Jeanes and Backhouse 2006). It is listed as endangered under the EPBC Act and threatened under the FFG Act.

The Maroon Leek-orchid is currently known only from seven populations containing about 1,000 plants. These include approximately 100 plants in a rail reserve at Clyde (Duncan *unpublished*) (Figure 30). Part of the population at Clyde is within the South-East Investigation Area.

RIVER SWAMP WALLABY-GRASS

River Swamp Wallaby-grass (*Amphibromus fluitans*) is a slender aquatic or semi-aquatic perennial grass. It is listed as vulnerable under the EPBC Act.

Numerous populations of River Swamp Wallaby-grass exist in northern Victoria. It is also known in several localities in the south Gippsland, Melbourne (Lysterfield, Werribee), Ballarat, and Portland-Casterton areas (Threatened Species Scientific Committee 2008a). It grows mostly in permanent swamps. This species has also been recorded within the Melbourne West Investigation Area (Figure 31). It most likely occurs in the wetlands to the south of Ballan Road (Biosis 2009).

SWAMP EVERLASTING

Swamp Everlasting (*Xerochrysum palustre*) is a perennial herb in the daisy family (Carter and Walsh 2006). It is listed as vulnerable under the EPBC Act and threatened under the FFG Act (where it is listed as *Bracteantha* sp. aff. *subundulata*).

The Swamp Everlasting grows in wetlands including sedge-swamps and shallow freshwater marshes, often on heavy black clay soils (Oberon and Walsh 2006). This species has been recorded on the edge of the Melbourne South-East Investigation Area near Clyde (Figure 32).

FIGURE 30. SURVEY RECORDS OF MAROON LEEK-ORCHID *(Prasophyllum frenchii)*

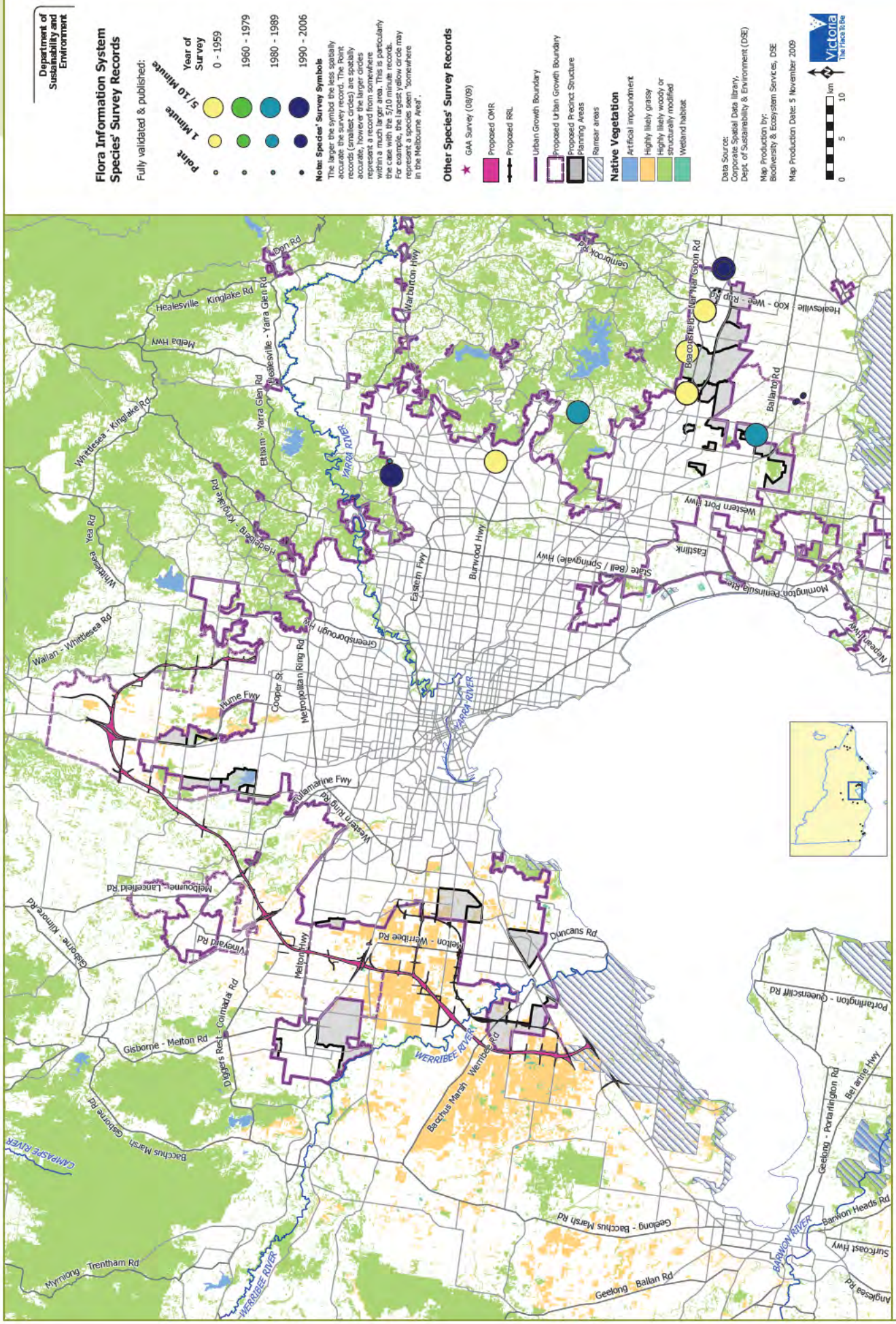

FIGURE 31. SURVEY RECORDS OF RIVER SWAMP WALLABY-GRASS *(Amphibromus fluitans)*

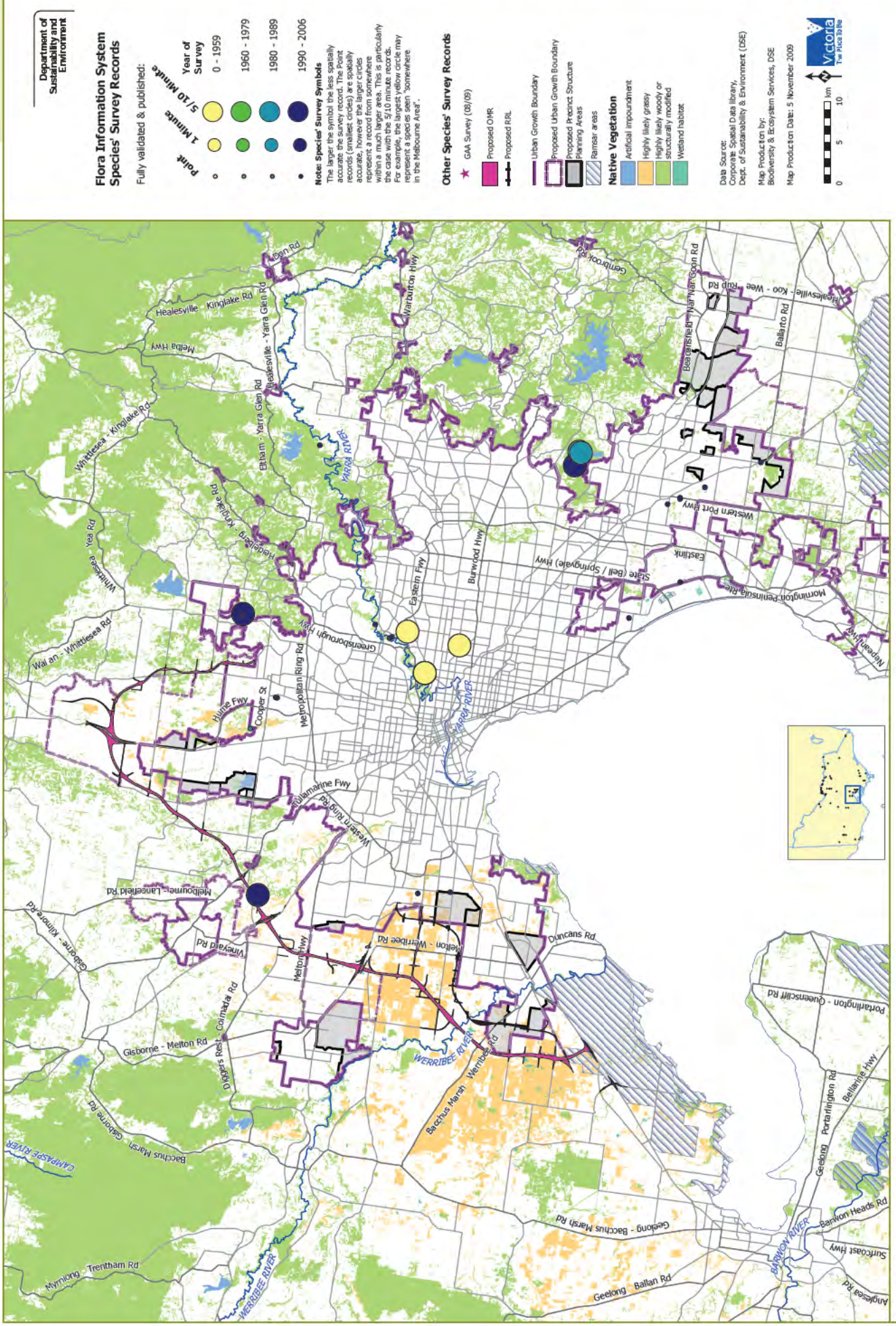

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FIGURE 32. SURVEY RECORDS OF SWAMP EVERLASTING *(Xerochrysum palustre)*

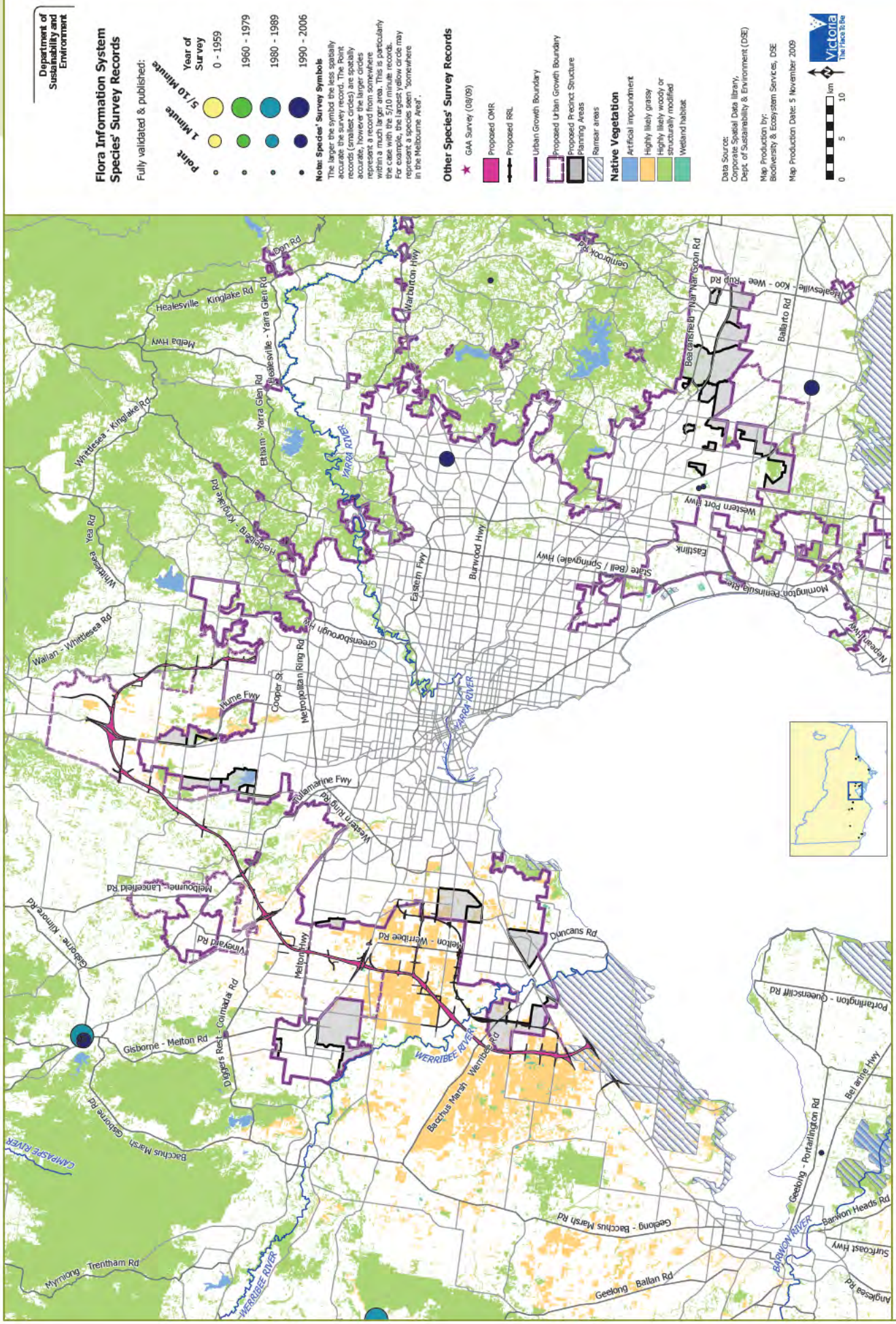

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TABLE 1: THREATENED FAUNA SPECIES LISTED UNDER THE EPBC ACT IDENTIFIED AS POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Species	EPBC listing	Likelihood of regular occurrence within study area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
MAMMALS					
Eastern-barred Bandicoot (Mainland) *Perameles gunnii* unnamed subsp.	Endangered	Negligible	Negligible	Negligible	The only current population near Melbourne is a colony established for captive breeding at Woodlands Historic Park near Tullamarine Airport. No other recent records from study area.
Grey-headed Flying-fox *Pteropus poliocephalus*	Vulnerable	Low–moderate	Low–moderate	Low–moderate	Can be assumed to be an occasional visitor in suitable foraging habitat in study area. Refer to text for discussion.
Leadbeater's Possum *Gymnobelideus leadbeateri*	Endangered	Negligible	Negligible	Negligible	Not known in study area and no suitable habitat.
Long-nosed Potoroo *Potorous longipes*	Vulnerable	Negligible	Negligible	Negligible	Not known in study area and no suitable habitat.
Smoky Mouse *Pseudomys fumeus*	Endangered	Negligible	Negligible	Negligible	Not known in study area and no suitable habitat.
Southern Brown Bandicoot *Isoodon obesulus obesulus*	Endangered	Negligible	Negligible	Moderate	Recent records south-east of Melbourne (see map), including in Cranbourne area. Importance of particular sites will need to be determined. Refer to text for discussion.
Spotted-tail Quoll *Dasyurus maculatus maculatus*	Endangered	Negligible	Negligible	Negligible	No recent records in study area and no suitable habitat.
BIRDS					
Australian Painted Snipe *Rostratula australis*	Vulnerable	Moderate	Low	Moderate	Previously recorded within the study area. Refer to text for discussion.
Helmeted Honeyeater *Lichenostomus melanops cassidix*	Endangered	Negligible	Negligible	Negligible	No recent records in study area and no suitable habitat.

Species	EPBC listing	Likelihood of regular occurrence within study area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
Orange-bellied Parrot *Neophema chrysogaster*	Critically endangered (marine/ migratory)	Low	Negligible	Low	Can be assumed to be an occasional visitor in suitable habitat in study area, however important habitat for the species highly unlikely to occur in Investigation Areas.
Plains-wanderer *Pedionomus torquatus*	Vulnerable	Low–moderate	Low	Negligible	Previously recorded in study area. Preferred habitat is grassland vegetation. Refer to text for discussion.
Superb Parrot *Polytelis swainsonii*	Vulnerable	Negligible	Negligible	Negligible	May be an occasional visitor in suitable habitat in study area, however recorded individuals most likely to be escapees.
Swift Parrot *Lathamus discolour*	Endangered	Low	Low–moderate	Low	Suitable foraging habitat present in the Melbourne North Investigation Area, but only very few individuals observed during annual surveys. Refer to text for discussion.
Regent Honeyeater *Anthochaera phrygia*	Endangered (marine/ migratory)	Negligible	Negligible	Negligible	Known breeding sites to the north-east of Melbourne (Plenty Gorge and Warrandyte State Park) but not within study area where there is insufficient suitable habitat.
REPTILES					
Corangamite Water Skink *Eulamprus tympanum marnieae*	Endangered	Negligible	Negligible	Negligible	Restricted to the basalt plains of south-western Victoria, between Colac in the south-east and Lake Bolac in the north-west (Robertson 1998).
Grassland Earless Dragon *Tympanocryptis pinguicolla*	Endangered	Low	Low	Negligible	The last confirmed sightings in Victoria were from the Rockbank area in 1968 and the Geelong area in 1969 (Robertson and Evans 2004). Sightings between 1988 and 1990 not confirmed despite survey effort. Refer to text for discussion.
Striped Legless Lizard *Delmar impar*	Vulnerable	High	High	Negligible	Can be assumed to be present as resident or regular user of suitable habitat. Often difficult to detect during general/standard field assessments but habitat requirements well understood. Refer to text for discussion.

Species	EPBC listing	Likelihood of regular occurrence within study area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
AMPHIBIANS					
Growling Grass Frog *Litoria raniformis*	Vulnerable	High	High	High	Can be assumed to be present as resident or regular user of suitable habitat. Relatively easily detected during general/standard field assessments. Refer to text for discussion.
FISH					
Australian Grayling *Prototroctes maraena*	Vulnerable	Negligible	Negligible	High	This species has been recorded within in Cardinia Creek which flows through the Melbourne South-East Investigation Area and adjacent proposed precincts (Backhouse et al. 2008). Refer to text for discussion.
Dwarf Galaxias *Galaxiella pusilla*	Vulnerable	Negligible	Negligible	Moderate–high	Likely to occur in creeks or wetlands within the Melbourne South-East Investigation Area. Refer to text for discussion.
Macquarie Perch *Macquaria australasica*	Endangered	Negligible	Negligible	Negligible	In Victoria, Macquarie Perch is thought to be confined to the Murray-Darling Basin (Department of the Environment, Water, Heritage and the Arts 2009a) outside the study area.
Murray Cod *Maccullochella peelii peelii*	Vulnerable	Negligible	Negligible	Negligible	The species occurs naturally in the waterways of the Murray Darling Basin (Department of the Environment, Water, Heritage and the Arts 2009b) outside the study area.
Yarra Pygmy-perch *Nannoperca abscura*	Vulnerable	Negligible	Negligible	Negligible	Populations in the Yarra River and Dandenong Creek presumed extinct. Unlikely to occur within creeks and rivers in the study area.
INVERTEBRATES					
Golden Sun Moth *Synemon plana*	Critically endangered	High	High	Low	Can be assumed to be present as resident or regular user of suitable habitat. Importance of particular sites will need to be determined. Refer to text for discussion.
Giant Gippsland Earthworm *Megascolides australis*	Vulnerable	Negligible	Negligible	Negligible	Not known in study area and no suitable habitat.

TABLE 2: THREATENED FLORA SPECIES LISTED, OR NOMINATED FOR LISTING, UNDER THE EPBC ACT THAT HAVE BEEN IDENTIFIED AS POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Species	EPBC listing	Likelihood of Occurrence within Study Area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
Adamson's Blown-grass *Lachnagrostis adamsonii*	Endangered	Low	Negligible	Negligible	Some recent records from Greater Melbourne area, but no recent records in the study area. Refer to text for discussion.
Austral Toadflax *Thesium australe*	Vulnerable	Low	Low	Negligible	Possibly extinct in Melbourne. No recent records from the study area. Refer to text for discussion.
Basalt Greenhood *Pterostylis basaltica*	Endangered	Negligible	Negligible	Negligible	No recent records from the study area. Has a very localised distribution and is now known in one locality in western Victoria (Ingeme and Backhouse 1999).
Basalt Peppercress *Lepidium hyssopifolium*	Endangered	Low	Low	Negligible	One recent record from Greater Melbourne area, but no recent records in the study area (see Figure 32). Refer to text for discussion.
Bellarine Yellow-Gum *Eucalyptus leucoxylon* subsp. *bellarinensis*	Being assessed for listing	Negligible	Negligible	Negligible	The Bellarine Peninsula supports the only known locations of this subspecies (Department of Sustainability and Environment 2003a). No records from the study area.
Button Wrinklewort *Rutidosis leptorrhynchoides*	Endangered	Moderate	Low	Negligible	Some recent records from within the study area. Refer to text for discussion.
Charming Spider-orchid *Arachnorchis amoena* (syn. *Caladenia amoena*)	Endangered	Negligible	Negligible	Negligible	Known from two populations on public land at Plenty and private land at Wattle Glen. Previous range across the Greensborough-Plenty-Hurstbridge area to the north-east of Melbourne (Todd 2000). No records from within study area and lack of suitable habitat.
Clover Glycine *Glycine latrobeana*	Vulnerable	Moderate	Moderate	Low	Grows mainly in grasslands and grassy woodlands (Jeanes 1996). Found in Greater Melbourne area. Refer to text for discussion.

Species	EPBC listing	Likelihood of Occurrence within Study Area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
Cream Spider-orchid *Arachnorchis orientalis* (syn. *Caladenia fragrantissima* ssp *orientalis*)	Endangered	Negligible	Negligible	Low	Previous range extended from the eastern shores of Port Phillip Bay to Wilsons Promontory. Grows in coastal environments. Now known at Rosebud, Wonthaggi, Cape Patterson and Walkerville (Todd 2000). No recent records from the study area, but may potentially occur in Cranbourne area. Refer to text for discussion.
Curly Sedge *Carex tasmanica*	Vulnerable	Low	High	Low	Is now known in only nine sites of remnant grasslands in Victoria: at Craigieburn; Lake Condah; and near Portland (Department of Sustainability and Environment 2004a). Recent records from within the Greater Melbourne area including the study area. Importance of particular sites will need to be determined. Refer to text for discussion.
Fragrant Leek-orchid *Prasophyllum suaveolens*	Endangered	Negligible	Negligible	Negligible	Presumed extinct in Melbourne. Now known in only five populations in western Victoria (Department of Sustainability and Environment 2003b).
Gorae Leek-orchid *Prasophyllum diversiflorum*	Endangered	Negligible	Negligible	Negligible	No records from study area. Known from six isolated populations in south west Victoria, extending from the Cobboboonee State Forest in the west, to Orford in the south and private land near Glenthompson in the north (Ingeme and Govanstone1999).
Green-striped Greenhood *Pterostylis chlorogramma*	Vulnerable	Negligible	Negligible	Low	Grows in moist areas in open forest. No records from the study area (see Figure 35), but may potentially occur in Cranbourne area. Refer to text for discussion.
Hoary Sunray *Leucochrysum albicans* var. *tricolor*	Endangered	Negligible	Negligible	Negligible	Presumed extinct in the Melbourne area. No recent records despite being highly conspicuous when flowering.
Large-fruit Groundsel *Senecio macrocarpus*	Vulnerable	High	Low	Low	Found in grasslands and grassy woodlands west of Melbourne (Department of Sustainability and Environment 1996). Recent records from within the study area. Refer to text for discussion.

Species	EPBC listing	Likelihood of Occurrence within Study Area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
Maroon Leek-orchid *Prasophyllum frenchii*	Endangered	Negligible	Negligible	Moderate–high	Known from Melbourne South-East Investigation Area at Clyde near Cranbourne. Refer to text for discussion.
Matted Flax-lily *Dianella amoena*	Endangered	High	High	High	Many records from within the Greater Melbourne area including the Melbourne South-East Investigation Area (see map). Refer to text for discussion.
Metallic Sun-orchid *Thelymitra epipactoides*	Endangered	Negligible	Negligible	Low	Known with certainty from eight main populations in Victoria in the south-west and Gippsland (Coates et al. 2003). There are no recent records from the study area (see map), but may potentially occur in Cranbourne area based on habitat requirements. Refer to text for discussion.
River Swamp Wallaby-grass *Amphibromus fluitans*	Vulnerable	High	High	High	Recent records in the Greater Melbourne area, including the study area. Importance of particular sites will need to be determined. Refer to text for discussion.
Round-leaf Pomaderris *Pomaderris vacciniifolia*	Being assessed for listing	Negligible	Negligible	Negligible	The species is known to occur to the north-east of Melbourne in the Eltham-Kinglake-Castella area and in Gippsland (Cameron 2005). No populations or suitable habitat known in the study area.
Small Golden Moths *Diuris basaltica*	Endangered	High	Low	Negligible	Recent records from the Greater Melbourne area, including the study area. Refer to text for discussion.
Southern Shepherd's Purse *Ballantinia antipoda*	Endangered	Negligible	Negligible	Negligible	Presumed extinct from Melbourne area. Now known only from several sites in the Mount Alexander Regional Park, 30km south of Bendigo (Alexander 1999).
Spiny Peppercress *Lepidium aschersonii*	Vulnerable	Low	Negligible	Negligible	Formerly widespread in western Victoria, only 14 stands in eight localities are known to exist in Victoria far from the study area: in the western district near Colac, and Lake Omeo at Benambra (Department of Sustainability and Environment 2004b).

Species	EPBC listing	Likelihood of Occurrence within Study Area			Comments
		West Investigation Area	North Investigation Area	South-East Investigation Area	
Spiny Rice-Flower *Pimelea spinescens* subsp. *spinescens*	Critically endangered	High	Moderate	Negligible	Recent records from study area (see Map). Relatively easily detected during general/ standard field assessments. Refer to text for discussion.
Strzelecki Gum *Eucalyptus strzeleckii*	Vulnerable	Negligible	Negligible	Negligible	No records from Greater Melbourne area. Occurs east of Westernport Bay (Carter 2006) well outside the study area.
Sunshine Diuris *Diuris fragrantissima*	Endangered	Low	Negligible	Negligible	Known from only one secure site in Sunshine despite historical searches (Murphy et al. 2008). Highly unlikely to occur elsewhere due to grazing sensitivity. . Refer to text for discussion.
Swamp Everlasting *Xerochrysum palustre*	Vulnerable	Low	Low	Moderate	Scattered populations across western Victoria including one to the north and one to the south-east of Melbourne. Refer to text for discussion.
Swamp Fireweed *Senecio psilocarpus*	Vulnerable	Low	High	Negligible	Scattered populations across western Victoria including one to the north and one to the south-east of Melbourne. Refer to text for discussion.
Tall Astelia *Astelia australiana*	Vulnerable	Negligible	Negligible	Negligible	All 12 known colonies are within a relatively small area in the Powelltown-Beenak area of the Central Highlands, except for one colony in the Lavers Hill area of the Otway Ranges (Department of Sustainability and Environment 1991). No suitable habitat in the study area.
Trailing Hop-bush *Dodonaea procumbens*	Vulnerable	Negligible	Negligible	Negligible	Does not occur within the Greater Melbourne area and no suitable habitat in the study area.
Werribee Blue Box *Eucalyptus baueriana* subsp. *thalassina*	Being assessed for listing	Low	Negligible	Negligible	Not recorded in study area during recent surveys despite being highly conspicuous. Recorded outside of the Melbourne West Investigation Area.
White Star bush *Asterolasia asteriscophora* subsp. *albiflora*	Being assessed for listing	Negligible	Negligible	Negligible	This subspecies is known only from three localities in the Emerald-Avonsleigh district of Victoria, which is outside the study area (Mole 2002).

5.4 LISTED MIGRATORY SPECIES AND THEIR HABITATS

5.4.1 SHOREBIRDS RECORDED WITHIN THE STUDY AREA

The shorebirds that are found in the Greater Melbourne area are primarily dependent on wetland or coastal habitats. Existing records indicate that shorebirds occur within the Melbourne West and Melbourne North Investigation Areas. It is likely that they also occur in the Melbourne South-East Investigation Area, but few surveys have been done in this area.

The most common species of shorebirds listed as migratory and/or marine under the EPBC Act that occur within the study area are:

- Latham's Snipe *Gallinago hardwickii* (marine/migratory);
- Masked Lapwing *Vanellus miles*;
- Red-necked Stint *Calidrus ruficolis* (marine/migratory);
- Sharp-tailed Sandpiper *Calidrus acuminate* (marine/migratory);
- Black-winged Stilt *Himantopus himantopus* (marine);
- Common Greenshank *Tringa nebularia* (migratory);
- Red-capped Plover *Charadrius ruficapillus* (marine);
- Curlew Sandpiper *Calidrus ferruginea* (marine/migratory); and
- Marsh Sandpiper *Tringa stagnatilis* (marine/migratory).

No known nationally significant areas for shorebirds occur within the Investigation Areas, although migratory and resident shorebirds have been observed within the proposed development areas and it is possible that nationally significant numbers of shorebirds use some of the wetlands present.

The species most likely to occur in nationally significant numbers within the proposed development areas is Latham's Snipe.

5.4.2 WETLAND BIRDS RECORDED WITHIN THE STUDY AREA

Other than the shorebirds discussed above, a number of wetland-dependent bird species listed as marine and/or migratory under the EPBC Act that have been recorded within the Investigation Areas. These are:

- Australasian Shoveler *Anas rhynchotis* (migratory);
- Australian Pelican *Pelecanus conspicillatus* (marine);
- Australian Reed-Warbler *Acrocephalus australis* (migratory);
- Australian White Ibis *Threskiornis molucca* (marine);
- Blue-billed Duck *Oxyura australis* (migratory);
- Cape Barren Goose *Cereopsis novaehollandiae* (marine);
- Cattle Egret *Ardea ibis* (migratory);
- Crested Tern *Sterna bergii* (marine);
- Eastern Great Egret *Ardea modesta* (marine/migratory);
- Fairy Tern *Sterna niris* (marine);
- Hardhead *Aythya australis* (migratory);
- Musk Duck *Biziura lobata* (marine);
- Pied Cormorant *Phalacrocorax varius* (migratory);
- Purple Swamphen *Porphyrio porphyrio* (migratory);
- Royal Spoonbill *Platalea regia* (migratory); and
- Straw-necked Ibis *Threskiornis spinicollis* (marine).

A further 22 bird species associated with wetlands have been recorded within 10km of the development areas.

Figure 33 shows survey records of migratory species within and near the study area.

5.5 RAMSAR WETLANDS OF INTERNATIONAL IMPORTANCE

Three Ramsar wetlands listed under the EPBC Act occur within, or near, the study area (Figure 33). These are:

- Port Phillip Bay (Western Shoreline) and Bellarine Peninsula;
- Edithvale-Seaford Wetlands; and
- Western Port.

These sites are described below with reference to their ecological character, defined in Ramsar Convention Resolution IX.1: "Ecological character is the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time".

5.5.1 PORT PHILLIP BAY (WESTERN SHORELINE) AND BELLARINE PENINSULA

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site includes parts of the shoreline, intertidal zone and adjacent wetlands of western Port Phillip Bay from Altona south to Limeburners Bay and of the Bellarine Peninsula from Point Henry to Barwon Heads (Casanelia 1999a).

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site includes the Werribee-Avalon area (wetlands) and part of the Point Cook and Laverton Saltworks.

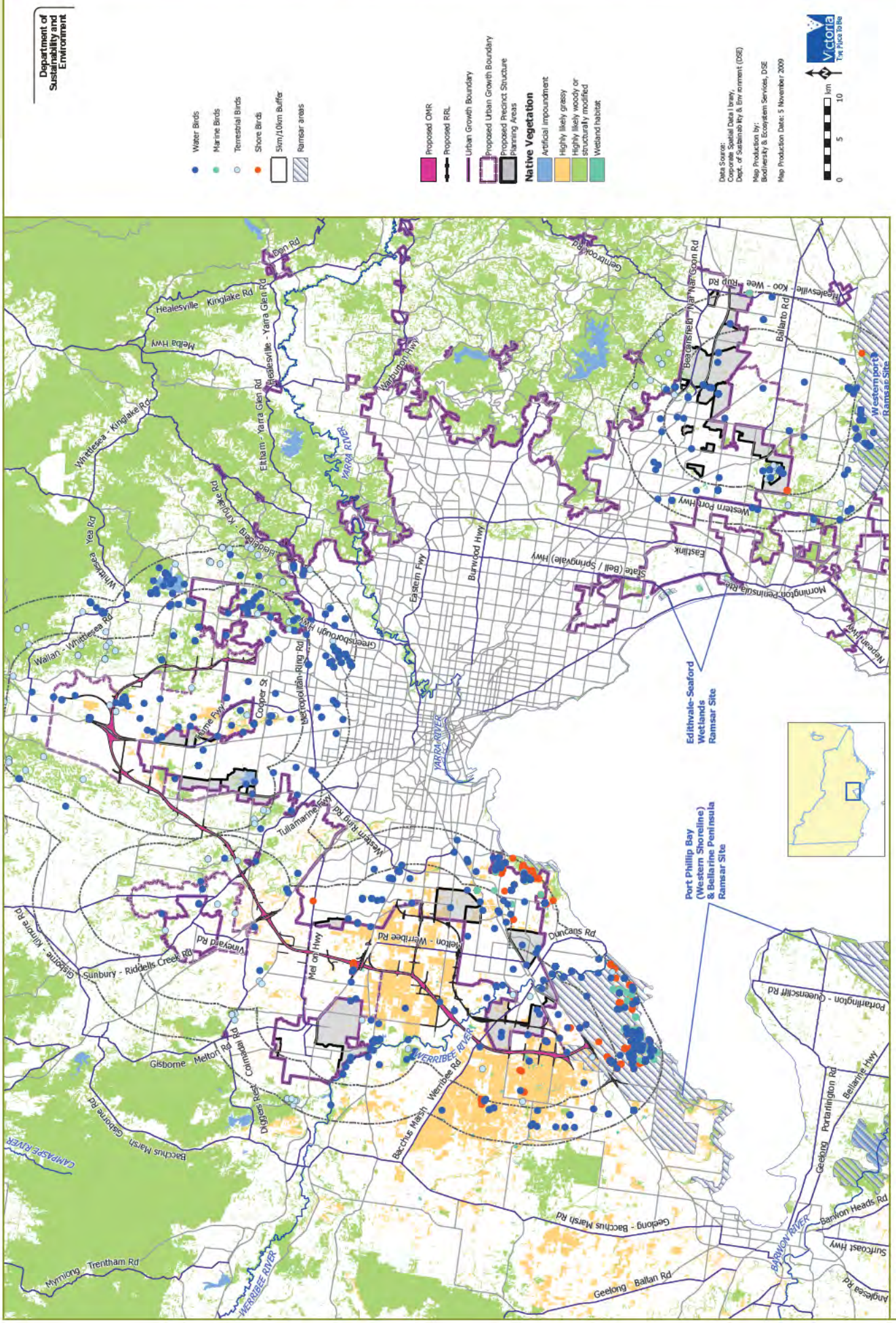
Most of the Port Phillip Bay Ramsar site is outside the study area, but some small sections around Werribee are included in the Melbourne West Investigation Area.

The ecological character of this Ramsar site is described in the 1999 update of the Ramsar Information Sheet (Department of Sustainability and Environment 1999a). A detailed description of the ecological character of the Ramsar site is currently being prepared following the National Framework and guidance for describing the ecological character of Australian Ramsar wetlands (see http://www.environment.gov.au/water/publications/environmental/wetlands/module-2-framework.html for reference).

The site includes a variety of wetland types ranging from shallow marine waters to seasonal freshwater swamps and extensive sewage ponds, including intertidal mudflats, seagrass beds and saltmarshes, which support a large and diverse population of migratory waders, seabirds and waterfowl and demonstrate a range of geomorphic processes. The opening of Port Phillip Bay to the ocean is very narrow, reducing tidal amplitude within the bay compared with Bass Strait. Almost four million people live around the Bay, which is used intensively for recreation.

The Port Phillip Bay Ramsar site was designated primarily in recognition of its high value as habitat for waterbirds (Department of Sustainability and Environment 2003c). It is the sixth most important area in Australia, and most important area in Victoria, for migratory waders. It contains the most important known wintering sites for the critically endangered Orange-bellied Parrot, with highest numbers occurring at The Spit, the Western Treatment Plant, Swan Bay, Swan Island (adjacent to the Ramsar site) and Lake Connewarre (Department of Sustainability and Environment 2003c).

FIGURE 33. SURVEY RECORDS OF MIGRATORY SPECIES; AND RAMSAR SITES



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The Port Phillip Bay Ramsar site met the following specific criteria when it was listed in 1982 (from Department of Sustainability and Environment 1999a and Department of Sustainability and Environment 2003c). It should be noted that the Ramsar Secretariat has subsequently revised the criteria for identifying a Ramsar wetland and an updated Ramsar Information Sheet is currently being prepared which will state the revised criteria for which the site is listed:

Criterion 1(a) *The wetland is a particularly good representative example of a natural or near-natural wetland characteristic of the appropriate biogeographical region.*

The Ramsar site includes a range of marine and inland wetlands characteristic of the Victorian Volcanic Plain bioregion as well as artificial wetlands. All eight of Victoria's wetland categories are included within the site.

Criterion 1(b) *The wetland is a particularly good representative example of a natural or near-natural wetland common to more than one biogeographical region.*

The Ramsar site contains good examples of saltmarshes, estuarine wetlands and a shallow marine embayment and nearshore areas.

Criterion 2(b) *A wetland is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna.*

The Ramsar site is one of the most important sites in Victoria for migratory shorebirds. The site contains 332 indigenous flora species, including two nationally threatened and 22 state threatened species, and 285 fauna species, including ten nationally threatened and 50 state threatened species.

The vegetation of Lake Connewarre State Game Reserve is very diverse, with 137 native plants being recorded. Forty-five (85 per cent) of the 53 salt marsh species which occur in Victoria occur at Lake Connewarre.

Criterion 3(a) *Regularly supports 20,000 waterfowl.*

Ramsar and non-Ramsar wetlands in Port Phillip Bay regularly support more than 60,000 shorebirds during the summer months. Other waterfowl include large numbers of Black Swans, ducks, ibis and cormorants.

Criterion 3(b) *Regularly supports substantial numbers of waterfowl from particular groups.*

The Avalon-Werribee Wetlands regularly support tens of thousands of Straw-necked Ibis. In 1983, 14 per cent of the Australian population of Chestnut Teal were recorded at the Western Treatment Plant (part of these wetlands). Mud islands support 2,000 pairs of Crested Terns and up to 5,000 White-faced Storm Petrels.

Criterion 3(c) *Regularly supports one per cent of the individuals in a population of one species or subspecies.*

There are twelve species of shorebird for which the site supports more than one per cent of the flyway population (international significance) and two species for which the site supports more than one per cent of the Australian population (national significance).

5.5.2 EDITHVALE-SEAFORD WETLANDS

The Edithvale-Seaford Wetlands Ramsar site, located in Melbourne's south-east suburbs approximately 30km from Melbourne, is comprised of two separate wetlands: Edithvale and Seaford (Lane 2001).

The Edithvale-Seaford Wetlands Ramsar site contains the last remnants of the once extensive Carrum Carrum Swamp and supports very rich biodiversity, including bird species and populations of international importance (Lane 2001).

The Edithvale-Seaford Wetlands Ramsar site is not within the study area. The Melbourne South-East Investigation area is approximately 13km to the east of the Seaford wetlands and 15km to the southeast of the Edithvale wetlands.

Due to the distance of proposed new urban areas from this Ramsar site, it is not described in detail in this report. However, the ecological character is described in Department of Sustainability and Environment (2001), and KBR (2009) provides an updated site management plan. An ecological character description for the site is currently being finalised.

5.5.3 WESTERN PORT

The Western Port Ramsar site is a large bay located 60 kilometres to the south-east of Melbourne. The bay is connected to Bass Strait by a wide channel between Flinders and Phillip Island and a narrow channel between San Remo and Phillip Island (Department of Sustainability and Environment 2003d).

The ecological character of the site is described in the 1999 update of the Ramsar Information Sheet (Department of Sustainability and Environment 1999a). A detailed description of the ecological character of the Ramsar site is currently being prepared following the National framework and guidance for describing the ecological character of Australian Ramsar wetlands (see http://www.environment.gov.au/water/publications/environmental/wetlands/module-2-framework.html for reference)

Western Port has an unusually wide variety of habitat types, ranging through deep channels, seagrass flats, extensive mangrove thickets (accounting for more than 50 per

cent of Victoria's mangrove vegetation) and saltmarsh vegetation. These communities are very productive and relatively undisturbed, supporting a rich and diverse bird, fish and invertebrate fauna. The seagrass flats are nursery grounds for many species of fish and are used by many waterbirds that feed on the seagrass itself or associated marine invertebrates. Many sites in Western Port are of special significance as breeding, roosting or feeding sites for waterbirds, including migratory waders (Department of Sustainability and Environment 1999b).

Western Port is of national zoological significance as a foraging area and high tide roosting site for migratory waders, as well as for its population of the endangered Orange-bellied Parrot. It is of national botanical significance because of its extensive saltmarsh communities and it also has a number of sites of national and international geomorphological significance (Casanelia 1999b).

The Western Port Ramsar site met the following specific criteria when it was listed in 1982 (from Department of Sustainability and Environment 1999b and Department of Sustainability and Environment 2003d). It should be noted that the Ramsar Secretariat has subsequently revised the criteria for identifying a Ramsar wetland and an updated Ramsar Information Sheet is currently being prepared which will state the revised criteria for which the site is listed:

Criterion: 1(a) *The wetland is a particularly good representative example of a natural or near-natural wetland characteristic of the appropriate biogeographical region.*

> Western Port Bay is a particularly good example of a natural wetland marine embayment with extensive intertidal flats, mangroves, saltmarsh, seagrass beds within the Gippsland Plain bioregion.

Criterion 1(b) *The wetland is a particularly good representative example of a natural or near-natural wetland common to more than one biogeographical region.*

> Western Port is a very good example of a saltmarsh-mangrove-seagrass wetland system.

Criterion 3(a) *Regularly supports 20,000 waterfowl.*

> Western Port regularly supports about 10,000 migratory waders and periodically supports in excess of 10,000 ducks and Black Swans.

Criterion 3(b) *Regularly supports substantial numbers of waterfowl from particular groups.*

> Western Port is one of the three most important areas for migratory waders in Victoria. Wader surveys indicate that Western Port supports about 10,000 waders (approximately 12 per cent of the Victorian population).

Criterion 3(c) *Regularly supports one per cent of the individuals in a population of one species or subspecies.*

> Western Port has supported more than one per cent of the population of several waterfowl species and more than five per cent of the Victorian population of the Whimbrel, Grey-tailed Tattler and Bar-tailed Godwit.

The Western Port Ramsar site is not within the study area. The Melbourne South-East Investigation area is approximately fivekilometres to the north of the Ramsar site and includes part of the catchment of the Ramsar site.

5.6 HERITAGE SITES AND COMMONWEALTH PROPERTIES

Point Cook Airbase is the only listed National Heritage place close to the study area. It is also a Commonwealth property. However, it is outside the current Urban Growth Boundary and is not included within an Investigation Area.

The Officers Mess at RAAF Williams Laverton Base is a Commonwealth Heritage Place and also a Commonwealth property. It is located within the current Urban Growth Boundary but is not within the study area.

The EPBC Act covers actions that may impact on heritage values on Commonwealth land. No Commonwealth land is included within the study area or may be impacted by the Program.

In considering a strategic assessment under the EPBC Act, the Commonwealth Minister will also consider impacts to places listed on the Register of the National Estate. A number of sites listed on the register occur within or near the study area. These are listed together with the above mentioned heritage sites in Table 3 and shown on Figures 34 and 35.

TABLE 3: HERITAGE SITES LISTED UNDER THE EPBC ACT AND REGISTER OF THE NATIONAL ESTATE (RNE) THAT HAVE BEEN IDENTIFIED AS POTENTIALLY OCCURRING WITHIN THE STUDY AREA

Heritage site	Class (RNE)	Status (RNE)	Town/ suburb	Location in study area			Comments
				West Investigation Area	North Investigation Area	South-East Investigation Area	
NATIONAL HERITAGE PLACE							
Point Cook Air Base	–	–		✘	✘	✘	Outside study area
COMMONWEALTH HERITAGE PLACE							
Officers Mess – RAAF Williams Laverton Base	–	–		✘	✘	✘	Outside study area
REGISTER OF THE NATIONAL ESTATE							
John Batmans Pastoral Run Outstation Sites	Historic	Indicative place	Craigieburn	✘	✘	✘	Outside study area and within Urban Growth Boundary
O'Herns Road Farming Complex & Ford	Historic	Indicative place	Epping	✘	✓	✘	On edge of study area at the border between Urban Growth Boundary and Investigation Area
Camoola	Historic	Indicative place	Beveridge	✘	✘	✘	Outside study area
Werribee River Area	Historic	Indicative place	Exford	✓	✘	✘	On edge of study area at the border between Urban Growth Boundary, Investigation Area and non-urban land
Summerhill Homestead and Outbuildings	Historic	Indicative place	Wollert	✘	✓	✘	Within study area
State School No. 1051	Historic	Registered	Mickelham	✘	✓	✘	On outer edge of study area
Jacksons Creek Road Bridge	Historic	Registered	Sunbury	✘	✘	✘	Outside study area and within Urban Growth Boundary
Mickleham Post Officer (former)	Historic	Registered	Mickleham	✘	✓	✘	On outer edge of study area

Heritage site	Class (RNE)	Status (RNE)	Town/ suburb	Location in study area			Comments
				West Investigation Area	North Investigation Area	South-East Investigation Area	
Victoria Bridge	Historic	Registered	Kalkallo	✘	✓	✘	On edge of study area at the border between Urban Growth Boundary and Investigation Area
St Johns Presbyterian Church (former)	Historic	Registered	Kalkallo	✘	✓	✘	Within study area
Strathtulloh Homestead	Historic	Registered	Melton South	✓	✘	✘	On edge of study area at the border between Urban Growth Boundary, Investigation Area and non-urban land
Jacksons Creek Rail Bridge	Historic	Registered	Sunbury	✘	✘	✘	Outside study area and within Urban Growth Boundary
Catholic Church (former)	Historic	Registered	Beveridge	✘	✓	✘	Within study area
Deanside Group	Historic	Registered	Rockbank	✓	✘	✘	Within study area
John Kelly House (former)	Historic	Registered	Beveridge	✘	✓	✘	Within study area
Sunbury Rings Aboriginal Ceremonial Site (RNE)	Information not publicly available	Information not publicly available	Information not publicly available	✘	✓	✘	Adjacent to study area.
Werribee River Burial Site (RNE)	Information not publicly available	Information not publicly available	Information not publicly available	✘	✘	✘	Outside study area
Craigieburn to Cooper street Grasslands	Natural	Registered	Craigieburn	✘	✓	✘	Mostly within study area

FIGURE 34. SITES LISTED ON THE REGISTER OF THE NATIONAL ESTATE IN THE WESTERN INVESTIGATION AREA

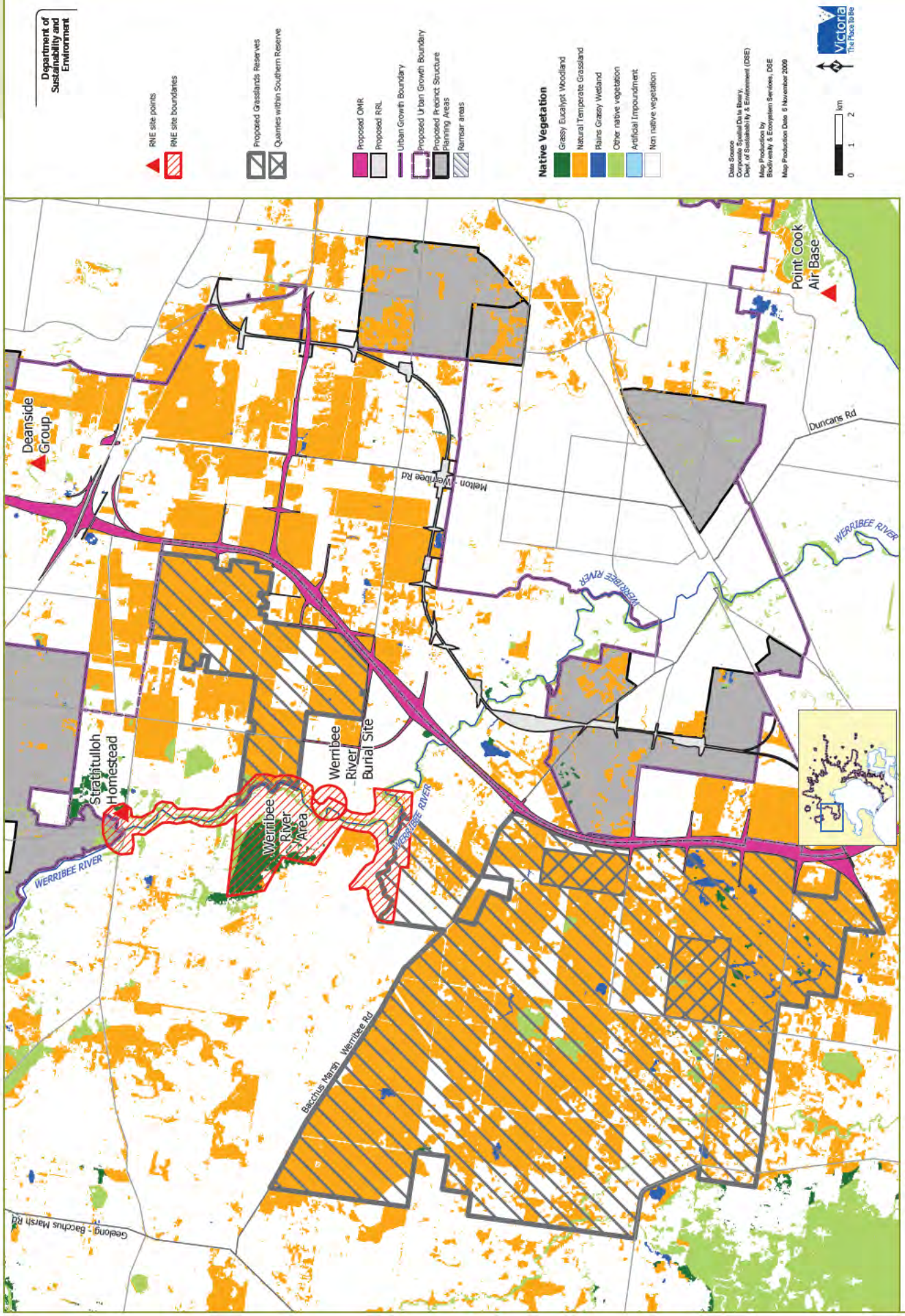

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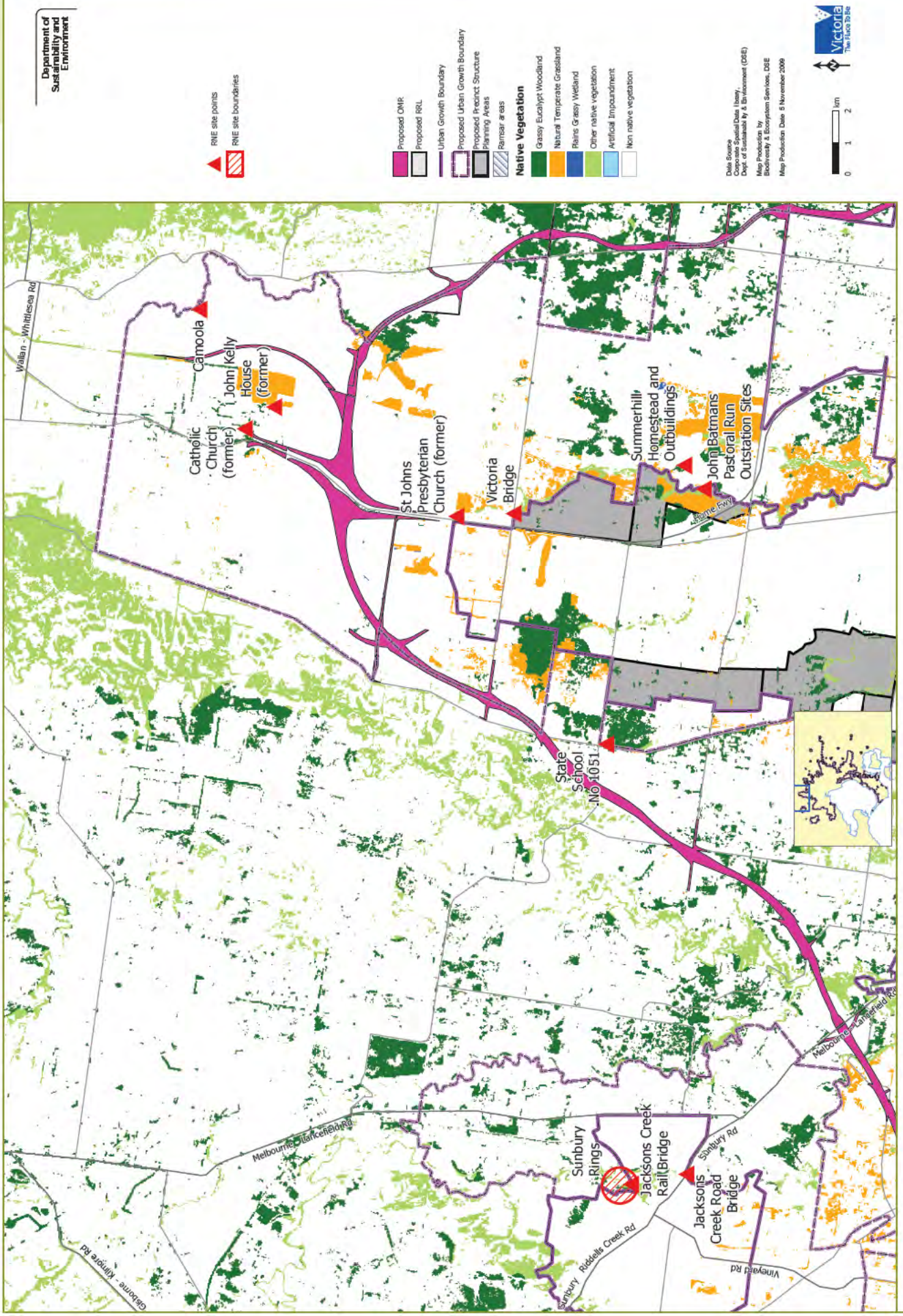
FIGURE 35. SITES LISTED ON THE REGISTER OF THE NATIONAL ESTATE IN THE NORTHERN INVESTIGATION AREA



6 IMPACTS AND MITIGATION

6.1 STRATEGIC MITIGATION APPROACH

This section describes the strategic mitigation approach proposed by Victoria to manage the majority of impacts likely to result from the Program. It does not deal with every mitigation measure, as these are described separately under each of the Matters of National Environmental Significance (Sections 6.2–6.7). It discusses the larger proposals, including those likely to make a significant positive difference to biodiversity conservation over the medium to long-term and at a far reaching spatial scale. The major initiative is the Western Grassland reserves, and this is discussed first and in considerable detail.

The section also discusses threatening processes and the potential interplay with climate change, as well as setting out the accounting approach for native vegetation losses and gains and threatened species offsets.

6.1.1 WESTERN GRASSLAND RESERVES

Large grassland reserves will be formally established outside the Urban Growth Boundary at the same time as the gazettal of the new Urban Growth Boundary. These proposed Western Grassland Reserves (Figure 36) are in two core areas and total approximately 15,000ha in size. They will contain the largest consolidated area of Natural Temperate Grassland remaining on the Victorian Volcanic Plain, and support several nationally threatened plant and animal species and provide potential habitat for a range of other nationally threatened species. They also include a range of other habitat types including wetlands, riparian habitats and scattered open grassy woodlands. Parts of these reserves will be made available as offsets for clearing of grasslands within the Urban Growth Boundary.

OFFSETS

The *Victorian Native Vegetation Management – A Framework for Action* (NRE 2002) and supporting technical documents (DSE 2006, 2007) establish a basis for calculating losses from permitted clearing and gains from proposed offsets.

Losses are calculated in Habitat Hectares based on the quality and extent of vegetation proposed for clearing. Offset targets are established according to the amount and significance of the proposed vegetation loss and involve the use of risk multipliers for vegetation losses of higher conservation significance. For example offsets for removal of patches of High conservation significance vegetation must provide a gain of at least 1.5 times the loss measured in Habitat Hectares. For removal of patches of Very High Conservation significance vegetation the gain required from the offset is at least twice the loss measured in Habitat Hectares.

Gains in native vegetation quality and extent are calculated in Habitat Hectares from agreed protection and management and/or revegetation actions on proposed offset sites. In general, the more complete the suite of management actions and the larger the area, the bigger the offset gains that are achievable.

By definition, gains in vegetation quality and/or quantity must be over and above the existing quality and/or quantity at a given offset site, and measured/predicted over a certain period of time. Offsets are therefore typically much bigger than the clearing site, but the actual size depends on the amount of gain that is achievable on the site including the degree to which the security can be enhanced. The Victorian approach allows for 'trading up' to higher conservation significance offsets where the clearing is of lower conservation significance vegetation. In such cases, the amount of offset is proportionally reduced.

Like for like criteria in the Native Vegetation Framework are graded according to the conservation significance of the vegetation to be removed. This sets rules regarding the type and quality of the vegetation in the offset site and its proximity to the clearing site, with a relatively high degree of specificity for offsets for higher conservation significance clearing. Offsets must be permanently protected by legal agreement. This is most commonly achieved using an on-title agreement under s72 of the *Victorian Conservation Forests and Lands Act 1987* or s173 of the *Victorian Planning and Environment Act 1987* or an on-title conservation covenant under the *Victorian Conservation Trust Act 1972*. The agreement sets out the way that the site is to be managed to improve the condition and/or security of the site. Additional "gain" can be achieved by elevating the security of private land, for example by converting it to a public conservation reserve.

Offsets are also required for individual large trees in addition to patches of vegetation. In grassy woodland these typically involve a requirement to permanently protect four to eight large trees for each large tree permitted to be removed, or in some cases replanting as an alternative, typically in the range of 120 to 180 new plants for each large old tree removed.

Offset arrangements for the Program

Offsets associated with the Program will need to comply with the Victorian Native Vegetation Framework and any additional requirements included in prescriptions approved by the Commonwealth Minister for Environment. All such offsets must be approved and secured prior to the commencement of the associated clearing of native vegetation or habitat.

Offsets for clearing of Natural Temperate Grassland and associated threatened species habitat will be located in the proposed Western Grassland Reserve. Grassy Eucalypt Woodland offsets will be located within the reserve to be established for the conservation of Grassy Eucalypt Woodland, south-west of Whittlesea.

Victoria will finalise a complete dataset of native vegetation type, extent and habitat score in 2010 for the Program Area, following further survey and consultation with stakeholders. The habitat scores determined and published as a result of this process will be used to calculate losses and offset liabilities for all future clearing in accordance with the Program. That is, the offset required for the removal of native vegetation will be calculated using these 2010 condition scores regardless of the condition of the vegetation at the time it is removed.

ASSESSING THE BENEFIT OF THE STRATEGIC OFFSET APPROACH FOR NATIVE GRASSLANDS IN THE WEST OF MELBOURNE

RMIT University researchers were asked by the Department of Sustainability and Environment to model the future extent and condition of native grasslands in the west of Melbourne under a range of scenarios. The aim of the investigation was to quantify where possible the net benefit of a strategically-located grassland reserve to the west of Melbourne to offset likely clearing of native grasslands within proposed Melbourne development precincts.

The researchers investigated a number of possible but realistic land use change scenarios including "no land use change" (no further urban growth and no active management of grasslands); "clearing within Melbourne precincts and randomly-located grassland offsets requiring active management"; and "clearing within Melbourne precincts and strategically-located grassland offsets (i.e. a grassland reserve) requiring active management". The researchers also investigated the impact of timing of the reserve establishment on the overall outcome.

The figures in Appendix 7 illustrates the results of that investigation. The four curves represent the extent and condition of native grasslands in the west of Melbourne under the four scenarios described. The investigation conducted by RMIT University is further described in Appendix 7.

Modelled native grassland quality-extent under various future scenarios

The base curve is the "*No land use change*" curve. Under this scenario, no grasslands are cleared for development, however grassland extent-condition on private land continues to decline over time due to a range of entitled uses and the impact of unmanaged threats such as environmental weeds.

The results support the use of offsets to achieve net benefits over time when compared to the base case (compare *no land-use change vs randomly located offset curve*) and show the added benefit of a strategic grassland offset reserve (see *strategic offset reserve vs randomly located offset curve*). The greatest benefit occurs when creating the offset reserve as early as possible in the process, as shown in the *strategic reserve (all implemented at time zero) curve*. See Appendix 7.

Approximately 19 per cent of the native grasslands within the proposed reserves are High quality (habitat score greater than 0.6) and a further 80 per cent are Medium quality (habitat score between 0.31–0.6) (Figure 36, Appendix 1). The Western Grassland Reserves will secure at least 5,491 Habitat Hectares of existing grasslands and the increased protection and improved management of these areas is expected to generate gain of 4,217 Habitat Hectares, sufficient to offset losses from clearing of Natural Temperate Grassland, Plains Grassy Wetland and habitat of several threatened species as a result of urban development and infrastructure projects. This is explained in detail in section 6.1.5 below. These figures do not include active quarries within the grassland reserves that are likely to remove up to 620ha (275 Habitat Hectares) of Natural Temperate Grassland over the life of their operation. However the quarries will eventually be acquired as part of the grassland reserve, and following rehabilitation by the owner and management by the Crown (Parks Victoria) additional gains and habitat values will potentially be realised. It is currently unknown when the quarries will be conclude operation and be acquired for conservation.

Conservation reserves currently account for only two per cent of the current extent of Natural Temperate Grassland and the addition of this proposed 15,000ha reserve will increase the level of reservation of Natural Temperate Grassland to 20 per cent.

TABLE 4. NATIVE VEGETATION WITHIN PROPOSED WESTERN GRASSLAND RESERVES

Reserve section	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares
		No Native Vegetation 0	Low 0.01–0.30	Medium 0.31–0.60	High 0.61–1		
North	Natural Temperate Grassland		56	1534	89	1679	820
	Plains Grassy Wetland			0		0	0
	Other native vegetation		0	44		44	22
	No native vegetation	311				311	0
North Total		**311**	**56**	**1578**	**89**	**2034**	**844**
South	Grassy Eucalypt Woodland		1	21	19	41	22
	Natural Temperate Grassland		52	5841	2520	8412	4453
	Plains Grassy Wetland		9	132	1	142	70
	Other native vegetation		2	178	21	201	104
	No native vegetation	3575				3575	0
South Total		**3575**	**64**	**6172**	**2561**	**12371**	**4649**
Grand Total		**3886**	**120**	**7750**	**2650**	**14405**	**5493**

Currently it is known that these proposed Western Grassland Reserves support several nationally threatened species: Golden Sun Moth (critically endangered), Striped Legless Lizard (vulnerable), Spiny Rice-flower (critically endangered), Large-headed Fireweed (vulnerable), and Clover Glycine (vulnerable). It also contains Werribee Blue Box, which is likely to be listed under the EPBC Act in the near future. It includes the most likely suitable habitat on the Volcanic Plains for Plains-wanderer (vulnerable) and potential habitat for a range of other specialist grassland species such as Button Wrinklewort (endangered) and the Grassland Earless-dragon (endangered).

The reserves take in a range of other habitats, including Buloke Grassy Woodlands, and a variety of wetland types including Plains Grassy Wetland of the Victorian Volcanic Plain, both ecological communities which have been nominated for listing under the EPBC Act. These wetlands provide habitat for existing populations of Growling Grass Frog (vulnerable) and several migratory bird species.

The proposed Western Grassland Reserves have been designed to maximise the area of habitat available to resident plant and animal species, in particular threatened species, and to enable management activities critical to the long term survival of species and vegetation to be undertaken. As a result, not all areas within the reserves support high quality native vegetation and some areas are quite degraded. Some of the key management actions that will occur within the reserves are as follows:

- Detailed mapping and threatened species assessment to fill gaps and to plan management priorities for different areas;
- Progressive removal of barriers to connectivity across the reserves;
- Biomass reduction in areas of known habitat to maintain habitat quality through the use of fire, strategic grazing and slashing;
- Rehabilitation of degraded areas through targeted weed control and native grassland establishment;
- Ongoing control of pest animal species, in particular foxes, rabbits and hares;
- Management of buffer areas to reduce the impact of adjoining land uses on the reserve values and to ensure appropriate management of the reserve does not adversely impact on surrounding land uses;
- Investigate the suitability of and where feasible implement species reintroductions and establish grassland 'seed orchards' for broader local and regional grassland rehabilitation projects;
- Ongoing monitoring of key assets including further survey and refinement of management actions as a result of new information using adaptive management principles.

It is important that some parts of the proposed reserves become available to and are appreciated by the community, particularly residents of the west where such areas are scarce. The reserves will therefore include a range of access types, with large areas off limits to members of the public due to their highly sensitive conservation requirements and other large areas where a mix of conservation and visitor appreciation can be more comfortably balanced. Some of the more degraded areas will be ideal for visitor facilities and infrastructure, and there is potential to include some iconic attractions/alternative uses such as alternative energy production, sustainable agriculture or sculpture parks where this is compatible with the achievement of biodiversity objectives.

In the future the proposed Western Grassland Reserves will be considered as potential reintroduction sites for Eastern Barred Bandicoot, bettongs and other locally extinct species. The south-western boundary of the proposed Western Grassland Reserves abuts the Mount Rothwell Conservation Research Centre (formerly owned by Earth Sanctuaries) which promotes the conservation of several such species of the Victorian Volcanic Plains.

The vast majority of the land within the proposed Western Grassland Reserves is currently in private ownership. These areas will need to be permanently protected and managed in order to create the eventual grassland reserve. To achieve this the land (shown as "proposed western grassland reserves" in the Program Report) will be reserved through applying a Public Acquisition Overlay under the *Planning and Environment Act 1987*. This gives the State Government the first right of purchase should a landowner wish to sell their property. An acquisition schedule will be prepared setting out the priorities and targets for acquisition. The land will be acquired through negotiating voluntary-sale purchase agreements where possible, and it is anticipated that this process will generate most of the sales. Where acquisition through voluntary-sale purchase is not achievable, and where supply of land is not keeping pace with the acquisition schedule or demand for offsets, compulsory acquisition under the *Land Acquisition and Compensation Act 1986* will be pursued. The land for the grassland reserves will be acquired within ten years of the Public Acquisition Overlay being applied to the land. The exception to this will be land within the two active quarries, which will be acquired at the end of the quarrying operation and some possible short-term arrangements that may be negotiated with some affected residents where this does not compromise the overall objectives of the grassland reserves.

The increased legal protection and improved management of grasslands within the reserves will create gains in native vegetation quality and extent. These gains will be made available (as Native Vegetation Credits) for purchase by developers requiring offsets for permitted clearing in accordance with the Program. The calculation of native vegetation losses and gains (in Habitat Hectares), and like for like criteria for

offsets will be in accordance with Victoria's Native Vegetation Framework and related implementation tools. In some cases, where specified by prescriptions approved by the Commonwealth Minister for the Environment, additional criteria such as offsets for threatened species may be specified in addition to native vegetation offsets in the Victorian Native Vegetation Framework. The grassland reserves will also provide a source of these threatened species offsets where relevant.

The process of creating, advertising and selling Native Vegetation Credits will utilise the well established BushBroker® program. It is expected that developers requiring offsets for clearing native grasslands in accordance with the Program will purchase Native Vegetation Credits generated from the western grassland reserves, given the readily available source of offsets this process will provide.

In order to minimise the likelihood that current habitat values will be degraded prior to the reserves coming under the management of Parks Victoria, incentives and management assistance will be offered to landholders. Where habitat values are at risk of significant degradation as a result of pests and weed infestation the *Catchment and Land Protection Act 1994* will be used to require the control of specific species in accordance with defined methodologies. Again management assistance will be offered. Resources have been allocated for this and it is intended that field rangers will be employed to identify and manage threats and provide financial assistance or expertise to manage the threats to a high standard, in partnership with the Shires of Wyndham and Melton.

Victoria will also pursue a strategy of increasing the protection and sympathetic management of remaining areas of native grassland on private land. An Environmental Significance Overlay is being developed specifically for the protection of native grasslands. This Environmental Significance Overlay will initially target the Werribee Plains hinterland of the proposed Western Grassland Reserves and will be gazetted in local planning schemes by June 2010. The Program Report shows the extent of the proposed Environmental Significance Overlay. It will afford targeted protection through the planning scheme to mapped grassland areas, and ensure that areas are assessed in detail prior to any clearing proposal being considered or approved, with a formal "referral authority" role created for the Department of Sustainability and Environment in all such cases. Decision making for any clearing applications will be made in accordance with Victoria's Native Vegetation Framework. Unless exceptional circumstances exist, clearing of most remnant native grasslands will not be permitted.

The Environmental Significance Overlay will also be used as a vehicle to target private landholders with important grassland remnants to consider joining one of Victoria's existing programs such as BushTender or BushBroker. These programs offer landholders an income in return for securing and managing their native vegetation to improve its extent and quality either permanently (BushBroker) or for a defined period (BushTender).

A program of more detailed mapping of native grasslands across the Werribee Plains, and progressively covering other key parts of the Victorian Volcanic Plain, will be undertaken with the objective of improving the effectiveness of the Environmental Significance Overlay and better targetting investment to important areas of native grassland in the landscape. Accordingly the Environmental Significance Overlay will be revised after a few years, once sufficient new data are gathered.

6.1.2 GRASSY EUCALYPT WOODLAND RESERVE

A large (at least 1200ha) Grassy Eucalypt Woodland reserve (nature conservation reserve) will be established south west of Whittlesea outside of the Urban Growth Boundary. It will be based around the core areas of Grassy Eucalypt Woodland immediately to the east of the Melbourne North Investigation Area, including an area of c. 314ha of this ecological community that has been specifically excluded from the Urban Growth Boundary (Figure 8). Following detailed investigation including community consultation, a reservation proposal and acquisition schedule will be developed and provided to the Department of the Environment, Water, Heritage and the Arts. As for the Western Grassland reserves there is a commitment to secure the reserve fully (including acquisition) by 2020.

The creation of this reserve will increase the reservation of Grassy Eucalypt Woodland from three to five per cent of it's estimated current extent.

An Environmental Significance Overlay is being developed specifically for the protection of Grassy Eucalypt Woodland, similar to the proposed overlay for native grasslands. The Program Report shows the extent of the proposed Environmental Significance Overlay, which will be gazetted in the Whittlesea planning scheme by June 2010. The area covered by the Environmental Significance Overlay will include the area within which the conservation reserve will be established.

6.1.3 SOUTH-EASTERN WETLAND RESERVES

As discussed in Section 6.6 a major area of former wetlands just outside the Melbourne South East Growth Area will be re-established. This will be up to 300ha in size and has the potential to recreate a small, but nonetheless significant area of the former Koo Wee Rup Swamp (Craigie et al. 2009). A detailed plan will be prepared that sets out the management objectives, implementation steps and responsibilities. The land for this major wetland restoration would be acquired and reserved under the *Crown Land Reserves Act 1978* with Melbourne Water appointed as the land manager. A significant portion of the site would be designated specifically for biodiversity conservation.

6.1.4 PROTECTION OF OTHER KEY SITES

Other areas including 525ha of Grassy Eucalypt Woodland and 325ha of associated Natural Temperate Grasslands in the Northern (Hume and Whittlesea) Growth Area have been excluded from urban development despite remaining with the new Urban Growth Boundary. The intention is that these areas will be protected for biodiversity conservation through a combination of planning scheme controls, private land management agreements and donation of land to the Crown (e.g. as offsets). The Program Report shows the proposed planning zones for these areas. Sites supporting Grassy Eucalypt Woodland will generally be zoned Rural Conservation, with an Environmental Significance Overlay applied for added protection.

A Biodiversity Conservation Strategy will be prepared for each of the growth areas prior to the preparation of updated Growth Area Framework Plans. The Biodiversity Conservation Strategies will set out the biodiversity values of retained land and the mechanisms by which land will be secured and managed over the long term. All such sites will be the target of negotiations with landowners regarding their future protection and management.

In the Hume-Whitllesea and Sunbury areas this network of reserved and protected areas within the urban area will provide a connection between the proposed Grassy Eucalypt Woodland reserve to the east and the Merri Creek to the west. It will also connect these grassy woodland areas to remnant patches of Natural Temperate Grassland and riparian areas of the Merri Creek. This network of grassy vegetation will incorporate much of the "Craigieburn to Cooper Street Grasslands" site on the Register of the National Estate.

The Sunbury Biodiversity Conservation Strategy will focus on retention and enhancement of the 130ha Grassy Eucalypt Woodland excluded from development in the Sunbury area.

Other sites supporting important populations of listed threatened species have been similarly excluded from the development zone within the Urban Growth Boundary and will be zoned Rural Conservation, with an Environmental Significance Overlay prepared to enhance planning scheme protection. This includes grassland at Clarke's Road, Rockbank, sites protected for the Golden Sun Moth abutting the OMR in the west (c. 300ha of high quality native grassland) and woodlands, riparian areas and other habitat areas throughout the new urban area. These sites will be subject to additional protection and management to enhance their value to the persistence of key species, through a combination of acquisition, land management agreements and conservation covenants. Details of the network of protected areas and the mechanisms to protect them will be similarly set out in the Biodiversity Conservation Strategies for these Growth areas (Wyndham, Melton-Caroline Springs and Casey-Cardinia).

Fuller details are provided below under each taxon. All sites proposed for retention and planning scheme protection are shown in the accompanying Program Report.

6.1.5 ACCOUNTING FOR NATIVE VEGETATION LOSSES AND GAINS

Victoria has a well established offsetting approach that ensures offset "gains" are commensurate with the type and scale of "losses" (i.e. clearing) as described under "Offsets" (Section 6.1.1).

Table 5 summarises the estimates of native vegetation losses from proposed development in areas proposed for the Urban Growth Zone, the OMR/E6 Transport Corridor and Regional Rail Link. A more detailed breakdown is provided in Appendix 1.

TABLE 5. ESTIMATED LOSS OF LISTED EPBC-LISTED VEGETATION COMMUNITIES FROM PROPOSED DEVELOPMENT ASSOCIATED WITH MELBOURNE'S FUTURE GROWTH.

Vegetation	Area (ha) by Habitat Score			Total Area (ha)	Habitat Hectares	Offset Target* (Habitat Hectares)
	Low 0.01–0.30	Medium 0.31–0.60	High 0.61–1			
Grassy Eucalypt Woodland	466	242		708	188	300
Natural Temperate Grassland	897	3696	72	4665	1921	3599
Plains Grassy Wetland	6	69		75	30	58
Other native vegetation	549	489	2	1040	315	480
Totals	1918	4496	74	6488	2454	4437

*Based on determination of Conservation Significance using Ecological Vegetation Class x Habitat Score only (and does not include requirements for threatened species habitat).

Offsets for permitted clearing of Natural Temperate Grassland and Plains Grassy Wetland are proposed to be aggregated into two new, large grassland reserves located outside the Urban Growth Boundary. Estimates of native vegetation gains from these offsets are based on the creation of the two reserves and associated improved management of existing vegetation patches (Table 6) in line with the Victorian *Vegetation Gain Approach* (DSE 2006). Although the intention will be to restore large parts of the reserve from their current degraded state, gains arising from revegetation of currently non-vegetated areas have not been used in the offset calculation as the development and application of broad-scale grassland revegetation techniques are still in their infancy. Similarly, given the level of disturbance and risk of invasion from high threat weeds across much of the area, estimates of gain from proposed activities such as weed control are necessarily conservative until the scale of threat and impact of strategic management interventions can be properly assessed.

Estimated gains have been calculated using the Department of Sustainability and Environment's Gain calculator – Version 1.2 October 2008 available on the Department of Sustainability and Environment website at: http://www.dse.vic.gov.au/

TABLE 6. ESTIMATED GAINS OF EPBC-LISTED (OR NOMINATED) VEGETATION COMMUNITIES FROM THE CREATION OF THE WESTERN GRASSLAND RESERVES. .

Vegetation	Area (ha) by Habitat Score			Total Area (ha)	Gain* (Habitat Hectares)	Offset Target** (Habitat Hectares)	% of offset target met
	Low 0.01–0.30	Medium 0.31–0.60	High 0.61–1				
Grassy Eucalypt Woodland	1	21	19	41	13.3	300	4%
Natural Temperate Grassland	108	7375	2609	10091	4154.4	3599	100%
Plains Grassy Wetland	9	132	1	142	58.3	58	100%
Other native vegetation	2	222	21	245	Not calculated	480	
No native vegetation	0	0	0	3886	Not calculated	0	
Totals	120	7750	2650	14405	4217	4437	

* Gains calculated in accordance with Victorian Vegetation Gain Approach (DSE 2006). Includes gains from improved protection (security) and management (i.e. weed control, pest animal control, biomass management).

** Based on determination of Conservation Significance using Ecologic Vegetation Class x Habitat Score only (and does not include requirements for threatened species habitat).

Offsets for permitted clearing of Grassy Eucalypt Woodland are proposed to be aggregated into the proposed Grassy Eucalypt Woodland reserve located outside the Urban Growth Boundary, south west of Whittlesea. Due to the lack of sufficiently detailed assessment data from the proposed reserve, only very preliminary estimates of native vegetation gains from this area can be made. However it is likely that a conservation reserve for Grassy Eucalypt Woodland would need to be approximately 1,000 to 1,300 hectares in area to generate sufficient gain (and sufficient protection of large old trees) to offset losses of Grassy Eucalypt Woodland within the Program area. This is based on this area being secured as a nature conservation reserve and that the vast majority of clearing of Grassy Eucalypt Woodland that would be permitted within the Program area would be low quality.

Determining offset requirements for vegetation and threatened species

To ensure that there is a clear link between the native vegetation or habitat type that is lost through clearing and the subsequent mitigation, Victoria's Native Vegetation Framework allows a graded response from a direct link between loss and offset for vegetation of higher significance down to more flexibility for vegetation of lower significance. These like-for-like rules help determine whether a site is eligible to offset a proposed clearing site.

In the case where native vegetation proposed for loss also provides habitat for threatened species, Victoria has developed an approach that enables a suitable offset to be determined. This approach relies on first determining which of the vegetation or species habitat attributes is driving the conservation significance of the vegetation. If the highest or equal highest conservation significance rating of the clearing site is due to the vegetation (i.e. combination of Ecological Vegetation Class Bioregional Conservation Status and Habitat Score), then the like-for-like rules for the offset follow the vegetation type requirements. If the highest conservation significance rating of the clearing site is due to confirmed habitat for a rare or threatened species, then the like-for-like rules for the offset follow the species habitat type requirements (see Table 6 in DNRE 2002).

For clearing sites where the highest significance rating is triggered by more than one species, then the like-for-like rules for the offset follow the habitat type requirements for the species experiencing the greatest proportional loss of habitat as a result of the clearing at the proposed clearing site.

Proposed offset sites may potentially provide a vegetation offset and species offset for one or more species. However, the Victorian approach requires that an offset site must be allocated to either a vegetation offset or a single species habitat offset but not multiple combinations. For sites with the option of providing more than one offset type, the designation of the offset site will be linked to the offset requirement for a permitted clearing proposal. While it is recognised that vegetation offsets will also often provide habitat for a range of threatened species, allocating an offset site to one type of offset mitigates the risk of double counting of an offset site and is also used to inform appropriate management for the offset site. Identifying an appropriate management regime is of particular importance where preferred management interventions for one outcome (e.g. vegetation) may be in conflict for preferred management interventions for another outcome (e.g. a species). Examples of this in relation to the Western Grassland Reserves include potential conflicts arising from different preferred grassland biomass management regimes for vegetation outcomes (and including component flora and fauna species such as Spiny Rice-flower and Striped Legless Lizard) and species outcomes (e.g. Golden Sun-moth, Plains-wanderer). It is highly likely therefore that different parts of the grassland reserves will be managed for different outcomes.

The analysis indicates that based on preliminary modelled data, that the proposed Western Grassland Reserve should provide sufficient offsets to meet the requirement for the two EPBC-listed vegetation communities (Natural Temperate Grassland and Plains Grassy Wetland). The "unallocated" areas would then be available for threatened species offsets, where these are required in addition to native vegetation offsets. The two key species in this category are Golden Sun Moth and Spiny Rice-flower.

The Victorian approach outlined above will form the basis of the native vegetation and threatened species offsetting approach. However for three endangered species likely to be impacted within the Program – Golden Sun Moth, Spiny Rice Flower and Matted Flax-lily – the Commonwealth have requested the development of prescriptions that strengthen the mitigation approach for these species (Section 6.4.1). In each case the prescriptions require offsets for clearing of 'high contribution habitat' (. native habitat) to be treated as Very High conservation significance and to be driven by the habitat requirements of the species, irrespective of whether the native vegetation to be removed is also Very High conservation significance. In each of these cases the offset site must support a population of the species in question and must be located within areas of 'high contribution habitat'. This will result in the need for both a Victorian native vegetation offset and a Commonwealth species offset in some cases, recognising that both requirements could be met at the same site.

This may also require some species offsets to be located in areas other than the Western Grassland Reserves in the future, given the likely additional demands for habitat areas, although this is currently difficult to estimate based on current data. Additional offset areas outside the Western Grassland Reserves are likely to be necessary in the case of the Golden Sun Moth, given its likely extent in the Program area and the fact that the prescription for this species also requires offsets to be found for removal of non-native ('medium persistence') habitat. In such cases offsets must be located in areas of 'high contribution habitat' (i.e. native grassland or grassy woodland). This is not considered a significant risk. The Golden Sun Moth is also assumed to be relatively widespread outside the Program area and it is likely that there is ample supply of potential offset sites.

Developing an appropriate accounting system for all the matters of National Environmental Significance within clearing and offset areas will be an important vehicle for communicating outcomes to the Commonwealth and other stakeholders. This will be prepared by Department of Sustainability and Environment as part of the overall Monitoring and Reporting Framework to be developed and submitted following approval.

PRESCRIPTIONS

Prescriptions have been developed for managing several matters of National Environmental Significance likely to be impacted as a result of the Program. The thresholds applied throughout the various prescriptions are the result of a strategic approach that explicitly considered the benefits and trade-offs of in situ (i.e. sites retained within future growth areas) and ex situ conservation (i.e. clearing of sites within future growth areas and improved protection of sites outside these areas). Appendix 7 demonstrates this approach for Natural Temperate Grasslands.

As Appendix 7 shows, this approach has involved consideration of the likely effectiveness of current and potential longer-term protection and management in maintaining or enhancing the conservation values of sites both within and outside the growth areas. This includes the requirement for species populations and habitat to be functionally connected to other species populations and habitats to increase the likelihood of longer term species persistence.

This approach builds on general ecological principles that:

- larger areas are more likely to support stable populations of pollinators and seed dispersers.
- larger areas are more likely to be able to cope with and recover from stochastic catastrophe.
- (all other things being equal) larger areas are likely to retain more infraspecific genetic variability.
- isolated areas of habitat, proximal to more extensive areas of habitat are more likely to be recolonised more readily if populations are extirpated by catastrophe/accident.

For the strategic assessment, Department of Sustainability and Environment adopted a risk averse approach informed by observations over 20 years that recognises the additional difficulties of managing particular habitat types with urban landscapes and the negative effects of increased fragmentation on these habitats and their component species populations.

This approach resulted in the creation of area thresholds (e.g. 150ha for Natural Temperate Grassland), that are considered a practical minimum area where there is a higher likelihood that conservation values and function could maintained in the future within an urban context given typical resources and current knowledge and required management practices. Areas less than this in size are considered at greater risk of decline or require considerably more management resources, and for these reasons ultimately risk losing their conservation values and function over the long term. This is not to say that smaller areas cannot retain their values, but that the risk of failure is more likely due to either practical management constraints (e.g. biomass control), intrinsic factors (e.g. enhanced edge effects) or simply cost limitations.

In such cases it was decided that in the longer term, the conservation benefits that could be achieved by protection and management of sites outside the growth areas (as part of an offsetting requirement) would outweigh the costs of the loss of habitat within the proposed growth areas. This approach was facilitated by the strategic – rather than site by site – assessment, as these trade-offs and opportunities could be explicitly factored into our preferences.

However the thresholds are also aimed at maximising the conservation outcomes achievable within an overall constraint imposed by the requirements for Melbourne's future growth. Hence the overall social and economic drivers intrinsic to the Program (e.g. housing affordability, access to public transport, efficient urban form) also acted as constraints on the widespread retention of conservation reserves over the urban area.

Similarly, the 80 per cent protection target of 'protected confirmed high contribution habitat' that applies to a number of the species prescriptions recognises that in some circumstances, there are greater conservation benefits in better protecting and managing species populations outside the growth areas rather than aiming to protect 100 per cent of populations – some of which will be at risk of extinction – within the growth areas. This recognises that in the broader context many species populations and habitat outside the growth areas are at risk of on-going loss and decline through entitled uses and unmanaged threats and that better protection and management of a high proportion of these sites albeit traded off against the loss of some areas within the growth areas would lead to an overall greater conservation outcome. The 80 per cent figure is not scientific – it merely sets a high standard for conservation of the most important habitats, while allowing for some overall flexibility in the interests of operational practicality.

6.1.6 DEALING WITH CLIMATE CHANGE

The future climate of the Port Phillip and Westernport region is expected to be hotter and drier than it is today.

By 2030, average annual temperatures will be around 0.8°C warmer compared to 1990 figures, particularly in summer, and the number of days over 30°C is also expected to increase (Department of Sustainability and Environment 2008). Reductions in the total average annual rainfall of around four per cent are expected, with the greatest percentage reductions occurring in spring (seven per cent). By 2070, under a higher emissions growth scenario, Melbourne's temperatures would resemble those of present day Echuca in North Central Victoria, while annual rainfall would be similar to present day Seymour (c. 100km north of Melbourne) (Department of Sustainability and Environment 2008).

The consequences of these changes on biodiversity are difficult to predict, however it is very likely that there will be changes at different levels, from individuals to ecosystems. Species may alter in terms of distribution, abundance, behaviour and the timing of events such as migration or breeding. The most susceptible species will be those with restricted or specialised habitat requirements, poor dispersal abilities or small populations. It is likely that current threats impacting on threatened species and communities and other matters of National Environmental Significance will be exacerbated, although the extent to which this is the case is very difficult to predict.

Climate change is one of many pressures that face threatened species and communities and the likely effects are very difficult to separate from other threatening processes.

To manage this risk and uncertainty we need to deal with it as part of an adaptive management approach, and maximise opportunities to build resilience into ecosystems (NBSRTG 2009). The conversion of a large area of private land to public management in the form of new grassland reserves will give us the best opportunity to take adaptive management measures as required if and when climate change responses become more apparent. According to Taylor and Figgis (2007, cited in NBSRTG 2009) this securing and enhancing of important habitats is the "most important and immediate step" that can be taken to increase such resilience. Examples of the type of action that may be required in the future as part of an adaptive management approach would include the potential to add an additional area or a buffer to the habitat of a particular threatened species.

The native grasslands to the immediate west of Melbourne occupy a rainshadow area cast by the You Yangs/Brisbane Ranges that largely limits tree growth in the area. These grasslands have historically received between 500–550mm annual rainfall with the result that they share strong floristic, structural and faunal assemblage affinities with grasslands north of the Great Dividing Range in Victoria, in particular within the Wimmera and Victorian Riverina bioregions. These "northern" grasslands occupy areas receiving between 450–550mm annual rainfall. They are largely replaced by chenopod grasslands below these annual means. A rainfall reduction of the order described above would therefore appear to be within the climate envelope of the vegetation community if comparisons with northern Victoria are a useful guide.

In addition to the inherent capacity of the vegetation community to accommodate climate change, the proposed reserve occupies a north-south rainfall gradient of 500–550mm rainfall per annum, meaning that there is scope for plants and animals to adjust within the reserve as rainfall reductions occur.

It is expected that this scenario will similarly play out for Grassy Eucalypt Woodland. The grassy woodlands to the north of Melbourne are representative of a vegetation type that extends across the Victorian Volcanic Plain. This vegetation also shares close affinities (including dominant eucalypt species) with grassy woodlands north of the Great Dividing Range including in the Victorian Riverina. As for native grasslands, building resilience to the likely pressures resulting from climate change will best be accommodated by securing and enhancing a substantial portion of the ecological community in a conservation reserve as is proposed to the north of Melbourne.

6.1.7 THREATENING PROCESSES

The *Environment Protection and Biodiversity Conservation Act* (1999) protects Australia's native species and ecological communities by providing for, amongst other matters, recognition of key threatening processes. In addition, where relevant the EPBC Act provides for the development of threat abatement plans that provide for the research, management, and any other actions necessary to reduce the impact of a listed key threatening process on native species and ecological communities.

Assessment of the currently EPBC-listed key threatening processes indicates that *Land Clearance* and possibly *Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases* are matters of relevance to the Program.

Land Clearance

The published EPBC advice recommends that:

1. a threat abatement plan is not considered a feasible, effective or efficient way to abate the process; and
2. each State and Territory needs an appropriate response to this Key Threatening Process and further advises the Minister that the Commonwealth should encourage and support land management quality assurance and planning mechanisms at the appropriate scales to ensure the conservation of biodiversity, especially threatened species and ecological communities.

Victoria introduced clearing controls in 1989, which effectively halted broad-scale clearing across the state. The release of the Victorian Native Vegetation Framework (DNRE 2002) and its subsequent incorporation into the Victoria Planning Provisions in 2003 introduced methods for assessing the quality, quantity and significance of native vegetation across the state and established the three step approach of 'avoid, minimise and offset'. The Program is making use of appropriate planning mechanisms at a variety of scales as described in this report and will need to satisfy Victorian planning requirements, including the requirements of the Victorian Native Vegetation Framework.

As such, the Program satisfies the recommendations in the published EPBC *Land Clearance* advice, in particular quality assurance and planning mechanisms at the appropriate scales to ensure the conservation of biodiversity, especially threatened species and ecological communities.

Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases

The published EPBC advice recommends that:

1. the Commonwealth, States and Territories have actions underway to abate this Key Threatening Process and therefore recommends that a threat abatement plan is not considered a feasible, effective or efficient way to abate the process; and
2. along with the issues of emissions reduction, the adaptation requirements of species and communities likely to be affected by climate change should be given greater priority.

As discussed in Section 6.1.6, future climate modelling indicates that Victoria's annual rainfall may decrease by 5–10 per cent over the next 50 years. Such a reduction would appear to be within the climate envelope of the Western Grassland Reserves and component wetlands. In addition, the reserve occupies a north-south rainfall gradient of 500–550mm per annum meaning that there is scope for plants and animals to adapt within the reserve as rainfall reductions occur.

As such, the Program satisfies the recommendations in the published EPBC advice, in particular giving priority to adaptation requirements of species and communities.

Threat abatement plans

In addition to the above, the establishment of the Western Grassland Reserves will address a number of EPBC-listed key threatening processes and contribute to their threat abatement plans, in particular:

- competition and land degradation by rabbits; and
- predation by European Red Fox.

Establishment and management of the Western Grassland (and other) Reserves will seek to eradicate these species from the area and a community education campaign will be important for gaining the support and cooperation of surrounding landholders to achieve this objective. The combined effect will be to promote recovery of native species and ecological communities affected by these pest species in keeping with the relevant threat abatement plans.

6.2 COMPONENTS OF BIODIVERSITY, ECOLOGICAL AND PHYSICAL ENVIRONMENTAL PROCESSES

The study area is considered to have been highly altered from its natural state by its land-use history. Further land-use change from predominantly rural to urban is likely to further exacerbate effects on biodiversity and ecological processes in most areas. However, the creation of well managed urban areas may in some cases provide benefits when compared with the current rural land uses. This is particularly so in the south-east, where the quality of water entering Westernport is difficult to regulate and is often poor because of the highly modified drainage pattern and intensive agricultural land use.

Extending the urban area to the west, north and south-east will further compromise ecological processes persisting in those areas. In the south-east, some road reserves and minor drainage lines are known to afford narrow avenues of connected habitat for the Southern Brown-bandicoot, albeit tenuous ones (Practical Ecology 2009). This connectivity within the south-east will more than likely be removed as a result of urban development. The mitigation emphasis will be on maintaining and restoring connectivity at a sub-regional level, focusing on larger areas of habitat and major strategic linkages. The challenge for monitoring will be finding practical ways to assess the degree of ecological function remaining in this part of the landscape, and identifying how urban development and the mitigation strategies influence the net result.

Creating reserves for both grassland and grassy woodland communities provides an opportunity to re-establish natural ecosystem processes, such as appropriate fire regimes, and secure habitat for threatened species.

6.3 IMPACTS ON LISTED AND NOMINATED COMMUNITIES AND PROPOSED MITIGATION

Mitigation of impacts is based on a mitigation hierarchy of avoidance, minimisation, rehabilitation, re-establishment and offset. This is similar to international approaches to mitigation (see for example Business and Biodiversity Offsets Program 2009) and mirrors the key steps set out in Victoria's Native Vegetation Framework.

Avoidance occurred as part of the detailed planning process to determine the Investigation Areas, extent of potential Urban Growth Boundary, future urban areas and the location of associated infrastructure. Avoidance also occurred as part of the previous process to locate the Urban Growth Boundary in 2005 (*Melbourne 2030*). These processes were designed to exclude larger areas of high conservation value native vegetation from the Urban Growth Boundary.

Minimisation occurred in setting the new Urban Growth Boundary within the Melbourne West Investigation Area, and in determining which areas were to be excluded and permanently protected and which areas would be designated for urban development (e.g. through rezoning proposals as set out in the Program Report). However, in other Investigation Areas and in the proposed Precinct Structure Planning areas where this level of detail is not yet available, minimisation will occur primarily as part of the downstream Precinct Structure Planning process, which is a requirement for all areas designated urban. As this will mostly occur after this strategic assessment, any reductions in extent of clearing as a result of the Precinct Structure Planning process are not reflected in this document. Therefore, the strategic assessment represents a worst case scenario in terms of scale of clearing.

Rehabilitation or on-site management of particular assets will be a natural consequence of the minimisation process once retained areas are defined. Management of retained areas is absolutely critical if the assets for which they were retained are to be protected and enhanced in the long term.

In some cases, where unavoidable impacts will occur and it is not considered practical or desirable to retain and manage an asset on-site, *re-establishment* and management elsewhere may be deemed necessary. Translocation may sometimes be involved.

Finally, and as discussed in detail in Section 6.1, Victoria has a well established and robust offsetting approach that ensures that offset gains are commensurate with the type and scale of losses (DNRE 2002). Offsets are rigorously defined and take account of the extent, quality and conservation significance of the loss using the Habitat Hectare metric and multipliers where relevant as well as counts of large trees. As discussed in Section 6.1 Victoria will permanently protect 15,000ha of significant areas of native grassland to the west of Melbourne by acquiring it as a Crown land reserve and this will be used to offset unavoidable clearing of native vegetation and habitat within the urban area. A similar, but smaller reserve will be established to conserve Grassy Eucalypt Woodland and provide a source of offsets for permitted clearing of this ecological community.

6.3.1 NATURAL TEMPERATE GRASSLAND OF THE VICTORIAN VOLCANIC PLAIN

The greatest threats to the Natural Temperate Grasslands of the Victorian Volcanic Plain are land clearing and degradation in quality. This is primarily due to weed invasion, and also to closing over of inter-tussock spaces and the subsequent senescence of plants. This results in loss of diversity and occurs where there is inadequate biomass reduction due to lack of appropriate fire or grazing regimes.

Native Temperate Grasslands of the Victorian Volcanic Plain is a vegetation type that cannot effectively be replanted or regenerated elsewhere, although research is continuing and some positive results have been demonstrated in small scale trials. Targeted and effective long term management of existing grasslands is a critical requirement to maintain the quality (and therefore most of the values) of this critically endangered ecological community. Most (93 per cent) of Natural Temperate Grassland of the Victorian Volcanic Plain is found on private land, and in general the quality of these unsecured sites is deteriorating. Four main conservation reserves have been established across the Victorian Volcanic Plain: Craigieburn Grasslands Reserve (340ha); Derrimut Grassland Reserve (154ha); Boral Deer Park Reserve (90ha); and Laverton Grassland reserve (52ha). All of these are either within the study area or within the existing urban area. Conservation reserves currently account for only two per cent of the current extent of native temperate grassland.

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's *Significant Impact Guidelines* (Department of the Environment and Heritage 2006) apply as no specific guidelines are yet available for the natural temperate grasslands of the Victorian Volcanic Plain.

ACTUAL/LIKELY IMPACTS

Actions associated with *Melbourne @ 5 Million* are likely to have significant impact on the Natural Temperate Grasslands of the Victorian Volcanic Plain, particularly in Melbourne's west. Loss of extent as a result of direct clearing for housing, roads and other infrastructure will be the primary impact. It is likely that up to 3,278ha of this native grassland will be cleared over the next 20–30 years as a result of the revised Urban Growth Boundary and associated infrastructure projects. Of this proposed grassland removal, around 525ha would be cleared for the proposed OMR/E6 Transport Corridor and 95ha for the proposed Regional Rail Link. An additional 769ha of this Natural Temperate Grassland occurs within proposed precincts adjoining the Melbourne West and Melbourne North Investigation Areas and much of this is likely to be removed also, subject to the outcomes of the Precinct Structure Planning process. Hence, a total of up to 4,667ha could be cleared as a result of all projects within the Program. Using the measurement system developed in Victoria's Native Vegetation Framework, which combines vegetation extent and quality into a Habitat Hectare measure, the maximum amount of clearing is estimated at 1,922 Habitat Hectares. The estimated offset requirement as a result of this clearing (assuming a precautionary, worst case scenario) is 3,599 Habitat Hectares (includes multipliers based on conservation significance). Appendix 1 provides a detailed breakdown of these loss statistics.

The expected maximum total clearing of 4,667ha of Natural Temperate Grassland is allocated as follows across the three major projects:

Regional Rail Link	95ha (37 Habitat Hectares)
OMR/E6 Transport Corridor	525ha (241 Habitat Hectares)
Urban development in new growth areas	3,278ha (1,354 Habitat Hectares)
Urban development in proposed precincts (existing growth areas)	769ha (290 Habitat Hectares)
Total	**4,667ha (1,922 Habitat Hectares)**

MITIGATION OBJECTIVES

- Retain 15,000ha of the largest consolidated area of native grassland remaining in the Western Grassland Reserves, and additional areas in the north (in association with Grassy Eucalypt Woodland habitat). The Western Grassland Reserves will be purchased by the Victorian Government and will become a National Park (or similar conservation reserve) outside the urban area.
- Manage native grassland reserves to improve their quality over the long term and maximise habitat condition for threatened and other resident species (for example, through removal of barriers to dispersal and active maintenance of open-tussock structure). This will generate gain to offset the loss from clearing.
- Monitor and manage adaptively.

MITIGATION STRATEGY

Avoid: A major objective of *Melbourne @ 5 Million* and the Victorian Transport Plan has been to avoid the development of native grasslands west of Melbourne. The current Urban Growth Boundary, Investigation Areas, the proposed Urban Growth Boundary revision, and related infrastructure have been located to avoid the majority of known native grasslands.

Avoidance is difficult to quantify precisely: however, large areas of native grassland were specifically excluded from the Melbourne West Investigation Area. It is very likely that several thousand hectares of additional native grassland would have been proposed for clearing had this deliberate avoidance not occurred, particularly in the areas proposed as the Western Grassland Reserves south of Melton and west of Werribee.

Minimise: Considerable effort has already been applied to minimising native grassland clearing in the Melbourne West Investigation Area by fine-tuning the proposed location of the Urban Growth Boundary, OMR/E6 Transport Corridor, Regional Rail Link and exclusion areas.

Approximately 1136ha of Natural Temperate Grassland will be included within the non-urban areas of the western (Wyndham and Melton-Caroline Springs) Growth Area, at least 642ha of which (and probably a total of 760ha) will be initially protected in relevant conservation zones. The conservation outcomes from the remaining areas excluded from urban development and designated Farming Zone are less certain at this stage.

A further 661ha of Natural Temperate Grassland will be retained and excluded from urban development in the Melbourne North Growth Area, of which 532ha will be secured in Conservation Zones. A proportion of this area is expected to provide habitat for populations of Golden Sun Moth that will be confirmed through subsequent site surveys. The remaining 129ha excluded from urban development will be designated Farming Zone to cover a range of uses such as quarry buffers and utility easements. Some biodiversity benefit will be gained from these areas but it is difficult to estimate at this point.

These retention figures exclude grassland that occurs within active quarry areas within the Program area, within which grasslands totalling 724ha in the Wyndham and Melton-Caroline Springs Growth Areas and 59ha in the Hume and Whittlesea Growth Area are likely to be progressively cleared under separate State and Commonwealth approval arrangements. These quarries with existing approvals are not subject to this Strategic Impact Assessment.

Given this minimisation, the creation of the proposed Western Grassland Reserves nearby and the important social and economic outcomes required from the western Growth Area, further minimisation of grassland clearing is unlikely to be achieved in the west.

However, the Precinct Structure Planning process will provide additional minimisation, particularly within the existing Urban Growth Boundary and for areas of native grassland that provide important habitat for threatened species. Surveys to confirm the presence or likely presence of threatened species and the management needs at that location will be conducted.

A prescription based on *Victoria's Native Vegetation Management – A Framework for Action* (DNRE 2002) has been developed to guide all future decisions regarding retaining or clearing natural temperate grassland of the Victorian Volcanic Plain within the study area. The Native Vegetation Framework provides a robust, risk based approach to marrying conservation objectives with clearing decisions.

The prescription is described below.

PRESCRIPTION FOR NATURAL TEMPERATE GRASSLAND

Preamble

Between the proposed new Urban Growth Boundary and the existing Urban Growth Boundary clearing of native grasslands has already been avoided and minimised. Further areas will only be retained within these areas if required to meet another relevant prescription (e.g. Spiny Rice-flower, Matted Flax-lily, Golden Sun Moth).

Inside current Urban Growth Boundary the Precinct Structure Planning process will seek to avoid and minimise impacts on native grasslands, as required by the *Native Vegetation Management Framework*. Priority will be given to retention of areas of native grassland that support other nationally significant species, where these different assets can be effectively managed within the retained area over the medium to long term.

Prescription

- Grasslands will be retained between the proposed new Urban Growth Boundary and the existing Urban Growth Boundary if the site contains an endangered or critically endangered orchid species.
- Inside the current Urban Growth Boundary native grasslands within precincts will be retained if they are manageable and demonstrably able to retain their values in the long term, that is, part of a contiguous area of native vegetation under the same type of management typically of at least 150ha including adjacent areas outside the precinct.
- All permitted clearing of native grasslands will be offset in accordance with the Victorian *Native Vegetation Management Framework* and offsets will be secured prior to commencement of clearing. Offsets for clearing of Natural Temperate Grassland will be sourced from the proposed Western Grassland Reserves.

This prescription will be used in the Precinct Structure Planning process, as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure and future quarries.

Offset: If a site supporting natural temperate grasslands of the Victorian Volcanic Plain is approved for clearing, the primary mitigation measure will be offsets. These will be sourced from credits generated by the establishment and management of the proposed 15,000ha Western Grassland Reserves, outside the Urban Growth Boundary (Figure 36). The process to acquire the reserves will commence with the gazettal of the new Urban Growth Boundary. The reserves will eventually become a National Park (or equivalent). These reserves contain the largest consolidated area and some of the highest quality areas of the grasslands known, and support several nationally threatened flora and fauna species (Figure 36).

Section 6.1.1 provides additional information on the proposed Western Grassland Reserves.

OTHER MITIGATION AND RELATED PROCESSES

The proposed natural temperate grassland reserves will consolidate a large and adequate area of native grassland into public ownership and management. Victoria will also pursue a strategy of increasing the protection and sympathetic management of remaining areas of native grassland on private land.

This will be achieved by mapping additional private land remnants on the Victorian Volcanic Plain, applying Environmental Significance Overlays to protect remnant grasslands and targeting market based incentive programs to relevant landowners through programs such as BushTender and BushBroker. These programs offer landholders an income in return for securing and managing their native vegetation to improve its extent and quality either permanently (BushBroker) or for a defined period (BushTender).

MITIGATION OUTCOME

Mitigation aims to achieve a demonstrable net gain in the extent and quality of natural temperate grasslands of the Victorian Volcanic Plain, as measured by the Habitat Hectare system. Losses that occur in areas of urban development will be offset by the additional security and improved quality provided by establishment and management of the large new reserves. The predicted net impact on the grasslands as a result of this Program is therefore likely to be positive over the long term. This is discussed further in Section 6.1.1.

The outcomes sought are:

- The creation of large (at least 15,000ha) consolidated areas of permanently protected native grasslands outside the Urban Growth Boundary in Melbourne's west, managed to improve their quality and offset losses from clearing associated with urban development and transport Infrastructure.
- A number of smaller reserves within the Urban Growth Boundary at Clarkes Road, Truganina Cemetery, Craigieburn and associated with Merri Creek in the north, some within the urban context, providing additional protection for key sites and connectivity between related habitat types, particularly grassy woodlands, stony knolls and floodplain grasslands.
- The long term sustainability and persistence of the Natural Temperate Grasslands of the Victorian Volcanic Plain ecological community through permanent protection and enhancement of the ecological functions and values of the largest consolidated remaining area of grasslands.

6.3.2 GRASSY EUCALYPT WOODLAND OF THE VICTORIAN VOLCANIC PLAIN

The greatest threats to the grassy woodlands of the Victorian Volcanic Plain are land clearing for agriculture and urban development, fragmentation of existing remnants and degradation of quality through weed invasion and inappropriate management. Most of this community (92 per cent) occurs on private land and in general the quality of these unsecured sites is deteriorating, depending on the intensity of grazing and other agricultural practices. Only three per cent of the current extent of this community exists within conservation reserves. Of the few conservation reserves containing this community, the largest are the Woodlands Historic Park Reserve (200ha), just beyond the Melbourne North Investigation Area, and Mount Ridley Flora and Fauna Reserve (100ha) and Amaroo Reserve (20ha) within the existing urban area.

SIGNIFICANT IMPACT THRESHOLD

Grassy Eucalypt Woodland of the Victorian Volcanic Plain was recently listed under the EPBC Act, therefore the Commonwealth's *Significant Impact Guidelines* (Department of the Environment and Heritage 2006) apply. No specific guidelines are yet formally available for the Grassy Eucalypt Woodland of the Victorian Volcanic Plain.

ACTUAL/LIKELY IMPACTS

The actions associated with the Program are likely to result in significant impact on Grassy Eucalypt Woodland of the Victorian Volcanic Plain at some sites in the north. The primary impact will be the loss of extent as a result of direct clearing for housing, roads and other infrastructure. It is likely that up to 709ha of Grassy Eucalypt Woodland will be cleared over the next 20 to 30 years, mostly in the Melbourne North Investigation Area. Using the measurement system in Victoria's Native Vegetation Framework, which combines vegetation extent and quality into a Habitat Hectares measure, the maximum amount of clearing is estimated at 187 Habitat Hectares.

The allocation of the expected clearing of 709ha of Grassy Eucalypt Woodland across the various projects is outlined below.

Regional Rail Link	N/A
OMR/E6 Transport Corridor	125ha (33 Habitat Hectares)
Urban development in new growth areas	449ha (118 Habitat Hectares)
Urban development in proposed precincts (existing growth areas)	135ha (36 Habitat Hectares)
Total	**709ha (187 Habitat Hectares)**

MITIGATION OBJECTIVES

1. Retain large and better quality areas of grassy eucalypt woodland in a network of areas within the Melbourne North Growth Area, ensuring maximum connectivity between reserves and private land areas.
2. Progressively secure the long-term protection of retained areas of Grassy Eucalypt Woodland on private land within the Melbourne North Growth Area by donation to the Crown or by private land management agreements.
3. Establish a large reserve of at least 1,200ha south-west of Whittlesea that includes areas of Grassy Eucalypt Woodland excluded from the urban growth boundary;
4. Manage retained and reserved Grassy Eucalypt Woodland to improve their quality over the long term and maximise habitat condition for threatened and other resident species; and
5. Monitor and manage adaptively.

MITIGATION STRATEGY

Avoid: The location of the current Urban Growth Boundary, Investigation Areas, the proposed Urban Growth Boundary revision and related infrastructure have been sited to ensure that more than half of the area of known Grassy Eucalypt Woodland will not be developed for urban uses. This includes an area of approximately 700ha supporting 314ha of Grassy Eucalypt Woodland within the Investigation Area which has been excluded from the Urban Growth Boundary altogether.

Minimise: Fine-tuning the proposed location of Urban Growth Boundary and OMR/E6 Transport Corridor and, in particular, the proposed exclusion areas in the Melbourne North Investigation Area has significantly minimised impacts on Grassy Eucalypt Woodland. Approximately 773ha of Grassy Eucalypt Woodland has been protected from urban development within the growth area. Additional minimisation will occur as part of the Precinct Structure Planning process required for all proposed urban areas, particularly in the south-east of the Melbourne North Investigation Area. Although this report assumes a worst case scenario in assessing the extent of Grassy Eucalypt Woodland that will be cleared as part of the Program, there will be an opportunity to minimise impacts to the grassy woodland through sympathetic design responses that retain areas of grassy woodland in public areas (such as reserves for conservation and passive recreation).

PRESCRIPTION FOR GRASSY EUCALYPT WOODLAND

Preamble

The Precinct Structure Planning process will seek to avoid and minimise impacts on Grassy Eucalypt Woodland, as required by the *Native Vegetation Management Framework*. It will take into account avoidance and minimisation efforts that are already complete, in particular in areas between the new Urban Growth Boundary and the existing Urban Growth Boundary where avoidance has already been achieved. Priority will be given to retention of areas of woodland that support other nationally significant species, where these different assets can be effectively managed within the retained area over the medium to long term.

Eighty (80 per cent) of all Grassy Eucalypt Woodland (i.e. that meet the Commonwealth thresholds) within the Urban Growth Boundary will be retained and managed in a secure conservation reserve.

Prescription

- Areas of Grassy Eucalypt Woodland (i.e. that meet the Commonwealth size and condition thresholds for the community) should not be cleared and should be retained and managed in a secure conservation reserve. If clearing is required for construction of state significant infrastructure (e.g. OMR/E6 Transport Corridor), or if Department of Sustainability and Environment determines that the 80 per cent target (above) has been reached, offsets will be obtained after reasonable minimisation efforts have been concluded.
- Retention of degraded Grassy Eucalypt Woodland areas (i.e. below the Commonwealth condition threshold for meeting the Grassy Eucalypt Woodland definition) will be incorporated into open space where practical (as trees in parks and roadsides).
- All permitted clearing of grassy woodland will be offset in accordance with the Victorian Native Vegetation Framework. Offsets for clearing of Grassy Eucalypt Woodland will be sourced from the Northern Grassy Woodland Reserves including retained areas within the Growth Area. No clearing of Grassy Eucalypt Woodland within the Program area may occur until the Northern Grassy Woodland reserve has been established.

This prescription will be used in the Precinct Structure Planning process, as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure.

Offset: Offsets will be the primary mechanism for mitigating the impacts of vegetation approved to be cleared after the minimisation process is complete. The proposed Northern Grassy Woodland Reserves and retained areas of Grassy Eucalypt Woodland on private land within the Melbourne North Growth Area will be used as offsets for clearing elsewhere within the Urban Growth Boundary. Land for offset sites within the Growth Area would either be donated to the Crown or the land owner would enter into a permanent management agreement to secure the long-term protection of the native vegetation. Land within the proposed Northern Grassy Woodland Reserves will be acquired by Government or in some cases secured using a permanent management agreement or conservation covenant. This will compliment areas of retained and reserved Grassy Eucalypt Woodland on public land that will be managed to improve their quality over the long term and maximise habitat condition for threatened and other resident species.

The total size of Grassy Eucalypt Woodland retained on public and private land within the Melbourne North Growth Area is 773ha. This includes 581ha that will be in secure conservation zoning. The remaining 192ha that will be included in the Farming Zone includes quarry buffers, utility easements and a range of other uses, some but not all of which will be compatible with protection and management of this ecological community. Hence the 581ha of this community that will be initially secured for conservation represents a likely minimum.

In addition to this the proposed Northern Grassy Woodland Reserves will be at least 1,200ha in size and located south-west of Whittlesea outside the Urban Growth Boundary.

MITIGATION OUTCOMES

The intention is that there will be no net loss of Grassy Eucalypt Woodland of the Victorian Volcanic Plain as measured by the Habitat Hectare measure of extent and quality over the short to medium term. Losses in extent that occur in areas of urban development will be offset by areas retained nearby or outside the Urban Growth Boundary. Over the longer term it is expected that there will be an overall gain in Grassy Eucalypt Woodland once the reserves are established and management to improve understorey condition and structure take effect.

A Biodiversity Conservation strategy that sets out the particular arrangements for each retained area within the Urban Growth Boundary including the land manager, conservation objectives (where relevant) and mechanisms to achieve them will be prepared.

The outcomes sought are:

- A large conservation reserve outside the urban Growth Boundary south-west of Whittlesea of at least 1,200ha in size.
- Eighty per cent of all Grassy Eucalypt Woodland within the Urban Growth Boundary retained and managed in secure conservation reserves.
- A network of small and medium sized conservation reserves and permanently protected private land habitat in the Hume-Whittlesea Growth Area associated with Merri Creek and Darebin Creek floodplains. These will consolidate and connect key areas of grassy woodland and associated habitats (stony knolls, plains grassland, floodplain grasslands and riparian areas);
- A network of small connected conservation reserves in the Sunbury area to protect Grassy Eucalypt Woodland and associated habitats.
- Improved quality of retained areas of vegetation inside and outside the Urban Growth Boundary including supplementary planting to improve structure.

6.3.3 TEMPERATE LOWLAND PLAINS GRASSY WETLAND

This ecological community nominated for listing under the EPBC Act occurs within the study area and is likely to be impacted as a result of actions undertaken as part of the Program. Given the status of this ecological community it remains unclear precisely what will be included within the Commonwealth's definition hence it has not been treated in detail in this report.

Using Victoria's Ecological Vegetation Class number 125 as the surrogate (as indicated by the nomination description) it is estimated that 110ha of Temperate Lowland Plains Grassy Wetland will be impacted. Approximately the same amount (105ha) will be retained and protected within the Urban Growth Boundary.

This vegetation type is often difficult to map with certainty given its dependence on seasonal conditions. The present prolonged dry conditions are likely to have masked the true extent of this vegetation within development and non-development areas.

The likely extent of unavoidable impact is therefore not yet known with certainty. Further surveys will be undertaken during the transport planning and Precinct Structure Planning process to determine the extent and location of this vegetation at potential impact sites.

A prescription will be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth to inform requirements for the Precinct Structure Planning process and also for the OMR/E6 Transport Corridor and Regional Rail Link projects should the ecological community be located in these areas. This

prescription will guide mitigation and management decisions including whether to retain the vegetation on site.

In situations where clearing is permitted, offsets may be able to be sought from the proposed Western Grassland Reserves or the area proposed for wetland re-establishment outside the Melbourne South East Growth Area, as Temperate Lowland Plains Grassy Wetland is known to occur at both those locations.

6.4 IMPACTS ON LISTED THREATENED SPECIES AND THEIR HABITATS AND PROPOSED MITIGATION

6.4.1 SPECIES THAT INHABIT GRASSLANDS AND GRASSY WOODLANDS

PLAINS-WANDERER

As indicated in Section 5.2.1, although it cannot be ruled out, the Plains-wanderer is unlikely to have persisted within the study area, although it would have been present historically. The last confirmed record was to the immediate west of the Melbourne West Investigation Area. According to Birds Australia (2009) "the two large tracts of remnant volcanic plains grassland west of the boundary of the Western Investigation Area are critical to retain habitat for this species in southern Victoria. These areas are of immense significance to the Plains-wanderer and should be formally reserved in the National Reserve System. Failure to achieve this may result in ongoing habitat loss and degradation which may lead to the loss of the Plains-wanderer from the broader region."

The Western Grassland Reserves proposed in Section 6.1.1 will be managed for a range of values, including Plains-wanderer. With active management to maintain and increase areas of suitable habitat for the species, Plains-wanderers are likely to continue to be recorded in the area, and numbers will increase over the medium term. The added pressure of increased urban development and human population near these areas will be mitigated by the sheer size of the reserved areas (approximately 15,000ha). As most known Plains-wanderer populations exist on private land (Department of Sustainability and Environment 2003), managing the proposed Western Grassland Reserves for this species will contribute significantly to its recovery across its range.

It is not considered likely that actions under the Program will cause a significant impact on the Plains-wanderer.

GRASSLAND EARLESS DRAGON

As indicated in Section 5.2.1 there is a small possibility that this species still occurs within the study area, but it is more likely to be locally extinct within the study area. If the species does persist close to Melbourne it is most likely to be in the grasslands to the west of the study area, including within the proposed Western Grassland Reserves, although areas of native grassland in the north (such as Craigieburn Grasslands reserve) cannot be ruled out.

Based on the absence of recent records of the species in the vicinity of the study area, actions under the Program are not likely to cause a significant impact on the Grassland Earless Dragon. It is also unlikely the species will be detected during urban development.

However, surveys targeting the Grassland Earless Dragon will be undertaken within proposed precincts as an additional precaution. If the species is found during these Precinct Structure Planning surveys, a prescription will be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth before Precinct Structure Planning or other relevant development planning is finalised. This prescription will guide mitigation and management decisions. Once approved it will be used to guide management of this species in these development planning processes for the remainder of the Program.

Given the endangered status of this species in Australia (and critically endangered in Victoria), it is likely that any populations located within proposed precincts will be retained and managed on site (e.g. within the precinct area). However, there may be situations identified within the prescription where this is impractical or not desirable, in which case translocation (or 'salvage') of animals for captive maintenance and/or research may need to be considered. This will also be the most likely scenario for animals located during construction (but not detected during surveys). It should be noted that the National Recovery Team does not support translocation as a mitigation measure and points out that translocated animals do not readily re-establish.

If translocation is necessary, animals will be caught and translocated to secure habitat elsewhere (e.g. proposed Western Grassland Reserves, Craigieburn Grassland Reserve), under the direction of the Department of Sustainability and Environment with advice from the National Recovery Team. A fully costed translocation plan must be prepared to the satisfaction of Department of Sustainability and Environment, which will include details of monitoring and management arrangements in the target habitat. A protocol to guide translocation will be prepared by the Department of Sustainability and Environment in conjunction with the National Recovery Team.

The progressive reservation and management of the proposed Western Grassland Reserves will incorporate a program of targeted surveys for the Grassland Earless Dragon.

STRIPED LEGLESS LIZARD

The greatest threats to the species are loss and degradation of habitat. Striped Legless Lizard is predominantly a grassland specialist and its decline is closely related to the depletion of temperate grasslands: 99 per cent of Victoria's lowland native grasslands have been destroyed or drastically altered/severely degraded since European settlement. The species cannot tolerate intense grazing, ploughing or pasture improvement (such as rock removal). It is also intolerant of fire unless it occurs when the soil is cracked and there is opportunity to escape the fire front (Department of Sustainability and Environment 2003). Fragmentation is a long term threat to extant populations due to the poor mobility of populations where physical barriers (such as major roads and bare ground) are present.

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's *Significant Impact Guidelines* (Department of the Environment and Heritage 2006) apply in this case as no specific guidelines are yet available for the Striped Legless Lizard, although a draft Striped Legless Lizard policy workshop that took place in Melbourne in December 2008 will also inform the decision-making process.

The *Significant Impact Guidelines* use the concept of an important population in some of the impact criteria. The draft outcomes of the recent Striped Legless Lizard policy workshop indicate that there may be a number of important populations that will be impacted by the Program, although these remain poorly defined. This may change in the future as more information is gathered.

ACTUAL/LIKELY IMPACTS

The actions associated with the Program are likely to impact directly on Striped Legless Lizard habitats and extant populations, particularly in the west and possibly in the north. Although current knowledge indicates that significant impacts on important populations are unlikely, they cannot be ruled out. It is therefore assumed that an important population may be found at a location impacted by urban development in the future, and which would make impacts significant: that is, above the thresholds specified in Department of the Environment and Heritage (2006).

As up to 4,667ha of native grassland may be cleared over the next 20–30 years, it can be assumed that, taking a precautionary approach, most of this area is potential habitat for Striped Legless Lizard.

Most populations of Striped Legless Lizard are small. Even though some of these are within small, secure areas of remnant grassland, these are considered inadequate for conserving Striped Legless Lizard populations in the long term (Department of Sustainability and Environment 2003).

The optimal size of a reserve to secure a population of Striped Legless Lizard is unknown. However, the Department of Sustainability and Environment (2003) suggests that a population of 300 individuals may be "viable" in a reserve of 140ha such as Derrimut Grassland Reserve, as long as general mortality rates are low and the site can be managed specifically for the species.

Given that multiple reserve management objectives are always present and some are competing, maintaining a sustainable population would probably require an area considerably larger than this (Department of Sustainability and Environment 2003), especially if fire management and ecological burning regimes are in place.

MITIGATION OBJECTIVES

1. Retain largest (best) areas of habitat in grassland reserves, and a proportion of smaller sites scattered across the range;
2. Manage retained areas of native grassland to improve the quality and connectivity of existing habitat for Striped Legless Lizard (such as by removing barriers and actively manage open-tussock grassland structure);
3. Monitor and manage adaptively; and
4. Consider translocation of doomed populations into large secure reserves.

These objectives and the strategy set out below will make a significant contribution to the most critical of the actions identified in the National Recovery Plan, i.e. *establish a series of reserves and other managed areas such that viable populations are maintained across the known distribution of the species* (Smith and Roberston 1999).

MITIGATION STRATEGY

Avoid: The current Urban Growth Boundary, Investigation Areas, the proposed Urban Growth Boundary revision, and related infrastructure have been located to avoid the majority of known native grasslands. This includes large areas of known Striped Legless Lizard habitat.

Minimise: Fine-tuning the proposed location of Urban Growth Boundary, OMR/E6 Transport Corridor, Regional Rail Link and exclusion areas in the Melbourne West and Melbourne North Investigation Areas has further minimised impacts on the species.

Additional minimisation will occur as part the Precinct Structure Planning process required for all proposed urban areas: particularly in the north where additional areas of native grassland and grassy woodland vegetation will be retained and managed for a range of values including Striped Legless Lizard after surveys confirm the likely presence of species and the management needs at that location. As with Volcanic Plains Grassland (Natural Temperate Grassland), further minimisation of Striped Legless Lizard habitat is less likely in the Melbourne West Investigation Area, given the extent

of effort that has already been applied to this task and the degree and importance of the social and economic outcomes required from this area. However, further minimisation will occur within proposed precincts inside the existing Urban Growth Boundary.

A prescription has been developed to guide all future decisions about retaining or clearing of Striped Legless Lizard within the study area. It is based partly on Victoria's Native Vegetation Framework.

The prescription is described below.

PRESCRIPTION FOR STRIPED LEGLESS LIZARD

Preamble

Between the proposed new Urban Growth Boundary and the existing Urban Growth Boundary impacts on native grasslands and Striped Legless Lizard habitat have already been avoided and minimised. Further areas will only be retained if required to meet a relevant prescription (e.g. Spiny Rice-flower, Matted Flax-lily, Golden Sun Moth).

Inside current Urban Growth Boundary the Precinct Structure Planning process will seek to avoid and minimise impacts on native grassland and grassy woodland (Striped Legless Lizard habitat), as required by the *Native Vegetation Management Framework*. Priority will be given to retention of areas of native grassland that support other nationally significant species, where these different assets can be effectively managed within the retained area over the medium to long term.

The price of the offset for clearing of native vegetation that is Striped Legless Lizard habitat will include a cost premium specifically to assist with the targeted management and monitoring of Striped Legless Lizard in the grassland or grassy woodland offset reserves, the cost calculated on a pro rata basis according to the size of habitat area removed.

Translocation is considered a last resort and is not a substitute for any of the other mitigation steps described in this prescription. Animals must only be translocated to areas of suitable habitat within secure conservation reserves (either on or off site), preferably to the proposed Western Grassland Reserves, Craigieburn Grassland Reserves or proposed Northern Grassy Woodland Reserves, unless the Department of Sustainability and Environment agrees (after consulting with the National Recovery Team) that a better outcome is likely to be achieved elsewhere.

Prescription

- Native vegetation that is Striped Legless Lizard habitat will be retained between the proposed new Urban Growth Boundary and the existing Urban Growth Boundary if the site contains an endangered or critically endangered orchid species.
- Inside the current Urban Growth Boundary areas of native vegetation that is Striped Legless Lizard habitat within precincts will be retained if they are manageable and demonstrably able to retain their values in the long term, that is, part of a contiguous habitat under the same type of management of at least 150ha including adjacent areas outside the precinct.
- All permitted clearing of Striped Legless Lizard habitat that is native vegetation will be offset in accordance with the Victorian Native Vegetation Framework and offsets will be secured prior to commencement of clearing. Offsets for clearing of native vegetation that is Striped Legless Lizard habitat will be sourced from the Western Grassland Reserves, the proposed Northern Grassy Woodland Reserves or areas reserved in the Hume and Whittlesea Growth Areas as appropriate.
- In addition, if individual Striped Legless Lizards occur within an area of habitat (native or non-native) that will be cleared, a fully costed translocation plan must be prepared to the satisfaction of the Department of Sustainability and Environment and following any protocol to guide the preparation of such plans agreed between the Department of Sustainability and Environment and the National Recovery Team. Any translocation attempted must be fully documented and monitored.

This prescription will be used in the Precinct Structure Planning process, as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure and other development approvals for the Program.

Offset and reservation: An estimated 4,667ha of potentially suitable habitat for Striped Legless Lizard will be cleared as a result of Melbourne's urban growth. The impacts of this clearing will be mitigated at a strategic level by establishing two large grassland reserves to the west of Melbourne as described in Section 6.1. The proposed reserves are already known to support Striped Legless Lizard at several locations (Figure 2) and will become the largest known area of Striped Legless Lizard habitat under dedicated conservation management in Australia.

In addition, a Northern Grassy Woodland Reserve of at least 1,200ha is proposed to the north of Melbourne and a network of retained native grasslands, grassy woodlands, stony

knolls and riparian areas associated with the Merri Creek corridor in the north (Hume -Whittlesea Growth Area) will be progressively protected through targeted acquisition in combination with surrender of land and protection as offsets. Some of these areas are likely to support populations of Striped Legless Lizard.

The National Recovery Plan utilizes the concept of geographically or ecologically distinct population clusters as the basis of a framework for reservation of the species habitat across its range. Although only in draft form, the potential clusters include two of relevance to this study area: West Melbourne, Keilor, Weribee Plains and North Melbourne, Craigieburn Volcanic Plains. The proposed Western Grassland Reserves, in combination with other retained areas of habitat within the western urban area, is very likely to achieve the reservation goal of the Recovery Plan in relation to the West Melbourne cluster. The progressive reservation of important areas in the north of Melbourne, including the proposed reserve outside the urban area, will be an important step to ensure the overall protection goals for Striped Legless Lizard habitat in the North Melbourne cluster are achieved. These areas will compliment the existing reserves in the Hume and Whittlesea Growth Area including Craigieburn Grassland Reserve and Cooper Street Grasslands Reserve.

The proposed Western Grassland Reserves will be managed specifically for the long term success of Striped Legless Lizard and other grassland dependent fauna and flora. Key management measures for Striped Legless Lizard will include:

- Active vegetation management (maintaining structure) and manipulation of abiotic components (provision of shelter) in areas of suitable habitat to maintain habitat quality;
- Progressive removal of barriers to connectivity across the reserves; and
- Ongoing monitoring including further survey and the ability to alter management actions as a result of new information.

The proposed Western Grassland Reserves will be at a scale and level of consolidation that will enable the land manager (Parks Victoria) to manage for Striped Legless Lizard as a priority, in combination with managing for other grassland values.

MITIGATION OUTCOMES

The establishment and management of the proposed Western Grassland Reserves will make a significant contribution to meeting Conservation Objective 4 of the National Recovery Plan and its seven sub-objectives. The additions of the proposed Northern Grassy Woodland Reserve outside the urban area, the protected and managed areas of habitat to compliment existing reserves within the Urban Growth Boundary in the north, and the linking of these wherever practicable, will also contribute to these objectives and will consolidate protection of the important North Melbourne cluster, albeit on a smaller scale than the reserves in the west.

If mitigation measures are successful, the net impact on this species is likely to be positive given the level of reservation and focused management that will result from the Program. However, given that the lack of current data and the time that will elapse before evidence that the trajectory for the species is improving can be seen, the approach taken must manage uncertainties and acquire new information.

The outcomes sought are consistent with the National Recovery Plan and are as follows:

- Large areas of conservation reserves and other permanently protected habitat managed to enable Striped Legless Lizard to be sustained over the long term through a series of connected populations;
- Significant contribution to recovery plan objectives including reservation and management of habitat sufficient to protect the West Melbourne and North Melbourne clusters (*sensu* Smith and Robertson 1999);
- A selection of smaller reserves within the urban context that provide insurance against the risk of catastrophic events and contribute important research and management knowledge;
- A program of research and monitoring undertaken to provide a basis for adaptive management of the Striped Legless Lizard; and
- Salvage and translocation options assessed, feasibilities determined and protocol developed for translocation

GOLDEN SUN MOTH

The greatest threats to the Golden Sun Moth are loss and degradation of habitat, primarily because of weed invasion, and also because of the closing of inter-tussock spaces that can result from inadequate biomass reduction. Fragmentation is a long term threat to extant populations due to the poor mobility of the species: the females are generally poor fliers. An area of more than 200m of unsuitable habitat effectively isolates populations. Although the species has been recorded at very small sites (as small as 40m x 40m) (Dear 2006), populations at such sites are prone to extinction from stochastic events. The species appears unable to recolonise once extinct from a site (DEC 2006) and even if this was possible the lack of mobility of the species would indicate that isolated sites would be less likely to be recolonised.

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's draft *Significant Impact Guidelines* for the Golden Sun Moth provide the following thresholds as a guide for determining whether an action is likely to result in a significant impact:

- Loss or degradation of more than 0.5ha from a habitat area of more than 10ha;
- Any loss or degradation from a habitat area of less than 10ha; and
- Fragmentation by more than 200m of an existing population (for example, by buildings, fences, breaks).

ACTUAL/LIKELY IMPACTS

Actions associated with *Melbourne @ 5 Million* are likely to have significant impact on the Golden Sun Moth at some sites, particularly in the west, and possibly in the north. Up to 4,667ha of native grassland may be cleared over the next 20 to 30 years. Although not all of this area has been surveyed for the species, it can be assumed that most of this is potential habitat if a precautionary approach is taken. The species also utilises grassy woodland, of which 683ha is likely to be cleared, and non-native grassy areas.

Of the approximately 50 known sites, around half are less than 10ha in size, most are in urban areas already approved for development and less than 10 are in conservation reserves. Those that are in reserves are in small Council reserves established as part of existing developments, the sizable Craigieburn Grassland Reserve (320ha) and a series of small, isolated reserves within the urban area, such as:

- Cooper Street Grassland Reserve (40ha);
- Derrimut Grassland Reserve (152ha);
- Woodlands Heritage Park (40ha);
- Altona Reserve (4ha);
- Amberfield Reserve (2ha);
- Highlands Craigieburn (40ha); and
- Amaroo Reserve (20ha).

Given the species' lack of mobility, populations at small isolated sites are less likely to persist in the long term compared to large, connected sites, without intensive management inputs.

MITIGATION OBJECTIVES

1. Retain largest (best) habitat areas in the proposed Western Grassland Reserves, plus a proportion of smaller sites scattered across the range according to the following statewide target:
   - Protection (through appropriate agreed management) of at least 80 per cent of the total area of places where 'high contribution to species persistence' and 'confirmed habitat' intersect (see Figure 38);
2. Manage retained areas of native grassland to improve the quality and connectivity of existing habitat, such as by removing barriers and actively managing open-tussock grassland structure. Connect suitable unoccupied habitat to occupied habitat;
3. Monitor and manage adaptively; and
4. Undertake broader targeted surveys for the species across its historic range to provide context for land use decisions.

MITIGATION STRATEGY

Avoid: The current Urban Growth Boundary, Investigation Areas, the proposed Urban Growth Boundary, and related infrastructure have been located to avoid the majority of known native grasslands. This includes large areas of known Golden Sun Moth habitat.

Minimise: Fine-tuning the proposed location of Urban Growth Boundary, OMR/E6 Transport Corridor, Regional Rail Link and exclusion areas in the Melbourne West Investigation Area Investigation Area has further minimised impacts on the species. Additional minimisation will happen as part the Precinct Structure Planning process required for all proposed urban areas, particularly in the north. This process will result in sympathetic design and construction techniques and retain additional areas of vegetation, some of which will managed for Golden Sun Moth (after surveys confirm the presence of the species and the management needs at that location).

A prescription has been developed to guide all future decisions about retaining or clearing Golden Sun Moth habitat within the study area. This prescription will be used in the Precinct Structure Planning process, as required by the Precinct Structure Planning Guidelines and in approvals required for transport infrastructure, extractive industries and other development approvals within the Program.

The prescription and the background to it is described below.

The finalization of the Urban Growth Boundary and areas proposed for urban development have been undertaken in conjunction with best available data on Golden Sun Moth distribution and associated native vegetation habitat data. Where these data have been sufficient to apply the proposed prescription for Golden Sun Moth, this has been done. The result of this process is that three additional areas of high quality native grassland have been excluded from the Urban Growth Zone and instead zoned Rural Conservation Zone. These sites, shown in the program Report, total approximately 300ha and will be managed for protection of the Golden sun moth at these sites. These may not be the only additional sites protected within areas proposed for urban development, however until further detailed site data are collected to enable the prescription to be applied to a site or a precinct, this remains unknown.

BACKGROUND TO THE PRESCRIPTION

The prescription relies on knowing the current spectrum of habitat in order of contribution to the persistence of the species across the State, and being able to compare this with information about confirmed sites as new survey data comes to hand. A similar 'habitat matrix' approach is used for other species, such as the Matted Flax-lily and Spiny Rice-flower.

Using this spectrum of habitat information (Figure 38), decision makers will seek to achieve:

> *The protection across the relevant bioregion (through appropriate agreed management) of at least 80 per cent of the total area of places where 'high contribution to species persistence' and 'confirmed habitat' intersect (see Figure 38).*

ABOUT THE SPECTRUM OF HABITAT APPROACH

The approach developed by the Department of Sustainability and the Environment combines known records (and pseudo-absences) of Golden Sun Moth with a range of environmental variables to develop a habitat probability model for Victoria. A threshold that included 95 per cent of confirmed records was then set against this raw model to estimate likely habitat for Golden Sun Moth across the State (see Appendices 2 and 3 for further details).

Information on habitat condition and connectivity requirements for Golden Sun Moth was then used to assign the likely habitat model into classes by their likely contribution to species persistence (from low to high).

The three species persistence categories, currently based on modelled information, are described in Appendix 3 and summarised as follows.

High: Areas of native vegetation (grassland, grassy woodland) within potentially well connected Golden Sun Moth habitat (at least 10,000ha) where connected habitat is separated by breaks in habitat of <200m. Native vegetation here essentially means that native species comprise at least 25 per cent of the understorey vegetation cover. This may include areas currently mapped as medium but upgraded as a result of on ground native vegetation survey.

Medium: Areas of non-native vegetation within well connected Golden Sun Moth habitat as above. May include areas currently mapped as high but downgraded as a result of on ground native vegetation survey.

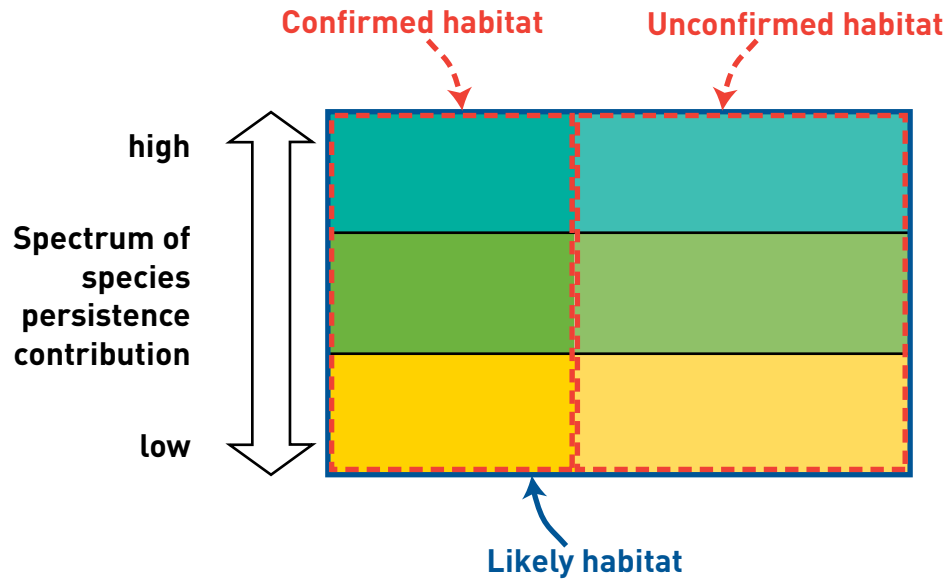
Low: Native or non-native vegetation within less connected habitat (less than 10,000ha).

The Golden Sun Moth habitat spectrum (Figure 38) shows all likely potential habitat (including native and non-native) for the Golden Sun Moth divided into their likely contribution to species persistence classes. Any of the habitat shown in Figure 38 could support a population of Golden Sun Moth. The position of each habitat in a class can be confirmed or questioned depending on whether Golden Sun Moth has actually been recorded.

The map does not indicate the likelihood of occurrence at any site. However, it does use the habitat spectrum to indicate which sites are likely to contribute more to the persistence of the species over time (once the species has been confirmed as occurring at the site).

The diagram below illustrates this process.

MATRIX OF HABITAT FOR GOLDEN SUN MOTH



Current examples of sites providing the greatest contribution to species persistence include the Craigieburn Grasslands Reserve, Cooper Street Grasslands Reserve and Salisbury Bushland Reserve (Nhill). Much of the proposed new Western Grassland Reserves west of Melbourne would also fall into this category once secured. At the lower end of the scale are sites such as those on private industrial zoned land in Altona and Laverton North, in suburban Melbourne.

The current percentage of confirmed 'high contribution to species persistence' habitat protected is approximately 15 per cent.

The Growth Areas Authority will be undertaking intensive, targeted surveys for Golden Sun Moth in peri-urban areas and Green Wedges over the next two years or more, and the Department of Sustainability and Environment will undertake surveys elsewhere in regional Victoria over a similar time period. This will enable more sites to be designated along the spectrum of their contribution to species persistence.

Following these surveys the Department of Sustainability and Environment will prepare a sub-regional strategy and revised prescription for the Golden Sun Moth in consultation with the Growth Areas Authority and relevant municipalities to the satisfaction of the Commonwealth. It will use the site data collected (after at least two years of survey) on native vegetation condition and Golden Sun Moth presence to address the sub-regional habitat requirements for the species, factoring in habitat condition and connectivity, as well as Victoria's progress towards the overall protection goal.

A key output of this sub-regional strategy will be a map showing potential retention zones (including the three retention zones already protected as described above). An

interim map of potential retention zones (western Melbourne only) is being prepared by Department of Sustainability and Environment and will be available soon. The potential retention zones will analyse the connectivity between areas that are confirmed Golden Sun Moth and 'high contribution to species persistence' habitat, and have <25 per cent cover of high threat weeds on the site. The output will be a map showing these sites that are connected by breaks in habitat of <200m. The map of 'high contribution to species persistence' habitat will also be revised and updated and published by the Department of Sustainability and Environment as part of the sub-regional strategy.

The detailed design responses developed in the Precinct Structure Planning process will be consistent with the prescription (below) until a revised prescription is prepared as part of the sub-regional strategy. This prescription will only apply to areas within the existing Urban Growth Boundary and the Regional Rail Link corridor.

PRESCRIPTION FOR GOLDEN SUN MOTH

Preamble

This prescription must be read in conjunction with any sub-regional strategy for Golden Sun Moth prepared by the Department of Sustainability and Environment in conjunction with the Growth Areas Authority and approved by the Commonwealth.

Before approving clearing of confirmed Golden Sun Moth habitat, decision makers must first check with the Department of Sustainability and Environment to determine the current level of protection across the relevant bioregion of confirmed 'high contribution' habitat.

In this case, protection means the same as it does for a Victorian native vegetation offset: that is, a permanent binding management agreement or public conservation reserve which targets the conservation of the species.

Surveys of Golden Sun Moth will be undertaken by Growth Area Authority and Department of Sustainability and Environment across the Bioregion over the next two years according to a standard methodology set out in the *Biodiversity Precinct Structure Planning Kit*. If Golden Sun Moth is recorded at a site, habitat within the whole land parcel in which it is recorded will be designated as 'confirmed'. The native vegetation data collected during site surveys will be used by the Department of Sustainability and Environment to confirm the relevant habitat classes (contribution to species persistence) actually on that site with reference to (Figure 38). For example areas currently mapped as non-native habitat may be found to be native (at least 25 per cent relative cover of native species) and upgraded to the High category, and vice versa.

Once this step has been undertaken, the area to be reconciled with the 80 per cent protection target across the bioregion is then the area of 'high contribution to species persistence' habitat on the land parcel as a whole.

Areas retained for Golden Sun Moth that meet the 100ha threshold below could be either scattered habitat within a broader public open space network or condensed habitat surrounded by urban development. Any retained habitat must be able to be practically managed given the current and future land use context and the thresholds below have been chosen partly for this reason. This would include identification of a practical biomass reduction regime (where required) that can be implemented in the long-term and that manages risk of collateral damage to the Golden Sun Moth population on the site (e.g. as a result of fire or slashing).

Prescription

Prior to permitting clearing, surveys to confirm presence or absence of Golden Sun Moth must be undertaken according to a standard methodology set out in the Biodiversity Precinct Structure Planning Kit and relevant native vegetation data must be collected to enable application of this prescription, in any areas shown as habitat on Figure 38 of this report or as updated by the Department of Sustainability and Environment.

Clearing of native vegetation on a land parcel confirmed to support Golden Sun Moth may not occur until there is:

> *protection across the relevant bioregion (through appropriate management) of at least 80 per cent of the total area of places where 'high contribution to species persistence' and 'confirmed habitat' intersect,*

as confirmed by the most recent publicly available report compiled by the Department of Sustainability and Environment;

or

If the 80 per cent target of 'protected confirmed high contribution habitat' has not been reached across the bioregion (as advised by the Department of Sustainability and Environment) such clearing may be permitted in the following circumstances:

1. If the clearance is unavoidable for the provision of infrastructure of state significance; **or**
2. If the native habitat that could otherwise be retained within the land parcel contains >25 per cent cover of high threat perennial grassy weeds; **or**
3. If the habitat proposed to be cleared is not located within an area of at least 100ha comprising native habitat patches less than 200m apart (e.g. as shown on Department of Sustainability and Environment's interim map of potential retention zones for Golden Sun Moth in western Melbourne).

Non-native habitat (shown as 'medium' and 'low' contribution habitat on Figure 38 or as updated by DSE) and areas of non-habitat on that land parcel may be cleared, subject to native vegetation or other requirements (see below).

If clearing of high contribution habitat is permitted, an offset must be found and secured prior to development being approved. In these cases offsets will be determined by treating the vegetation to be removed as Very High conservation significance as a result of its habitat values for the Golden Sun Moth, and the relevant like for like criteria followed including a requirement that the offset site must contain a population of Golden Sun Moth. Offsets in these cases must be located within areas of 'high contribution to species persistence' habitat, currently shown on Figure 38.

Prior to clearing of confirmed 'medium' contribution habitat an equivalent area of native vegetation confirmed to support Golden Sun Moth must be found and secured.

Prior to commencement of clearing of confirmed 'low contribution' habitat the proponent must commission surveys and confirm the presence of an area of confirmed Golden Sun Moth habitat outside the Urban Growth Boundary equivalent to that proposed to be cleared.

Any sites retained as a result of this prescription must be managed to the standards specified for a native vegetation offset under Victoria's Native Vegetation Framework in terms of security and management.

Sites retained as a result of this prescription will be managed in the same way as a native vegetation offset. A fully costed management plan must be prepared by the proponent in order to achieve this, providing for ten years of active management, permanent protection of the site and a land manager responsible to undertake the work. The tenure of the site may remain as it is or the proponent may choose to donate the site to the Crown.

Offset: The priority of the approach is to retain confirmed populations within high contribution habitat. However, there are additional considerations in applying this approach to ensure the desired outcomes are practically deliverable. In order to retain sites for Golden Sun Moth protection, consideration needs to be given to the management requirements of the site. Victoria's approach to native vegetation management is to avoid investing in management of grassy sites that have high levels of high threat weeds due to the increased difficulties and costs, and significantly increased risk of failure.

In addition, a key consideration in retaining habitat in an urban context is whether biomass reduction can be undertaken in order to maintain suitable conditions for the Golden Sun Moth. The use of fire is generally impractical in an urban context and unless the site is very large presents a high risk of destroying the population. Grazing is also problematic in an urban context due to animal welfare concerns unless the site is large and set up to exclude dogs and people. Slashing can be effective but is only practical in non-rocky sites and requires management of issues such as vehicle hygiene and weed spread. It is also unknown what impact slashing may have on a population of Golden Sun Moth, particularly at a small isolated site.

As a result, there will be situations where such high contribution habitat is permitted to be cleared. In these cases offsets will be required for Golden Sun Moth habitat, calculated in accordance with Victoria's Native Vegetation Framework. This includes permanent legal protection of the offset site, including a management regime and land manager. The result of this will be an offset secured prior to the habitat clearing that, depending on the security arrangements, will be an area of native vegetation larger than the clearing site (often several times larger) supporting a confirmed population of Golden Sun Moth and managed to sustain the population at the site.

If confirmed Golden Sun Moth habitat which is not classed as making a high contribution to species persistence is cleared, a contribution to the overall protection goal is still required. Therefore, in the case of confirmed 'medium contribution habitat' an equivalent area of native vegetation confirmed to support Golden Sun Moth must be found and secured prior to the clearing. For clearing of 'low contribution habitat', the proponent must commission surveys to confirm a similar area of Golden Sun Moth habitat (and species presence) outside the Urban Growth Boundary, but securing management of the site is not required.

The Department of Sustainability and Environment will be responsible for formal accounting of the 80 per cent protection goal. All permanently protected 'high contribution' habitat will be counted towards this goal if it achieves the same standard of protection as for an offset under Victoria's Native Vegetation Framework. This could include areas protected within the Urban Growth Boundary as part of precinct planning, offsets for clearing of Golden Sun Moth habitat inside or outside the Urban Growth Boundary and areas within conservation reserves (not used for native vegetation offsets) including the large new reserves to be established west of Melbourne.

The proposed 15,000ha Western Grassland Reserves are already known to support Golden Sun Moth at several locations (see Figure 36) (Gilmore et al. 2009 Figure 4). Additional areas in the Melbourne North Investigation Area and west of Melbourne are also likely to be protected or reserved as required by the prescription. This will help retain genetic diversity across the species' range, in conjunction with offsets secured outside urban Melbourne.

These reserves will be managed specifically for the long term success of Golden Sun Moth and other grassland dependent fauna and flora. Key management measures for Golden Sun Moth will include:

- Reducing biomass and controlling weeds in areas of known habitat to maintain habitat quality;
- Progressively removing barriers to connectivity across the reserves; and
- Conducting ongoing monitoring including further surveys and maintaining the ability to alter management actions as a result of new information.

The Department of Sustainability and Environment will prepare further guidance outlining the assessment and accounting process, data standards and curation arrangements for Golden Sun Moth, to be published as part of the Sub-Regional Strategy for the Golden Sun Moth.

OTHER MITIGATION AND RELATED PROCESSES

Translocation may be considered where sites have been approved for removal and areas of suitable but unoccupied habitat exist within secure conservation reserves. However, there is little evidence that this is an effective technique. Any translocation attempted will be fully documented and monitored.

Further survey work will be needed to inform the Golden Sun Moth habitat matrix. The current best practice survey protocols in the *Biodiversity Precinct Structure Planning Kit* provide a standardised methodology for Golden Sun Moth surveys. As indicated above, surveys will be undertaken as follows:

- The Growth Areas Authority will undertake targeted surveys of Golden Sun Moth across its historic range within peri-urban areas, Green Wedges and proposed precincts;
- The Department of Sustainability and Environment will undertake surveys of Golden Sun Moth across its historic range in areas of rural and regional Victoria; and
- Before proponents are permitted to clear confirmed Golden Sun Moth habitat, they will be required to confirm equivalent areas of habitat outside the Urban Growth Boundary through survey.

MITIGATION OUTCOMES

If mitigation measures are successful, the net impact on this species is likely to be positive over the long term. However, given the lack of current data combined with the time lapse needed before evidence that the trajectory for the species is improving can be seen, an approach that manages uncertainties and acquires new information is required.

The outcomes sought are:

- Large areas of permanently protected habitat managed in a way that enables Golden Sun Moth to be sustained over the long term through a series of connected populations;
- A selection of smaller reserves and protected areas under targeted management in areas with the greatest contribution to species persistence, providing insurance against risk of catastrophic events in the large reserves;

- Permanent protection and management of 80 per cent of highest priority habitat for the species across the bioregion (confirmed sites contributing most to species persistence); and
- Significantly improved information on Golden Sun Moth distribution within Victoria to support important research and management knowledge.

ADAMSONS BLOWN-GRASS

As indicated in Section 5.2.1, there is a small possibility that this species is still extant within the study area, and could be found within the Melbourne West Investigation Area during detailed surveys. However, this is not likely. If the species does persist close to Melbourne, it is more likely to be found in the proposed grassland reserves further west.

Actions under the Program are not considered likely to cause a significant impact on this species.

However, if the species is found during more detailed surveys for Precinct Structure Planning, or during construction, a prescription will need to be developed by Department of Sustainability and Environment to the satisfaction of the Commonwealth to guide mitigation and management decisions.

Once agreed, this prescription will be used in the Precinct Structure Planning process as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure and guide decision making for this species for the remainder of the Program.

BUTTON WRINKLEWORT

Given its particular habitat and management requirements, the Button Wrinklewort is unlikely to persist on any private land within the study area. The two known sites – a rail reserve and a cemetery – will both be protected from impacts associated with the Program and will not be developed.

Actions under the Program are therefore unlikely to cause a significant impact on this species, and additional populations are unlikely to be detected during more detailed surveys for Precinct Structure Planning.

However, surveys will be undertaken and if plants are found, a prescription will need to be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth to guide mitigation and management decisions.

Once agreed, this prescription will be used in the Precinct Structure Planning process as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure and will guide decision making for this species for the remainder of the Program.

CLOVER GLYCINE

Clover Glycine has not been recently recorded within the study area, but may be present as few targeted surveys have been undertaken in large parts of the study area. It is most likely to be found within the Melbourne West Investigation Area but could also be found in the Melbourne North Investigation Area.

Although current information indicates that actions under the Program are not likely to significantly impact this species, this may change as a result of surveys for the species over coming years as part of Precinct Structure Planning, transport infrastructure and other development planning. Department of the Environment and Heritage guidelines (2006) indicate that an impact will be considered significant if the population impacted meets the criteria for an important population.

If the Clover Glycine is found during surveys, a prescription will be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth before the Precinct Structure Planning or other development planning process is finalised. This prescription will guide mitigation and management decisions including whether to retain the species on site. Once approved it will be used to guide management of this species in these development planning processes for the remainder of the Program.

CURLY SEDGE

As outlined in Section 5.1.2, Curly Sedge is a very restricted plant in Victoria. In Melbourne, it is only associated with Curly Sedge Creek, which runs through the Craigieburn Grasslands Reserve. Important population sites within the Melbourne North Investigation Area will be protected from development. The Craigieburn Grassland reserves are already permanently protected and managed for their conservation values.

The area to the north along Curly Sedge Creek has scattered Curly Sedge plants along its margins. This area and its associated native grasslands will be excluded from urban development and managed for its conservation values in the long term.

The continuation of Curly Sedge Creek to the south of Craigieburn Grasslands Reserve also has scattered plants along its margins: however, the surrounding area is very degraded. This area south of O'Hearns Road will also be excluded from urban development and its potential contribution to the retained environment network will be determined in the Biodiversity Conservation Strategy prepared for the growth area.

Any use of this area (such as recreation) will need to be managed to ensure that the creek and an appropriate buffer are suitably protected. This will be resolved in the Biodiversity Conservation Strategy that will be developed for the Hume-Whittlesea Growth Area as an input to the Growth Area Framework Planning process.

Management arrangements will also be put in place to ensure the ongoing conservation of Curly Sedge along the creek and its margins. This will require monitoring and appropriate hydrological and vegetation management.

If these management measures are taken it is unlikely that Curly Sedge will be significantly impacted by actions under the Program.

LARGE-FRUIT GROUNDSEL

This species shares some habitat preferences with Button Wrinklewort and is unlikely to occur on private land in the study area, unless it is on a site well protected from grazing.

Within the Melbourne West Investigation Area it has been found within the Melbourne-Bendigo Railway Reserve and on one private land site on the north side of the railway at Rockbank, where it is scattered through rocky native grassland.

This site is not proposed to be excluded from development and further investigation will be required at the Precinct Structure Planning stage to determine the extent and location of the population at this site and the ability retain part of the population on private land in conjunction with management of the remainder of the population in the adjacent rail reserve or the non-urban network. Such a strategy may reduce impacts below the significant threshold (Department of the Environment and Heritage 2006). However it is quite possible that a significant impact may occur on this species if removal of a substantial proportion of this population is unavoidable.

Additional populations of this species are not likely to be located on private land within the study area, however targeted surveys will be undertaken as a precaution.

A prescription will be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth to inform the Growth Area Framework Planning and Precinct Structure Planning process at this Rockbank site. This prescription will guide mitigation and management decisions including whether to retain the species on site.

Once agreed, this prescription will be used in the Precinct Structure Planning process as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure and other development and will guide decision making for this species for the remainder of the Program.

There is some potential for the species to regenerate in the proposed Western Grassland Reserves to the west, perhaps from wind-blown propagules, once grazing stops and the sites are managed accordingly. However, whether this will occur naturally is unknown. This species has also been salvaged from development sites in the west of Melbourne and nursery grown stock will be available for planting into the grassland reserves where considered appropriate.

MATTED FLAX-LILY

There are some records of Matted Flax-lily within the southern edge of the Melbourne North Investigation Area and in adjacent precincts (Figure 20). Additional populations may also be found during more detailed surveys in the Melbourne North and possibly Melbourne South-East Investigation Areas and adjacent precincts, although the generally degraded condition of grassland and grassy woodland habitat in these areas indicates that populations are more likely to be small.

No plants were detected during consultant surveys within the Investigation Areas. Around 120 populations are known, but none of the 17 listed as important in the draft recovery plan (Carter in prep) are within the study area.

The species is presumed to have been much more widespread in the past, but is now generally reliant on small areas of habitat, with little connectivity between them. The key threats are habitat destruction or disturbance, weed invasion and fragmentation of populations. Fragmentation is exacerbated by the fact that the species is dependent on native bees for its pollination, and does not appear to reproduce from seed in the wild (Carter in prep). Much remains unknown about the species and the long term management of extant populations. Translocation has been undertaken where necessary, apparently with success, and reintroducing the species to secure areas of suitable habitat is an important recovery action (Carter in prep).

IMPACTS

Current knowledge of Matted Flax-lily and application of the Commonwealth's Significant Impact Guidelines (Department of the Environment and Heritage 2006) indicate that actions under Program are likely to result in significant impact at some sites in the north. It is assumed that such impacts would be on very small populations in degraded habitat.

Further detailed information will be collected to determine the extent of the impact.

MITIGATION

Avoid, minimise: As for other grassland and grassy woodland species, known and likely habitats were avoided in locating the current Urban Growth Boundary, Investigation Areas, proposed Urban Growth Boundary and related infrastructure. The Precinct Structure Planning process will enable impacts to be minimised further, after surveys confirm the presence of Matted Flax-lily.

A prescription has been developed to guide all future decisions about retaining or clearing Matted Flax-lily within the study area, should such a decision be required.

PRESCRIPTION FOR MATTED FLAX-LILY

Preamble

Before approving clearing of confirmed Matted Flax-lily habitat, decision makers must first check with the Department of Sustainability and Environment to determine the current level of protection across the relevant bioregion of confirmed 'high contribution' habitat.

In this case, protection means the same as it does for a Victorian native vegetation offset: that is, a permanent binding management agreement or public conservation reserve which targets the conservation of the species.

As part of the Precinct Structure Planning process, land will be further surveyed for native vegetation and threatened species (including Matted Flax-lily) according to a standard methodology set out in the *Biodiversity Precinct Structure Planning Kit*.

If Matted Flax-lily is recorded at a site, habitat within the whole land parcel in which it is recorded will be designated as 'confirmed'.

The native vegetation data collected during site surveys will be used by the Department of Sustainability and Environment to confirm the relevant habitat classes (contribution to species persistence) actually on that site with reference to (Figure 40). For example areas currently mapped as non-native habitat may be found to be native (at least 25 per cent relative cover of native species) and upgraded to the High category, and vice versa. This map will be publicly available and periodically updated.

Once this step has been taken, the area to be reconciled with the 80 per cent protection target across the bioregion is then the area of 'high contribution to species persistence' habitat on the land parcel as a whole.

Prescription

Prior to permitting clearing, surveys to confirm presence or absence of Matted Flax-lily must be undertaken according to a standard methodology set out in the Biodiversity Precinct Structure Planning Kit and relevant native vegetation data must be collected to enable application of this prescription, in any areas shown as habitat on Figure 39 of this report or as updated by the Department of Sustainability and Environment.

Clearing of native vegetation on a land parcel confirmed to support Matted Flax-lily may not occur until there is:

> *protection across the relevant bioregion (through appropriate management) of at least 80 per cent of the total area of places where 'high contribution to species persistence' and 'confirmed habitat' intersect*,

as confirmed by the most recent publicly available report compiled by the Department of Sustainability and Environment;

or

If the 80 per cent target of 'protected confirmed high contribution habitat' has not been reached across the bioregion (as advise by the Department of Sustainability and Environment) such clearing may be permitted In the following circumstances.

1. If the clearance is unavoidable for the provision of infrastructure of state significance; **or**
2. If the native habitat that could otherwise be retained within the land parcel contains >25 per cent cover of high threat perennial grassy weeds.

If clearing of high contribution habitat is permitted, an offset must be found and secured prior to the development approval. In these cases offsets will be determined by treating the vegetation to be removed as Very High conservation significance as a result of its habitat values for the Matted Flax-lily, and the relevant like for like criteria followed including a requirement that the offset site must contain a population of Matted Flax-lily.

The remaining 'medium' and 'low' contribution habitat and areas of non-habitat on that land parcel may be cleared, subject to native vegetation or other requirements.

Any sites retained as a result of this prescription must be managed to the standards specified for a native vegetation offset under Victoria's Native Vegetation Framework in terms of security and management.

If Matted Flax-lily plants are approved for removal at a site, a fully-costed translocation plan that satisfies the Department of Sustainability and the Environment must be prepared. Plants must be translocated to areas of suitable habitat within secure conservation reserves (either on or off site), preferably to the proposed northern grassland woodland reserve unless a better outcome is likely to be achieved elsewhere. Translocation must follow the *Guidelines for the Translocation of Threatened Plants in Australia*, 2nd Ed (or as updated). Any translocation attempt will be fully documented and monitored.

This prescription will be used in the Precinct Structure Planning process, as required by the Precinct Structure Planning Guidelines and in approvals for other developments associated with the Program

This prescription is similar in its approach to that used for Golden Sun Moth, as it relies on having a map showing the current spectrum of habitat as a reference point (refer Golden Sun Moth discussion above for further background). The spectrum of habitat for Matted Flax-lily is shown in Figure 39 and the three species persistence categories, currently based on modelled information, are described in Appendix 4.

Sites retained as a result of this prescription will be managed in the same way as a native vegetation offset. A fully costed management plan must be prepared by the proponent in

order to achieve this providing for ten years of active management, permanent protection of the site and a land manager responsible to undertake the work. The tenure of the site may remain as it is or the proponent may choose to donate the site to the Crown.

Offset: The priority of the approach is to retain confirmed populations within high contribution habitat. However there are additional considerations in applying this approach to ensure the desired outcomes are practically deliverable. In order to retain sites for Matted Flax-lily protection consideration needs to be given to the management requirements of the site. Victoria's approach to native vegetation management, is to avoid investing in management of grassy sites that have high levels of high threat weeds due to the increased difficulties and costs, and significantly increased risk of failure.

As a result there will be situations where such high contribution habitat is permitted to be cleared. In these cases offsets will be required for Matted Flax-lily habitat, calculated in accordance with Victoria's Native Vegetation Framework.

This includes permanent legal protection of the offset site, including a management regime and land manager. The result of this will be an offset secured prior to the habitat clearing that, depending on the security arrangements, will be an area of native vegetation larger than the clearing site (often several times larger) supporting a confirmed population of Matted Flax-lily and managed to sustain the population at the site.

A Northern Grassy Woodland Reserve of at least 1200ha in size will be established outside the Urban Growth Boundary (Section 6.1.2). In addition a network of retained grassland and grassy woodland areas will be established inside the northern Growth Area at the same time as the gazettal of the new Urban Growth Boundary. Many of these retained areas, which total approximately 773ha in size (within the Urban Growth Boundary), will be managed specifically for the long term success of the threatened species and ecological communities present in them. It is not known whether Matted Flax-lily is present in the proposed reserves, but suitable habitat is available it is considered likely. Additional survey will be undertaken to confirm whether this is the case. In addition the Western Grassland Reserves may support a population of the species and will be managed for the conservation of any resident or translocated populations. Suitable areas of habitat within secure reserves including the Northern Grassy Woodland Reserve will be identified as recipient sites for plants translocated from development areas.

MITIGATION OUTCOMES

Despite potential significant short term impacts on the Matted Flax-lily, the longer term prognosis is favourable, given the extent of actively managed, permanently protected grassland and grassy woodland habitat to be secured as a result of the Program.

The outcomes sought are:

- Large areas (greater than 1,200ha) of permanently protected grassy woodland habitat managed in a way that enables Matted Flax-lily to be sustained over the long term through a series of connected populations and adaptive management regimes;
- A selection of smaller reserves and protected areas under targeted management within the urban context and in areas with the greatest contribution to species persistence, providing insurance against risk of catastrophic events and important research and management knowledge; and
- Improved information regarding the distribution and location of important populations inside and outside Melbourne.

SMALL GOLDEN MOTHS

As described in Section 5.3.1, Small Golden Moths are known in only two populations, both in Melbourne. The smaller population is located at the Laverton Airbase, outside the study area, and the completed planning process for that site has ensured protection of some plants. The largest population, on private land along Clarke Road in the Melbourne West Investigation Area, will be excluded from urban development, permanently protected and managed to maintain this critically important population. This will be achieved either through a Crown purchase of the land or by entering into a binding agreement with the landowners that provides for the dedicated management of this site for the conservation of the species in perpetuity (in conjunction with stewardship or offset payments). The first step in this process will be the designation of this land as Rural Conservation Zone within the Melton planning scheme with an accompanying Environmental Significance Overlay.

If these arrangements are successfully put in place at an early stage, actions under the Program are not likely to result in a significant impact on this species.

If additional populations of Small Golden Moths are located during subsequent surveys, a prescription will need to be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth before Precinct Structure Planning is finalised. This prescription will guide mitigation and management decisions including whether to retain the species on site.

Once agreed, this prescription will be used In Precinct Structure Planning and transport infrastructure planning and will guide decision making for this species for the remainder of the Program. Given the critically endangered status of this species, it is likely that any subsequent populations will be managed on site.

SPINY RICE-FLOWER

The greatest threats to the Spiny Rice-flower are vegetation clearing (including cultivation and direct mechanical disturbance from vehicles) and degradation of habitat, particularly as a result of weed invasion and inappropriate grazing or fire regimes.

The species appears to be tolerant of, and may even benefit from, slight disturbance: however, absent or heavy grazing and frequent or intense fire appear detrimental (Department of Environment, Water, Heritage and the Arts 2009). Habitat fragmentation is also a significant long term threat to the survival of the species as most populations are small and isolated and rely on male and female plants for reproduction, and seed germination (which requires fire and rain) is rare.

Within the Strategic Assessment area Spiny Rice-flower has been found within the Melbourne West Investigation Area and within both the proposed Western Grassland Reserves.

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's draft *Significant Impact Guidelines* for the Spiny Rice-flower (Department of Environment, Water, Heritage and the Arts 2009c) indicate that the following events are likely to result in a significant impact:

- Fragmentation of a population (such as through buildings, fences, breaks in habitat);
- Loss of more than five individuals from a population; and
- Any loss of individuals from a population at the edge of the species' range.

Note that according to the Commonwealth's draft Significant Impact Guidelines a population of Spiny Rice-flower refers to "a collection of individual plants occurring close together but separated geographically from other such collections. Land use and management practices may limit the geographic extent of populations" (Department of Environment, Water, Heritage and the Arts 2009c).

ACTUAL/LIKELY IMPACTS

The actions associated with the Program are likely to result in a significant impact at some sites in the west, although further detailed information is needed to determine the extent of the impact. As populations close to Melbourne are at the south-eastern extent of the species' range, any loss may be considered a significant impact.

It is likely that up to 4,667ha of native grassland may be cleared over the next 20 to 30 years in the west and north of Melbourne. This figure includes the Melbourne North Investigation Area, which includes some potential habitat for the species, even though it has never been recorded there. Although not all of this grassland is habitat for the

Spiny Rice-flower, and much of the area has been surveyed with very few populations of Spiny Rice-flower found, if a precautionary approach is taken, it should be assumed that additional populations will be located during surveys.

Only nine of the 184 known sites in Victoria are in conservation reserves, and most are small, isolated reserves within the urban area. These reserves include half the known populations in western Melbourne.

In the Melbourne area, inside and outside the proposed Urban Growth Boundary, Department of Sustainability and Environment data indicates that there are approximately 46 known populations of which 33 are estimated to support 30 or less plants, three support 30 to 100 plants and seven support 100 to 600 plants (ranging from 252 to 600). Three of these larger populations occur within the actual study area for the Program. These are Truganina Cemetery (375 plants), Ravenhall Grasslands (500 plants) and a private property on Greigs Road, Rockbank (at least 400 plants). The first two will be protected as a result of the Program. The Greigs Road site is being considered for inclusion in the northern section of the proposed Western Grassland Reserve, (already known to include smaller populations of the Spiny Rice-flower) however this addition is not yet certain. The southern section of the proposed Western Grassland Reserve contains the fourth of the larger populations, along Kirks Bridge Road (400 plants), as well as other smaller populations. The other three large populations are:

- At a protected and managed grassland site owned by Melbourne Water to the south of the proposed Western Grassland Reserve;
- At a secure reserve in Rockbank negotiated as a result of a development proposal and in the process of becoming Crown Land; and
- At a proposed residential development at Burnside for which State and Commonwealth approvals are yet to be sought.

The prescription that has been developed for managing the retention of Spiny Rice-flower is likely to result in the retention of the Greigs Road population, and Victoria proposes to adopt a similar approach for the Burnside population, although it is not included within the strategic assessment area. Hence five of the seven larger populations are or will be protected, and protection of the sixth and seventh sites is likely.

Of the three populations of between 30 and 100 plants, two are already protected and managed in public or private reserves and the other is still under negotiation as part of an existing residential development.

Given the low levels and slow rate of recruitment of Spiny Rice-flower it is likely that populations at small, isolated sites will not persist in the long term without intensive

management inputs. Unless pollinators are identified and their habitat requirements successfully managed, this is likely to include hand pollination, and certainly seed germination and replanting activities, to reduce genetic problems such as inbreeding and bolster populations. Ecological burning is effective in stimulating recruitment but is often difficult to undertake at small sites. As the plants are long-lived, any decline in managed populations will not be seen for a long time, but this also means that this there is time to identify and manage key populations.

MITIGATION OBJECTIVES

1. Retain largest (best) habitat areas in the proposed Western Grassland Reserves, plus a proportion of smaller sites scattered across the range;
2. Ensure that population clusters are protected and managed appropriately by reserving representative populations within the clusters and managing their habitat appropriately;
3. Manage retained areas of native grassland to improve quality and connectivity of existing habitat by removing barriers and actively managing open-tussock grassland structure. Connect suitable unoccupied habitat with occupied habitat;
4. Monitor and manage adaptively; and
5. Undertake broader targeted surveys for the species across its historic range to provide context for land use decisions.

MITIGATION STRATEGY

Avoid: The current Urban Growth Boundary, Investigation Areas, the proposed Urban Growth Boundary revision and related infrastructure have been located to avoid the majority of known native grasslands. This includes some areas of known Spiny Rice-flower habitat, although additional areas have since been located during surveys.

Minimise: Fine-tuning the proposed location of Urban Growth Boundary, OMR/E6 Transport Corridor, Regional Rail Link and exclusion areas in the Melbourne West Investigation Area has minimised impacts on the species. Impacts will be further minimised through the Precinct Structure Planning process required for all proposed urban areas, and through the management prescription below. This will result in sympathetic design and construction techniques and, where possible, additional areas of vegetation will be retained and managed for Spiny Rice-flower (after surveys confirm the presence of the species and the management needs at that location) where population size or other attributes warrants this.

A prescription to guide all future decisions about retaining or clearing of Spiny Rice-flower habitat within the study area has been developed. It takes a similar approach to that of the Golden Sun Moth, in that it relies on having a current map of habitat in order

of contribution to the persistence of species across the State, and being able to compare this with new survey data as it comes to hand. In the lower classes of the matrix are sites where protection from physical or chemical disturbance remains at risk, such as those on unsecured private agricultural land, land already approved for urban development and some roadside/rail sites. The map of the three species persistence categories, currently based on modelled information, is shown in Figure 40 and the three categories are described in Appendix 5.

Sites retained as a result of this prescription will be managed in the same way as a native vegetation offset under Victoria's Native Vegetation Framework. A fully costed management plan must be prepared by the proponent in order to achieve this providing for ten years of active management, permanent protection of the site and a land manager responsible to undertake the work. The tenure of the site may remain as it is or the proponent may choose to donate the site to the Crown.

PRESCRIPTION FOR SPINY RICE-FLOWER

Preamble

Before approving clearing of confirmed Spiny Rice-flower habitat, decision makers must first check with the Department of Sustainability and Environment to determine the current level of protection across the relevant bioregion of confirmed 'high contribution' habitat.

In this case, protection means the same as it does for a Victorian native vegetation offset: that is, a permanent binding management agreement or public conservation reserve which targets the conservation of the species.

As part of the Precinct Structure Planning process, land will be further surveyed for native vegetation and threatened species (including Spiny Rice-flower) according to a standard methodology set out in the *Biodiversity Precinct Structure Planning Kit*. If Spiny Rice-flower is recorded at a site all the vegetation within the land parcel in which it is recorded will be designated as 'confirmed habitat'.

The native vegetation data collected during site surveys will be used by the Department of Sustainability and Environment to confirm the relevant habitat classes (contribution to species persistence) actually on that site with reference to (Figure 40). For example areas currently mapped as non-native habitat may be found to be native (at least 25 per cent relative cover of native species) and upgraded to the High category, and vice versa.

Once this step has been undertaken, the area to be reconciled with the 80 per cent protection target across the bioregion is then the area of 'high contribution to species persistence' habitat on the land parcel as a whole.

Prescription

Prior to permitting clearing, surveys to confirm presence or absence of Spiny Rice-flower must be undertaken according to a standard methodology set out in the Biodiversity Precinct Structure Planning Kit and relevant native vegetation data must be collected to enable application of this prescription, in any areas shown as habitat on Figure 40 of this report or as updated by the Department of Sustainability and Environment.

Clearing of native vegetation on a land parcel confirmed to support Spiny Rice-flower may not occur until there is:

> *protection across the relevant bioregion (through appropriate management) of at least 80 per cent of the total area of places where 'high contribution to species persistence' and 'confirmed habitat' intersect,*

as confirmed by the most recent publicly available report compiled by the Department of Sustainability and Environment;

or

1. If the clearance is unavoidable for the provision of infrastructure of state significance; **or**
2. If the native vegetation that would otherwise be retained within the land parcel contains >25 per cent cover of high threat perennial grassy weeds and the population of Spiny Rice-flower is less than 200 plants; **or**
3. If the vegetation removal will impact on no more than 20 per cent of the Spiny Rice-flower plants within a land parcel that supports at least 200 Spiny Rice-flower plants ; **or**
4. If the vegetation removal will impact on no more than 50 per cent of the Spiny Rice-flower plants within a land parcel that supports more than five and less than 200 plants; **or**
5. If there are no more than five Spiny Rice-flower plants within the land parcel.

If clearing of high contribution habitat is permitted, an offset must be found and secured prior to development being approved. In these cases offsets will be determined by treating the vegetation to be removed as Very High conservation significance as a result of its habitat values for the Spiny Rice-flower, and the relevant like for like criteria followed including a requirement that the offset site must contain a population of Spiny Rice-flower.

The remaining 'medium' and 'low' contribution habitat and areas of non-habitat on that land parcel may be cleared, subject to native vegetation or other requirements.

Any sites retained as a result of this prescription must be managed to the standards specified for a native vegetation offset under Victoria's Native Vegetation Framework in terms of security and management.

Before Spiny Rice-flower plants are approved for removal, a fully costed translocation plan must be prepared to the satisfaction of the Department of Sustainability and Environment and in consultation with the Pimelea spinescens Recovery Team. Translocation must be to areas of suitable habitat within secure conservation reserves (either on or off site), preferably to the proposed Western Grassland Reserves unless a better outcome is likely to be achieved elsewhere. Translocation must follow the Translocation Protocol prepared by the Pimelea spinescens Recovery Team (Mueck 2009) (or as updated) and Guidelines for the Translocation of Threatened Plants in Australia, 2nd Ed (or as updated). Any translocation attempted will be fully documented and monitored.

Figure 40 illustrates the current spectrum for Spiny Rice-flower.

This prescription will be used in the Precinct Structure Planning process, as required by the Precinct Structure Planning Guidelines and in approvals required for other development in the Program.

Offset: The priority of the approach is to retain confirmed populations within high contribution habitat. However, there are additional considerations in applying this approach to ensure the desired outcomes are practically deliverable. In order to retain sites for Spiny Rice-flower protection, consideration needs to be given to the management requirements of the site. Victoria's approach to native vegetation management is to avoid investing in management of grassy sites that have high levels of high threat weeds, due to the increased difficulties and costs, and significantly increased risk of failure.

In addition, a key consideration in retaining habitat in an urban context is whether biomass reduction can be undertaken in order to maintain suitable conditions for the Spiny Rice-flower. The use of fire is preferred but is generally impractical in an urban context.

As a result there will be situations where such high contribution habitat is permitted to be cleared. In these cases offsets will be required for Spiny Rice-flower habitat, calculated in accordance with Victoria's Native Vegetation Framework.

This includes permanent legal protection of the offset site, including a management regime and land manager. The result of this will be an offset secured prior to the habitat clearing that, depending on the security arrangements, will be an area of native vegetation larger than the clearing site (often several times larger) supporting a confirmed population of Spiny Rice-flower and managed to sustain the population at the site.

Initially, the proposed new Western Grassland Reserves will more than likely act as offsets, subject to the confirmation of Spiny Rice-flower populations in 'high contribution' habitat areas. The proposed Western Grassland Reserves are already known to support Spiny Rice-flower at several locations (Figure 36). If sufficient area of habitat confirmed as supporting Spiny Rice-flower is not found within the proposed Western Grassland Reserves, alternative offset sites will be required.

These reserves will be managed specifically for the long term success of the threatened species and ecological communities that are present. They will provide the largest and most secure area of habitat for Spiny Rice-flower in the state. Additional surveys will be undertaken to determine the extent of populations within the reserve. These data will be shared with the Pimelea spinescens Recovery Team. Population data, monitoring results and trends will be included within periodic reports provided to the Commonwealth.

Suitable areas of habitat within the reserves will also be identified as potential recipient sites should plants be translocated from development areas.

MITIGATION OUTCOMES

There will be significant impacts as a result of the Program in the short-term to medium. However over time, if mitigation measures are successful, the net impact on this species is likely to be positive. This will be a consequence of protecting and managing all moderate to large populations and securing a very large area of habitat (currently private agricultural land) specifically to protect and manage for Spiny Rice-flower. The lack of current data and the time lapse before evidence that the trajectory for the species is improving can be seen (as a result of positive management in the reserved areas), require an approach that manages for uncertainties and acquires new information.

The outcomes sought are:

- Large (approximately 15,000ha) areas of permanently protected habitat managed in a way that enables Spiny Rice-flower to be sustained over the long term through a series of connected populations;
- Protection of all known and future populations containing 200 plants or more;
- A selection of small reserves within the urban context providing insurance against the risk of catastrophic events, and important research and management knowledge; and
- Improved information regarding the distribution and location of important populations inside and outside Melbourne.

SWAMP FIREWEED

This species has only been recorded at one location within the Melbourne North Investigation Area, being Hearne Swamp, just north-east of Beveridge. There are several tens of records of the species at this site (Brett Lane, ecological consultant, pers. comm.) However, it may well be present elsewhere, including in the south-east where there is a record of the species near Clyde. It is also likely within areas of grassy wetland to the north and west of Melbourne and could occur within the proposed Western Grassland Reserve.

As discussed in the OMR/E6 report, the proposed railway connection into the main north-south railway line passes through one of the sites within the swamp where this species has been recorded. It is therefore likely that some of the population of this species at Hearne Swamp will be affected.

The likely extent of unavoidable impact is not yet known and further investigation will be required at the appropriate stage prior to commencement of construction to determine

the extent and location of the population at this site and the ability retain all or part of the population in a secure site.

A prescription will be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth to inform requirements for the OMR/E6 project and the Precinct Structure Planning process should the species be located in proposed urban areas. This prescription will guide mitigation and management decisions, including whether to retain the species on site.

6.4.2 SPECIES THAT PREDOMINANTLY INHABIT NON-GRASSY ENVIRONMENTS

GREY-HEADED FLYING-FOX

Colonies and satellite roosting sites are the major concerns for possible impacts on this species.

The study area does not include the two existing colonies, any known satellite sites or any specific foraging areas that are important for this species. The actions associated with the Program are therefore unlikely to impact on Grey-headed Flying-fox habitats and extant populations.

SOUTHERN BROWN BANDICOOT

The greatest threats to the species are habitat loss and habitat degradation from alteration of the vegetation structure by rabbits, weeds or fuel reduction burning; predation by foxes and cats; and fragmentation and isolation, particularly of small populations.

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's *Significant Impact Guidelines* (Department of the Environment and Heritage 2006) apply in this case, as no specific guidelines are yet available for the Southern Brown Bandicoot.

ACTUAL/LIKELY IMPACTS

Impacts on Southern Brown Bandicoot will only occur within the Melbourne South-East Investigation Area. Direct impacts resulting from future urban development inside the new Urban Growth Boundary are likely, but will be of a relatively local scale if key mitigation measures are taken.

This because likely areas of habitat are proposed to be excluded from the urban area and some of the remaining habitat in reserves/corridors is able to be retained. Degraded but still suitable habitat within the Melbourne South-East Investigation Area (in the north-west quarry and the Dandenong-Leongatha Railway Reserve) will more than likely be removed or further degraded over time.

Indirect impacts are likely to be of greater consequence to the species unless managed extremely well, as intensive urban development is expected to happen close to the more important retained areas of habitat in the future.

It is likely that significant impacts as defined by Department of the Environment and Heritage (2006) will occur in the short to medium term. The scale of such impacts depends on how well habitat connectivity is effectively maintained and enhanced, particularly outside the proposed Urban Growth Boundary. This will be considered and agreed during the Growth Area Framework Planning phase scheduled to follow the current Urban Growth Boundary review.

The degree of impact will also depend on how well these areas can be managed to minimise the impacts of nearby human occupation. If connectivity can be maintained through careful planning and management in the long term, impacts on the species can be kept to a local scale or even reduced further.

MITIGATION OBJECTIVES

1. Exclude major areas of suitable habitat from development;
2. Retain, upgrade and connect existing habitats within proposed precincts and outside the Urban Growth Boundary, including the important population at the Royal Botanic Gardens Cranbourne;
3. Secure and manage retained habitat and linkages to conserve Southern Brown Bandicoot;
4. Monitor retained and new habitat and adjust management accordingly; and
5. Carefully plan and construct urban development within precincts to minimise impacts on species (such as employing road design and other techniques that facilitate road crossings, and restricting cat, dog and human access in particular areas).

MITIGATION STRATEGY

Avoid: The current Urban Growth Boundary, South-East Investigation Area and proposed zoning within the proposed Urban Growth Boundary have been located to avoid the key area of Southern Brown Bandicoot habitat (a large quarry area in the south-west of the Investigation Area). Although this has been included within the proposed Urban Growth Boundary, it has not been designated as an area for urban development (refer Program Report). After quarrying is complete, the site will be retained in the long term for biodiversity protection and potentially other sympathetic land-uses.

Minimise: Impacts will be minimised through the Precinct Structure Planning process, which is required for all proposed urban areas. Where impacts to Southern Brown Bandicoot need to be further minimised, a precinct will be designed to include a network of retained habitat areas and sympathetic design and construction techniques (in

conjunction with further surveys to assess the habitat retention needs of Southern Brown Bandicoot).

Excluding urban development from waterways and their associated buffers will minimise some impacts to the Southern Brown Bandicoot. Although these areas are the most important habitats for the species, they do assist with local dispersal. Impacts will be minimised by dedicated management of retained areas to maintain habitat values for Southern Brown Bandicoot, including in areas that are nearby and outside the Urban Growth Boundary.

Offset/other mitigation: Protecting and managing Southern Brown Bandicoot habitat within the proposed network of retained areas inside and outside the Urban Growth Boundary will help with the long term conservation of the species in general, and the important population stretching from Melbourne to Wilsons Promontory in particular. This is probably the most important component of the mitigation strategy.

A sub-regional conservation strategy has been developed for the former Koo Wee Rup Swamp area (Schmidt et al. 2008) to the east of the Melbourne South-East Investigation Area. An assessment of regional biodiversity links (Practical Ecology 2008) has also identified options for increasing habitat connectivity for Southern Brown Bandicoot in and around the Royal Botanic Gardens Cranbourne, to the immediate west of the Melbourne South-East Investigation Area. An overall map of modelled habitat suitability for the Southern Brown Bandicoot is provided in Figure 41.

These studies will be used to develop a targeted Sub-Regional Strategy that includes the Melbourne South-East Investigation Area, retained habitat areas and linkages to the east, south and west (including between Botanic Ridge Precinct and the Quarry to the south west of the South-East Investigation Area).

The Sub-Regional Strategy will be developed by the Department of Sustainability and Environment in consultation with the Growth Areas Authority and relevant municipalities to the satisfaction of the Commonwealth. It will address the sub-regional connectivity between and within important populations over the long term. Implementation of the key strategic protection and management measures (such as planning scheme measures and land acquisition) will start before or in conjunction with Precinct Structure Planning. The Sub-Regional Strategy will be prepared prior to and as a key input into the Growth Area Framework Plans.

The Sub-Regional Strategy will identify management arrangements for retained areas, particularly those outside the Urban Growth Boundary. The detailed design responses developed in the Precinct Structure Planning process will be consistent with and guided by this Sub-Regional Strategy.

The following prescription will guide all future decisions about retaining, clearing or modifying Southern Brown Bandicoot habitat within the study area.

PRESCRIPTION FOR SOUTHERN BROWN BANDICOOT

Preamble

In the south east of Melbourne the following objectives should apply to management of Southern Brown Bandicoot in relation to urban development planning:

- Retain, upgrade and connect existing habitats within proposed precincts and outside the Urban Growth Boundary, including the important population at the Royal Botanic Gardens Cranbourne;
- Secure, manage and monitor retained habitat and linkages to conserve Southern Brown Bandicoot and adjust management accordingly; and
- Carefully plan and construct urban development within precincts to minimise impacts on species (such as employing road design and other techniques that facilitate road crossings, and restricting cat, dog and human access in particular areas).

Prescription

Precinct planning design should not commence until surveys to confirm suitable habitat and likely occurrence of Southern Brown Bandicoot in an area are complete (irrespective of whether the species is actually detected). Surveys to be consistent with *Biodiversity Precinct Planning Kit methodology*.

A Southern Brown Bandicoot Conservation Management Plan must be prepared to the satisfaction of the Department of Sustainability and Environment prior to the exhibition of the Precinct Plan, or prior to other development approval.

The plan must demonstrate how, in areas that are highly likely to be used by Southern Brown Bandicoot:

- Habitat will be retained, connected and managed so the population can function over the long term. This may consider and include habitat both on and off-site (including outside the precinct) but must not rely on translocation of individual animals;
- Monitoring will be employed for 30 years, extending well beyond the life of the Program so its effectiveness can be determined;
- Habitat and threatening processes will be appropriately managed and be responsive to the results of monitoring; and
- Actions related to development will be sequenced to ensure there is no net loss of habitat and local population (using best efforts).

The plan may conclude that retaining relatively small islands of habitat within the precinct is unsustainable and instead, may focus more on management activities adjacent to or beyond the precinct. Even if this approach is taken the mitigation objective is still relevant

The conservation management plan must be consistent with, and respond to, any relevant Sub-Regional Strategy for the Southern Brown Bandicoot approved by the Department of Sustainability and the Environment.

This prescription will be used in the Precinct Structure Planning process, as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport and other development consistent with the Program.

MITIGATION OUTCOMES

If mitigation measures are successful, and habitat quality and function is effectively enhanced, net impact may be minor for the species over the longer term – however, this will remain uncertain for many years.

The outcomes sought are:

- Functioning sustainable populations of Southern Brown Bandicoot with connectivity between populations; and
- Protection and enhancement of all populations of Southern Brown Bandicoot including the population at the Royal Botanic Gardens Cranbourne.

AUSTRALIAN PAINTED SNIPE

Both locations within the study area where Painted Snipe have been recorded will be excluded from the Urban Growth Boundary and included within the proposed Western Grasslands Reserve (Figure 36). A third site, to the west of the Melbourne West Investigation Area is also within the area of the proposed grassland reserve.

It is possible that the species uses areas within the proposed Urban Growth Boundary that will be progressively developed. However, suitable habitats for the species in this area are few and are generally more likely to be present further west (or elsewhere).

Overall, significant impacts on the Painted Snipe are not likely to result from actions under the Program, assuming that known or newly discovered habitat for the species is protected and managed appropriately. The proposed Western Grassland Reserves, with their scattering of grassy wetlands, includes known habitat for the species. These reserves will be managed to conserve Painted Snipe in addition to a range of other values.

Proposed reserves associated with Merri Creek and environs in the north, and the large area of retained and recreated wetlands associated with the Melbourne South-East Investigation Area also provide potential habitat. Suitable habitat within these reserves will be managed for Painted Snipe, and created wetlands will be designed for this and other significant wetland species.

If the species, or likely habitat, is detected during fauna surveys, a prescription will be developed by the Department of Sustainability and Environment to the satisfaction of the Commonwealth before the Precinct Structure Planning process is finalised. This prescription will guide mitigation and management decisions relating to the site.

Once agreed, this prescription will be used in the Precinct Structure Planning process and transport infrastructure planning and will guide decision making for this species for the remainder of the Program.

SWIFT PARROT

The Swift Parrot is a passage migrant through the study area, using woodlands that support lerp and flowering eucalypts as they pass through during autumn and winter (Birds Australia 2009). The Melbourne North Investigation Area contains such habitat and the species has been recorded in the area.

The key impact from the Program will be the removal of red gum grassy woodland – suitable habitat for the Swift Parrot – in the south of the Melbourne North Investigation Area as urban development in the area progresses. However, the relatively small reduction in habitat available to the species is unlikely to have a significant impact.

Retaining connected intact woodland vegetation is important for the Swift Parrot, as it requires suitable foraging sites in the Greater Melbourne region to meet its energy demands before and after migrating across Bass Strait to Tasmania (Birds Australia 2009). Creation of the Northern Grassy Woodland Reserve and protecting extensive adjacent woodland areas further east will be a positive action for the Swift Parrot. In the longer term the balance between clearing of grassy woodland (approximately 700ha) to permanent protection and active management of grassy woodland (approximately 2000ha) as a result of the Program is likely to provide a net benefit to the species.

GROWLING GRASS FROG

The greatest threats to the species are the loss and degradation of habitat (wetland vegetation or hydrology), introduction of barriers to movement between habitats, and fish predators and chytrid fungus.

The eggs and young of the Growling Grass Frog may be susceptible to predation by introduced species of fish. Of particular concern is the Eastern Gambusia *Gambusia holbrooki*, which is believed to have contributed to the decline of the Green and Golden Bell Frog *Litoria aurea* (Clemann and Gillespe 2007).

Adults move up to two kilometers between waterbodies, sometimes moving up to one kilometer in 24 hours through vegetated areas such as paddocks and drainage lines (Clemann and Gillespie 2007). Viable populations rely on a matrix of aquatic and terrestrial habitat across the landscape (Department of the Environment, Water, Heritage and the Arts 2008).

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's draft Significant Impact Guidelines for the Growling Grass Frog identifies that significant impact is likely to result from:

- Loss or degradation of terrestrial habitat within 200m of water body;
- Alteration to hydrology or aquatic vegetation;
- Fragmentation of existing population; and
- Introduction of predatory fish.

These events relate to important *populations* which are defined as any viable population that is functioning with sufficient connectivity and with a variety of habitats and locations available (Department of the Environment, Water, Heritage and the Arts 2009e).

ACTUAL/LIKELY IMPACTS

An important population of Growing Grass Frogs is located along the Merri Creek in the Donnybrook area (Robertson et al. 2002; Heard et al. 2004; Clemann and Gillespie 2007), and a population also occurs along the nearby Darebin Creek. It is assumed that the Melbourne South-East Investigation Area and adjacent precincts to the east also support an important population, although this has not been formally confirmed. There are also important populations in the west, particularly around Kororoit Creek in the Melbourne West Investigation Area east of Melton. The other significant population is found further south west, around Little River and other waterways and wetlands in the proposed Western Grassland Reserves.

Significant impacts on some important populations are expected, particularly in the short to medium term, as well as local scale impacts at some sites. The degree and scale of such impacts will depend on how well habitat connectivity is maintained and enhanced in key areas, and on ensuring that this connectivity is put in place before major new developments start.

MITIGATION OBJECTIVES

1. Protect the Merri Creek important population;
2. Identify and protect other important populations including in the Pakenham area and south east growth area, and along Kororoit Creek in the west;
3. Retain, upgrade and connect or buffer some existing habitats within proposed precincts, with up to 200m buffers around retained/constructed waterbodies where practicable and up to 100m buffers along connecting waterways (subject to recommendations from the Sub-Regional Strategy);
4. Create new habitat within precincts;
5. Manage suitable habitat within the proposed Western Grassland Reserves and proposed south eastern wetlands specifically for Growling Grass Frog;
6. Manage hydrology and aquatic vegetation carefully to avoid the introduction of predatory fish; and
7. Monitor retained and new habitat, and adjust management accordingly.

MITIGATION STRATEGY

Avoid: At a strategic level, avoiding impacts on Growling Grass Frog habitat by excluding it from the Investigation Areas and associated infrastructure and urban development areas is difficult. This is due in part to the relatively widespread distribution of the species across Melbourne. However, the two largest areas of potential habitat for Growling Grass Frog – in the south-west and north-east corners of the Melbourne South-East Investigation Area – have been excluded from development (Practical Ecology 2009).

Minimise: Excluding urban development from waterways and their associated buffers will minimise impacts on the Growling Grass Frog. Impacts will be minimised further as part of the Precinct Structure Planning process required for all proposed urban areas, especially in the north and south-east, where wetland areas and associated vegetation will be retained and sympathetic design and construction techniques used (after surveys confirm the presence of the species and the management needs at that location).

Impacts will also be minimised by the careful treatment of water and the ability to manipulate the hydrological regime to maintain habitat values.

Offset/other mitigation: Protecting and managing Growling Grass Frog habitat within the proposed Western Grassland Reserves will help with the long term conservation of the species. Along with Westgate Park (Australian Government 1997), the proposed Western Grassland Reserve will be one of the few conservation reserves supporting the species west of Melbourne.

The Melbourne South-East Investigation Area and adjacent areas will contain extensive areas of retained and constructed floodplain and wetlands that serve multiple objectives: water retention and quality; waterbird habitat; Growling Grass Frog habitat; and passive recreation.

A sub-regional conservation strategy developed for the Pakenham area (next to the Melbourne South-East Investigation Area Investigation Area) (Hamer and Organ 2006) will be broadened to consider the Investigation Area and adjacent precincts to the west, as well as areas outside the Urban Growth Boundary to the east and south.

The strategy will be developed by the Department of Sustainability and Environment in consultation with the Growth Areas Authority and relevant municipalities to the satisfaction of the Commonwealth and will address the sub-regional connectivity between and within important populations over the long term. Key strategic protection and management measures (such as planning scheme measures and land acquisition) will be implemented before or in conjunction with Precinct Structure Planning. The detailed design responses developed in the Precinct Structure Planning process will be consistent with and guided by this Sub-Regional Strategy.

PRESCRIPTION FOR GROWLING GRASS FROG

Preamble

The following objectives should apply to management of Growling Grass Frog in relation to urban development planning:

- Protect important Merri Creek population;
- Identify and protect other important populations including in the Pakenham area and south east growth area, and along Kororoit Creek;
- Retain, upgrade and connect or buffer some existing habitats within proposed precincts;
- Create new habitat within precincts;
- Manage hydrology and aquatic vegetation carefully to avoid the introduction of predatory fish; and
- Monitor retained and new habitat, and adjust management accordingly.

Prior to planning for precinct design surveys to confirm the presence of suitable habitat or the likely occurrence of Growling Grass Frog in an area (irrespective of whether the species is actually detected) to be completed. Surveys to be consistent with *Biodiversity Precinct Planning Kit methodology*.

Prior to exhibition of the Precinct Plan, or prior to other development approval, a Growling Grass Frog Conservation Management Plan must be prepared for precincts (or other development areas) containing suitable habitat for Growling Grass Frog to the satisfaction of the Department of Sustainability and Environment. The plan must demonstrate how, for an important population (or potentially important population):

- Habitat will be retained and/or created and managed with sufficient connectivity so the population can function over the long term. This may consider and include habitat both on and off-site but must not rely on translocation;
- Monitoring will be employed to determine effectiveness;
- Habitat and threatening processes will be appropriately managed in a way that is responsive to the results of monitoring; and
- Actions relating to proposed development will be sequenced to ensure there is no net loss of habitat and local population.

The conservation management plan must be consistent with, and respond to, any relevant Sub-Regional Strategy for the Growling Grass Frog approved by the Department of Sustainability and the Environment.

This prescription will be used in the Precinct Structure Planning process, as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport and other development.

MITIGATION OUTCOMES

If mitigation measures are successful, and habitat quality and function is effectively enhanced, net impact may be minor or potentially even positive for the species over the longer term – however, this will remain uncertain for many years.

The outcomes sought are:

- Functioning sustainable populations of Growling Grass Frog with connectivity between populations; and
- Protection and enhancement of important populations.

AUSTRALIAN GRAYLING

The only area of concern for the Australian Grayling is in the Melbourne South-East Investigation Area, where the species is known to be present in Cardinia Creek. Although the species is somewhat sensitive to reduced water quality (Backhouse et al. 2008), there is no reason to expect this will occur as a result of the Program. Cardinia Creek will be protected with a buffer up to 200m wide in total and managed to maintain the high conservation values of the creek corridor. This will require revegetation and woody weed removal as riparian vegetation along this section of the creek is degraded (Practical Ecology 2009). Given the proposed best practice stormwater management it is more likely that water quality will improve rather than deteriorate, when compared the present semi-agricultural catchment. The size of the buffer will be determined during the Precinct Structure Planning phase for precincts inside the existing Urban Growth Boundary and by the Growth Area Framework Planning phase for precincts outside the current Urban Growth Boundary. It is not expected that the Program will result in a significant impact on the Australian Grayling.

DWARF GALAXIAS

The Dwarf Galaxias has not been recorded within the study area, however Department of Sustainability and Environment fish experts believe it may be present in swamps and wetlands within the Melbourne South-East Investigation Area.

Given this uncertainty it is important that this species be specifically targeted with surveys during Precinct Structure Planning investigations. Should the species be located during surveys, a prescription will be developed by Department of Sustainability and Environment to the satisfaction of the Commonwealth before the Precinct Structure Planning process is finalised. This prescription will guide mitigation and management decisions for relevant sites, and may direct that some populations be retained and managed on site (for example, in a retained wetland within the precinct), while others be translocated to secure habitat nearby, depending on the context and the importance of the population.

Once agreed, this prescription will form part of the *Precinct Structure Planning Guidelines* and will guide decision making for this species for the remainder of the Program.

The large area of retained and recreated wetlands associated with the Melbourne South-East Investigation Area will be managed for a range of significant wetland species including Dwarf Galaxias.

MAROON LEEK-ORCHID

Section 5.2.2 describes a population of Maroon Leek-orchid found within the railway reserve around Clyde. Part of this population is within the Melbourne South-East Investigation Area, and it extends further south east beyond the Investigation Area.

The population is well known and is managed, but faces a range of threats. This section of the railway line will not be used for urban development or infrastructure and will be retained primarily for biodiversity protection. It is critical that this section of the railway line be protected and managed to conserve the population of this species, as few other populations are known in the wild.

Given the other significant values along this short section of disused rail reserve (including Swamp Everlasting, potentially Swamp Fireweed and use of this area by Southern Brown Bandicoot), the potential to establish the area as a conservation reserve will be explored as part of preparing the Biodiversity Conservation Strategy for the south-east and subsequent revised Casey-Cardinia Growth Area Framework Plan. In addition, a Conservation Management Plan will be prepared to the satisfaction of the Commonwealth (Department of the Environment, Water, Heritage and the Arts) and Department of Sustainability and Environment as part of preparing a Precinct Structure Plan for the area.

The plan must demonstrate how the population of Maroon Leek-orchid and other values along the railway reserve will be protected and managed over the long term, in light of nearby urban development. The plan must include implementation measures, responsibilities and monitoring. Managing this site will more than likely require the use of ecological burning from time to time. The Growth Area Framework plan and Precinct Structure Plans will need to be responsive to this requirement.

As the site containing the Maroon Leek-orchid will be excluded from development, it is not likely that the Program will result in significant impacts to this species. However, this outcome assumes the ongoing implementation of management actions in line with the Conservation Management Plan to conserve the population over the long term.

RIVER SWAMP WALLABY-GRASS

This species has only been recently recorded once within the Melbourne West Investigation Area (in a farm dam) but may well be present elsewhere. It is most likely

to be found within the proposed western grassland reserve, but could appear within the Melbourne West Investigation Area and potentially in the Melbourne South East and Melbourne North Investigation Areas in other farm dams or permanent swamps.

Based on current information, actions under the Program are not likely to result in a significant impact on this species unless additional populations are located during detailed surveys for Precinct Structure Planning. For an impact to be considered significant in this context, the population impacted must meet the criteria for an important population.

Should the species be found elsewhere during surveys, a prescription will be developed by Department of Sustainability and Environment to the satisfaction of the Commonwealth, before the Precinct Structure Planning is finalised. This prescription will guide mitigation and management decisions about the species, including whether to retain it on site.

Once agreed, this prescription will be used in the Precinct Structure Planning process and transport planning process and will guide decision making for this species for the remainder of the Program.

SWAMP EVERLASTING

Swamp Everlasting has been recorded within the rail reserve on the south east edge of the Melbourne South-East Investigation Area, but may potentially be present in shallow wetlands elsewhere, including within the other Investigation Areas. It may also occur within the proposed Western Grassland Reserves.

Current information indicates that actions under the Program are unlikely to result in a significant impact on this species unless additional populations are located during detailed surveys for Precinct Structure Planning.

For an impact to be considered significant in this context, the population impacted must meet the criteria for an important population.

The population within the rail reserve will be protected from urban development and a Conservation Management Plan developed for this section of the rail line as part of preparing the Precinct Structure Plan for the area (see discussion of Maroon Leek-orchid, above).

Should the species be found elsewhere during surveys, a prescription will be developed by Department of Sustainability and Environment to the satisfaction of the Commonwealth, before the Precinct Structure Planning is finalised. This prescription will guide mitigation and management decisions about the species, including whether to retain it on site.

Once agreed, this prescription will be used in the Precinct Structure Planning process and transport planning process and will guide decision making for this species for the remainder of the Program.

OTHER PLANT SPECIES

Table 2 lists several other plant species that are relatively cryptic or seasonal and may be present within the study area. These are all orchids or smaller herbaceous plants.

Three orchids could potentially be present within the Cranbourne area, although this is not considered very likely:

- Cream Spider-orchid *Arachnorchis orientalis* (syn. *Caladenia fragrantissima* ssp *orientalis*);
- Green-striped Greenhood *Pterostylis chlorogramma*; and
- Metallic Sun-orchid *Thelymitra epipactoides*.

In the Melbourne West Investigation Area and western grasslands the Sunshine Diuris *Diuris fragrantissima* is considered very unlikely but remains a possibility.

The following three herbs of grassland and grassy wetlands may also potentially be present within higher quality areas in the Melbourne West and Melbourne North Investigation Area:

- Austral Toadflax *Thesium australe*;
- Basalt Peppercress *Lepidium hyssopifolium*; and
- Swamp Fireweed *Senecio psilocarpus*.

Searches for all seven of these species will be undertaken as part of Precinct Structure Planning investigations. In the case of the orchids, surveys are quite specialised and suitably qualified botanists will need to search for the species at the appropriate time of year. This is July–August for Green-striped Greenhood and October–November for the other orchid species.

Should any of these species be found during surveys, a prescription will be developed by Department of Sustainability and Environment to the satisfaction of the Commonwealth, before the Precinct Structure Planning process is finalised. This prescription will guide mitigation and management decisions, including whether to retain the species on site. In the interim it should be assumed that any orchids listed under the EPBC Act as endangered or critically endangered will be retained and managed on site unless the Commonwealth advises otherwise.

Once agreed, the prescription will be used in the Precinct Structure Planning process and transport planning process and will guide decision making for this species for the remainder of the Program.

6.5 IMPACTS ON LISTED MIGRATORY SPECIES AND THEIR HABITATS

Wetland habitat loss and degradation is considered a significant threat to migratory waterbirds.

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's Significant Impact Guidelines (Department of the Environment and Heritage 2006), which use the concepts of important habitat and ecologically significant proportion of a population for migratory species, apply.

No known nationally significant areas for shorebirds occur within the Investigation Areas (Birds Australia 2009). However, it is possible that nationally significant numbers of shorebirds use some of the wetlands in and adjacent to the Investigation Areas, particularly those within the proposed Western Grassland Reserves and those associated with Merri Creek in the north. The most likely migratory species that could be using such areas in significant number is Latham's Snipe (Birds Australia 2009).

There are six sites known within 10km of the study areas where this species has been recorded in significant numbers (more than 18 birds). However, none of these are actually within the study area and it is not known whether these sites have retained their values for the species (Birds Australia 2009).

ACTUAL/LIKELY IMPACTS

The actions associated with the Program may impact on migratory bird species either through direct loss of wetland habitat or the disturbance and modification of habitat that may occur from increased urban development. However, current knowledge of bird usage and habitats within the study area indicate that it is not likely that impacts on migratory species will be significant.

It is estimated that 670ha of wetland habitat is contained within the study area although this includes some large, artificial impoundments. Of this, around 60ha will be protected from urban development and included within the retained environment network. Although much of the remaining wetland habitat could be directly impacted by urban development, it will be subject to the Precinct Structure Planning process on a site by site basis, which will provide the opportunity to identify and retain significant wetland areas. Any loss of wetland carries risks of losing habitat used by nationally significant numbers of Latham's Snipe, and loss of wetlands throughout the area could also result in significant cumulative impacts to shorebirds (Birds Australia 2009).

Birds' responses to urban development vary. Increased disturbance, for instance, from increased visitation by people, or the absence of an adequate buffer to urban areas, will

make a wetland unsuitable habitat for some birds (Birds Australia 2009). For instance, the Australasian Bittern would likely need a disturbance free buffer of 300m, with no pedestrian or dog access, to continue using an area (Birds Australia 2009).

If not carefully managed, run-off into existing Ramsar or other wetlands has the potential to reduce or alter benthic fauna communities which shorebirds rely upon for food (Birds Australia 2009).

MITIGATION OBJECTIVES

1. Avoid loss of wetlands where possible including ephemeral wetlands and surrounding habitat;
2. Provide buffers of 100m around identified significant wetlands;
3. Limit indirect disturbances (such as dogs) within 200m of identified significant wetlands;
4. Retain and manage a variety of wetland types throughout the urban and non-urban areas of Melbourne;
5. Recreate new wetlands for multiple objectives including bird habitat; and
6. Limit run-off pollution to wetlands.

MITIGATION STRATEGY

Avoid: The current Urban Growth Boundary, Investigation Areas, the proposed Urban Growth Boundary revision, and related infrastructure have been located to avoid many wetlands, including all those known to support nationally significant numbers of migratory species.

Minimise: Fine-tuning the location of the proposed Urban Growth Boundary and OMR/E6 Transport Corridor and, in particular, the proposed exclusion areas in the Melbourne North Investigation Area has further minimised impacts on migratory species. Large areas supporting wetlands have been either excluded from the proposed new Urban Growth Boundary (such as the proposed Western Grassland Reserves) or designated as protected areas within it (such as within the Melbourne North Investigation Area). Additional minimisation of impacts will occur as part the Precinct Structure Planning process required for all proposed urban areas, especially in the Melbourne South-East and Melbourne North Investigation Areas. The Precinct Structure Planning process affords opportunities to minimise impacts to wetlands and retain them through sympathetic design responses that incorporate areas of current natural wetland and potential inundation in public areas (such as by providing reserves for conservation and passive recreation).

The Precinct Structure Planning process will include additional detailed flora and fauna surveys, including within wetland areas. To keep impacts on migratory species to a minimum the following prescription will apply.

PRESCRIPTION FOR MIGRATORY SPECIES

Preamble

The following objectives should apply to management of migratory species in relation to urban development planning:

- Avoid loss of wetlands where possible including ephemeral wetlands and surrounding habitat;
- Provide buffers of 100m around key wetlands;
- Limit indirect disturbances (such as dogs) within 200m of identified significant wetlands;
- Retain and manage a variety of wetland types throughout the urban and non-urban areas of Melbourne;
- Recreate new wetlands for multiple objectives including bird habitat;
- Limit run-off pollution to wetlands; and
- Advice in Birds Australia (2009) relating to detail of buffers, constraints and opportunities for a range of wetlands should be followed where relevant.

Prescription

Wetlands will be surveyed and assessed as part of flora and fauna investigations for Precinct Structure Planning and other development planning.

Any potentially significant wetlands found within a proposed precinct or development area will be assessed against the Commonwealth's Significant Impact Guidelines (Department of the Environment and Heritage 2006). If a nationally important population of a migratory species is found or considered likely to use the area, the site will be excluded from development with a buffer of 200m and a Conservation Management Plan will be developed to the satisfaction of the Commonwealth and the Department of Sustainability and Environment.

Retained and constructed wetlands will be designed (using specialist ecological input) and managed wherever possible to maximise opportunities for migratory bird species, by excluding dogs and other disturbances in identified areas and imposing a minimum buffer of 100m.

Should surveys detect use of a wetland by the Australian Bittern, the buffer around the wetland (or the majority of the wetland) should be increased to 300m.

This prescription will be used in the Precinct Structure Planning process, as required by the *Precinct Structure Planning Guidelines* and in approvals required for transport infrastructure and other development.

Offset: Impacts on wetlands to be cleared will in part be offset by the creation and dedicated management of conservation reserves supporting a range of wet and dry habitats. The proposed Western Grassland Reserves are the largest and most significant of these: they contain many wetlands of varying types. These wetlands will be managed for migratory and threatened species (such as birds, frogs, and plants). A network of small and large reserves will also be formally established inside and outside the proposed Urban Growth Boundary in the Melbourne North and Melbourne South-East Investigation Areas, including a major new area of recreated wetlands adjacent to the Melbourne South-East Investigation Area.

Section 6.1.3 provides additional information on these new reserves.

MITIGATION OUTCOMES

There will be losses, hydrological modification and degradation of some wetlands within the study area. However, areas of existing wetlands will also be protected within new conservation reserves and open space networks and their management will improve. Many new wetlands will also be created within and adjacent to precincts. All wetlands supporting a nationally significant number of migratory species will be protected. The predicted net impact on migratory species is likely to be neutral or slightly positive over the long term.

The outcomes sought are:

- Managing a network of small and large conservation reserves including a diversity of wetland areas for their migratory species and other wetland values, particularly in areas distant from urban development; and
- Improved management and design of retained and constructed wetlands to maximise habitat opportunities for migratory species.

6.6 IMPACTS ON RAMSAR WETLANDS OF INTERNATIONAL IMPORTANCE

SIGNIFICANT IMPACT THRESHOLD

The Commonwealth's *Significant Impact Guidelines* (Department of the Environment and Heritage 2006) apply. Approval under the EPBC Act is required for an action that impacts significantly on the ecological character of a Ramsar wetland, irrespective of whether the action is within or outside the Ramsar site boundaries.

The ninth Conference of the Contracting Parties to the Ramsar Convention (CoP 9 2005), established the following revised definition of ecological character:

> "Ecological character is the combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time" (Resolution IX.1, Annex A: Ramsar Convention November 2005).

The same resolution established the following revised definition of 'change in ecological character' for the purposes of implementation of Article 3.2:

> "For the purposes of implementation of Article 3.2, change in ecological character is the human-induced adverse alteration of **any** *ecosystem component, process*, and/or ecosystem benefit/service."

The significant impact criteria (summarised from Department of the Environment and Heritage 2006) include:

- Direct disturbance or destruction;
- Substantial hydrological change;
- Substantial change in water quality;
- Serious change to the habitat of a dependant species; and
- Introduction of an invasive species.

Existing issues recognised for the Port Phillip Bay Ramsar site include monitoring by Melbourne Water of the impacts of improved water quality from the Werribee Sewage Farm and Western Treatment Plant (as a result of Victorian Environment Protection Authority licence requirements) to determine if waterbird usage of certain areas has decreased as a result of lower nutrient levels. If it has, the operational parameters for achieving the licence conditions may be varied as required. Other factors affecting the ecological character of the site at selected locations include pest plants and animals, livestock grazing and visitor impacts (Department of Sustainability and Environment 1999c).

Western Port has a surface area of 68,000ha and a catchment of 3,240sqkm. Many of the inflowing streams are largely straight drainage channels that transport unnaturally large volumes of water and sediment to northern Western Port, with consequent erosion and sediment impacts. Other factors affecting the ecological character within this Ramsar site include impacts on intertidal areas due to vehicle access and grazing of stock, construction of levee banks and drains and presence of Spartina at the mouth of the Bass River which has the potential to cover large intertidal areas. There is also a risk of oil spills associated with port development and shipping, and occasional dredging and dredge spoil disposal (Department of Sustainability and Environment 1999b).

ACTUAL/LIKELY IMPACTS

The northern extension of the Port Phillip Bay Ramsar area is close to the southern edge of the Melbourne West Investigation Area Investigation Area. However, the nearest area of this Ramsar site that includes a nationally important shorebird site is several kilometres to the south of the existing Geelong-Melbourne Freeway.

The OMR/E6 Transport Corridor is located partly within the Port Phillip Bay Ramsar area at its southern end. The property boundary of the Western Treatment Plant (owned and managed by Melbourne Water) was used in 1982 to define the boundary of that component of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The area within the site boundary is not all wetland and includes substantial areas of exotic pasture and some native grassland. The nearest major wetland is Ryan's Swamp, some 500m south of the Princes Freeway. OMR/E6 Transport Corridor report refers to a small, seasonal Cane-grass swamp (Paul and Belfrage's Swamp) just west of the proposed OMR/E6 Transport Corridor interchange with the Princes Freeway. This will not be directly affected by works but best practice construction environmental management measures will need to be adopted to prevent accidental disturbance to these wetlands or sediment laden runoff from reaching the wetland. Further investigation will be undertaken prior to more detailed planning of the OMR. This will gather important information to determine optimal management approaches.

The Western Port Ramsar site is approximately five kilometers south of the Investigation Area, and the Edithvale-Seaford Wetlands Ramsar site considerably further. Given the distance from each of the Ramsar sites, there will be no direct impacts as a result of the Program.

However, there are indirect impacts on Ramsar sites and their ecological character that could result from the Program. These relate to potential water quality and hydrological changes, and potential impacts on dependent species and their habitats.

Run-off from urban areas into Ramsar wetlands has the potential to reduce benthic fauna communities which shorebirds rely upon for food, if not carefully managed (Birds Australia 2009). Craigie et al. (2009) emphasise the importance of managing sediment to Western Port, and suggest that management of Total Suspended Solids (TSS) and Total Phosphorous (TP), perhaps more so than Total Nitrogen (TN), is a key issue for stormwater quality treatment.

Elevated levels of disturbance as a result of increased visitation is a risk of urban development close to important shorebird sites and is discussed by Birds Australia (2009). This is a particular issue for the Melbourne West Investigation Area given its proximity to the Port Phillip Bay Ramsar site.

MITIGATION OBJECTIVES

1. Improve water quality entering the Western Port Ramsar site;
2. Maintain or improve water quality entering the Port Phillip Bay Ramsar site;
3. Maintain the current hydrological regime of Ramsar sites receiving inflow waters from the expanded urban area; and
4. Limit indirect disturbances (e.g. dogs) to identified significant wetlands (200m buffer).

MITIGATION STRATEGY

Avoid: In locating the Investigation Areas, the proposed Urban Growth Boundary, the previous Urban Growth Boundary (2005) and related infrastructure, Ramsar sites were excluded from potential urban areas.

Minimise. The strategy is based on minimisation and mitigation of indirect impacts. The key elements relate to managing urban run-off (quantity, quality, periodicity) and increased visitation by humans / their vehicles and pets.

Hydrology and water quality

Downstream hydrological impacts will be addressed as part of the Precinct Structure Planning and subsequent development approval processes.

As set out in the *Precinct Structure Planning Guidelines*, an Integrated Water Management Plan is a prerequisite for a Precinct Structure Plan and subsequent urban development. The Integrated Water Management Plan must include:

- A plan that sets out potential water sensitive urban design elements and planned flood capacity and conveyance;
- An estimate of the amount of stormwater that can be harvested for use within the development; and
- Water sensitive urban design options (i.e. swale, rain garden, etc) that should apply to the precinct.

The *Precinct Structure Planning Guidelines* include nine standards to guide this work, including:

- The urban run-off system is designed and managed in accordance with the requirements of the relevant water authority;
- Existing natural waterways, wetlands and their riparian vegetation are incorporated into urban run-off systems where appropriate;
- Development is designed to ensure that the health of the downstream waterway does not decline as a result of urban development;

- Artificial lakes, ponds or other permanent water bodies provide an urban water management function, protect and enhance natural systems and are cost effective; and
- Urban run-off is not discharged to areas of native bushland unless such discharge cannot be avoided, will be managed and will be beneficial to the vegetation.

Clause 56.07 (Integrated Water Management) of all planning schemes (http://www.dse.vic.gov.au/planningschemes/aavpp/56_07.pdf) also provides objectives and standards relevant to the urban setting, including that the urban stormwater management system must be:

- Designed to meet the current best practice performance objectives for stormwater quality as contained in the Urban Stormwater – Best Practice Environmental Management Guidelines (CSIRO 1999) as amended; and
- Designed to ensure that flows downstream of the subdivision site are restricted to predevelopment levels unless increased flows are approved by the relevant drainage authority and there are no detrimental downstream impacts.

Urban development can only be approved if it complies with the Precinct Structure Planning requirements and those of the relevant planning scheme, which include the above standards. Local Government, the State Environment Protection Authority and Melbourne Water all have a role in monitoring and enforcing compliance with these requirements and in meeting published water quality standards.

According to Condina et al. (2005) as cited in Craigie et al. (2009) meeting "best practice" for stormwater quality would not be sufficient to allow discharge to Western Port, and treatment additional to current best practice will be required on all new urban development to contain the impacts of development and achieve some reduction in the existing high loads to Western Port. Craigie et al. (2009) therefore discuss the use of a large (c. 300ha) area of former swamp in the Melbourne South-East Investigation Area that could be re-established as a major waterway/wetland/floodplain enhancement project. This would create a sizable retarding storage system with significant water quality and biodiversity benefits.

The extensive wetland system could not only provide stormwater quality and quantity benefits but could also reduce flood risk to agricultural areas directly east of the Investigation Area and potentially provide additional supply of treated stormwater for irrigation purposes. In addition, the creation of a major wetland in this area would go some way to restoring representative swamp scrub habitat, which once covered an area of 45,000ha in the Western Port basin.

Investigation of the feasibility of this wetland/floodplain restoration project will be undertaken with a view to implementing it in conjunction with urban development in the Melbourne South-East Growth Area. Following appropriate rezoning of the land, and subject to investigation of funding and other implementation requirements, Melbourne Water would take over management responsibilities.

Drainage and water quality is less of an issue for the Port Phillip Bay Ramsar site and best practice as described above is considered adequate for managing downstream impacts. This is especially so given much of the current inflows occur via the highly regulated Werribee Sewage Farm and Western Treatment Plant.

Given the best-practice urban stormwater design that is proposed, together with the additional mitigation in the form of a large recreated wetland/floodplain area in the south-east, it is not anticipated that the hydrology or water quality will be impacted at any of the Ramsar sites close to the study area.

Increased visitor pressure

Increased visitation in sensitive areas will need to be carefully managed. Birds Australia (2009) recommend a 200m exclusion area for dogs and pedestrians surrounding significant shorebird sites within Ramsar areas. This will be needed in particular around parts of the Port Phillip Bay Ramsar site (e.g. Altona area) and possibly in parts of Western Port.

The following specific management measures will be taken:

- Increase monitoring of foxes and domestic predators in areas of the Port Phillip Bay Ramsar site within two kilometers of new urban areas, and take adaptive management measures as required; and
- Exclude dogs and pedestrians from significant shorebird sites (200m buffer) within two kilometers of new urban areas.

These steps will be taken prior to urban development commencing in relevant areas.

MITIGATION OUTCOMES

It is not therefore considered likely that actions resulting from the Program will impact significantly on the ecological character of Ramsar wetlands close to the study area.

6.7 IMPACTS BY PROJECT ON MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The estimated impacts of each major element of the Program on Matters of National Environmental Significance (MNES) are summarised here. Detailed reports on the research, investigation, and selection of areas (Urban Growth Boundary) or alignments (Regional Rail Link, Outer Metropolitan Ring/E6 Transport Corridor) have been produced (State of Victoria 2009a, b, and c).

Impacts on each individual MNES from the Program are described in other sections of the *Strategic Impact Assessment Report* (DSE 2009) under each matter.

Mitigation of the impacts from these projects is also described elsewhere in the *Strategic Impact Assessment Report* (DSE 2009) under each matter and under Section 6.1 Strategic Mitigation Approach.

6.7.1 PROPOSED EXPANDED URBAN GROWTH BOUNDARY

The expanded Urban Growth Boundary will extend the existing growth areas of Casey-Cardinia; Hume; Melton-Caroline Springs; Whittlesea and Wyndham. It will designate the Shire of Mitchell and the Sunbury area (within the Hume municipality) as growth areas.

Table 7 shows the amount of land that is considered to be suitable for development within the expanded Urban Growth Boundary.

TABLE 7: LAND SUITABLE FOR DEVELOPMENT WITHIN PROPOSED GROWTH AREAS

Growth area extension	Total land inside expanded Urban Growth Boundary (ha)	Total land suitable for development (ha)
Melbourne West	17,480	10,710
Melbourne North	21,235	10,135
Melbourne South-East	4,930	3,770

The remaining land is significantly constrained and not suitable for development due to a range of reasons including:

- Land that is floodprone, including major drainage lines;
- Land that is of high biodiversity and landscape value, such as volcanic cones;
- Easements or sites for major public infrastructure such as electricity, gas, sewerage treatment, and major transport corridors; and
- Buffers around industries with adverse amenity potential and quarries.

The impacts of the expanded Urban Growth Boundary includes losses to areas of ecological communities and on listed species. The estimated losses to communities are shown in Table 8. Further detail is provided in Appendix 1.

TABLE 8. LOSSES FROM DEVELOPMENT*

Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target**
	No Native Vegetation 0	Low 0.01–0.30	Medium 0.31–0.60	High 0.61–1			
Grassy Eucalypt Woodland		440301	146		449	118	109
Natural Temperate Grassland		607	2329	41	3278	1354	2541
Plains Grassy Wetland			64		64	65	52
Other native vegetation		256	179	2	445	125	191
No native vegetation	23,564				40,167	0	0
Grand Total	23,564	1165	3019	41	27,790	1624	2969

* Note – does not include losses proposed within existing quarries.

**Based on determination of Conservation Significance using Ecological Vegetation Class x Habitat Score only (and does not include requirements for threatened species habitat).

Significant impacts are likely for seven EPBC Act listed species. The expanded Urban Growth Boundary is likely to result in direct impact on Striped Legless Lizard habitats and extant populations, particularly in the west and possibly in the north. Actions are also likely to have significant impact on the Golden Sun Moth at some sites, particularly in the west, and possibly in the north, due to the removal of habitat in excess of the Commonwealth criteria. There will be significant impacts on some important populations of the Growling Grass Frog, particularly in the short to medium term, as well as local scale impacts at some sites and potential impacts on the Southern Brown Bandicoot. The degree and scale of such impacts on these two species depends on how habitat connectivity is maintained and enhanced in key areas, and on ensuring that this happens before work starts on major new developments. This will be considered and agreed during the Growth Area Framework Planning phase scheduled to follow the current Urban Growth Boundary review. Significant impacts are also likely on two plant species: Matted Flax-lily and Spiny Rice-flower. Prescriptions have been developed for these and other species to guide decision makers on whether to retain on site or remove and offset during the development planning process, in a manner that minimises net impacts. For some species, such as the Swamp Fireweed, the scale of impact cannot be determined until further detailed information has been collected.

6.7.2 PRECINCTS WITHIN THE EXISTING URBAN GROWTH BOUNDARY

The Program includes precincts within the existing Urban Growth Boundary where Precinct Structure Plans are exhibited after 26 May 2009.

Figure 1 shows the location of precincts within Melbourne's five existing growth areas of Casey-Cardinia, Melton-Caroline Springs, Hume, Whittlesea and Wyndham that form part of the Program.

The impacts of the expanded Urban Growth Boundary includes losses to areas of ecological communities and on listed species. The estimated losses to communities is shown in Table 9. Further detail is provided in Appendix 1.

TABLE 9: LOSSES WITHIN CURRENT URBAN GROWTH BOUNDARY

Investigation Area	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target
		No Native Vegetation 0	Low 0.01–0.30	Medium 0.31–0.60	High 0.61–1			
Melbourne North	Grassy Eucalypt Woodland		71	50		121	33	53
	Natural Temperate Grassland		2	75	0	77	37	72
	Other native vegetation		37	41		78	25	40
	No native vegetation	1,864				1,864	0	0
Melbourne North Total		**1,864**	**111**	**166**	**0**	**2,140**	**95**	**166**
Melbourne West	Grassy Eucalypt Woodland		216	203	2	421	132	199
	Natural Temperate Grassland	6,118				6,118	0	0
	Plains Grassy Wetland		5	1		5	1	2
	Other native vegetation		13	1		14	3	4
	No native vegetation		230	461	0	692	253	458
Melbourne West Total		**6,118**	**216**	**203**	**3**	**6,539**	**132**	**199**
Melbourne South-East	Other native vegetation		35	50		85	26	41
	No native vegetation	6,106				6,106	0	0
Melbourne South-East Total		**6,106**	**283**	**512**	**0**	**6,902**	**283**	**506**
Grand Total		**14,088**	**610**	**881**	**2**	**15,581**	**510**	**870**

As for areas within the expanded Urban Growth Boundary, significant impacts are likely for six EPBC Act listed species within the existing Urban Growth Boundary. Four of these are the species of grassy terrestrial ecosystems:

- the Striped Legless Lizard and Golden Sun Moth, in the west and north;
- the Matted Flax-lily in the north and south-east;
- the Spiny Rice-flower in the grassland areas of the west;

In addition, short to medium-term impacts on the Growling Grass Frog (north and south-east) and the Southern Brown Bandicoot (south-east) are likely. The degree and scale of such impacts on these two species depends on how habitat connectivity is maintained and enhanced in key areas, and on ensuring that this happens before work starts on major new developments. Strategic work on Growling Grass Frog in the Pakenham area has showed this is possible. This will be considered and agreed during Precinct Structure Planning.

Prescriptions have been developed for these and other species to guide decision makers on whether to retain on site or remove and offset during the development planning process, in a manner that minimises net impacts. Surveys are being undertaken for several other species that may be present, as part of precinct and other development planning. If additional species listed under the EPBC Act are located, prescriptions will be prepared for Commonwealth approval prior to development.

6.7.3 OUTER METROPOLITAN RING/E6 TRANSPORT CORRIDOR

The Outer Metropolitan Ring Transport Corridor (OMR Transport Corridor) is 100km long and links Werribee, Melton, Tullamarine and Craigieburn/Mickleham. It connects to the E6 Transport Corridor, which links Donnybrook to the Metropolitan Ring Road at Thomastown.

It will be located as shown in the Program Report. The final location for the corridor incorporates changes to the original alignments exhibited in June and July 2009. Public consultation on the proposed changes, which are based around Wollert and near Mount Cottrell, occurred in September 2009. The effect of the changes to matters of national environmental significance was a reduction in the impacts on Natural Temperate Grassland and Grassy Eucalypt Woodland, including the opportunity to add approximately 100ha of additional grassland to the Western Grassland Reserves.

The planning process for the OMR/E6 Transport Corridor is discussed in Section 3.5 and in the Program Report.

IMPACTS ON MNES

VicRoads participated in an integrated flora and fauna study with the Growth Areas Authority, Department of Sustainability and Environment, Department of Planning and Community Development and Department of Transport. The Growth Areas Authority managed the Native Vegetation and Fauna Habitat Assessment Project on behalf of the Department of Sustainability and Environment. The aim of this project was to identify key areas of biodiversity, including identifying key areas of grassland to be preserved for the future.

As much of the proposed OMR/E6 Transport Corridor would pass through the flora and fauna study area, VicRoads contributed to the project to minimise the time and cost involved in undertaking its own studies. This culminated in the following reports being prepared for the Growth Areas Authority:

- Biosis: Growth Areas Authority Investigations areas west of Melbourne
  : Biodiversity values, constraints and opportunities; and
- SMEC: Flora and Fauna Desktop Analysis – Area 3a; and
  : Flora and Fauna Desktop Analysis – Area 3b.

VicRoads engaged Brett Lane and Associates Pty Ltd to investigate flora and fauna impacts within the proposed OMR/E6 Transport Corridor Right of Way (ROW) and to produce a Habitat Hectare assessment for this area.

A detailed flora and fauna study including survey work along the entire alignment will be undertaken as part of further planning before construction.

6.7.4 OUTER METROPOLITAN RING TRANSPORT CORRIDOR

6.7.4.1 VEGETATION

The proposed OMR Transport Corridor ROW is dominated by exotic grassland and planted vegetation associated with farming and urban land uses. Approximately 26 per cent of the proposed ROW supports native vegetation of varying quality. Twelve different Ecological Vegetation Classes occur within the proposed ROW boundary. Natural Temperate Grassland makes up 84 per cent of the native component and Grassy Eucalypt Woodland 11 percent. Both communities are listed under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. Remaining vegetation occurs in wetlands, waterways and associated escarpments, which are landscape features that are comparatively limited in extent.

Table 10 presents the losses as a result of likely clearing within the three transport corridors, together with the Habitat Hectare offset target. Further details can be found in Appendix 1 and Section 6.1.

6.7.4.2 FLORA

Two flora species listed under the EPBC Act have been recorded within the proposed ROW. The species include Large-headed Fireweed (vulnerable) and Swamp Fireweed (vulnerable). Three EPBC listed species have the potential to occur within the ROW boundary. These species include Clover Glycine (vulnerable), Matted Flax-lily (endangered) and Spiny Rice-flower (critically endangered).

6.7.4.3 FAUNA

The Golden Sun Moth, listed as critically endangered under the EPBC Act 1999, has been recorded within the proposed ROW.

Several other EPBC listed species have the potential to occur within the proposed ROW including: Eastern Dwarf Galaxias (vulnerable), Grey-headed Flying-fox (vulnerable), Growling Grass Frog (vulnerable), Striped Legless Lizard (vulnerable) and Swift Parrot (endangered).

6.7.4.4 RAMSAR SITES

The OMR Transport Corridor is located partly within the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar area at its southern end. The property boundary of the Western Treatment Plant (owned and managed by Melbourne Water) was used in 1982 to define the boundary of that component of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. The area within the site boundary is not all wetland and includes substantial areas of exotic pasture and some native grassland. The nearest major wetland is Ryan's Swamp, some 500m south of the Princes Freeway. The OMR Transport Corridor will pass near to a small, seasonal Cane-grass swamp (Paul and Belfrage's Swamp). This is just west of the proposed OMR Transport Corridor interchange with the Princes Freeway. This wetland will not be directly affected by works, but best practice construction environmental management measures will need to be adopted to prevent accidental disturbance to these wetlands or sediment laden runoff from reaching the wetland.

Further investigation will be undertaken prior to more detailed planning of the OMR. This will gather important information to determine optimal management approaches.

6.7.5 E6 TRANSPORT CORRIDOR

6.7.5.1 NATIVE VEGETATION

The proposed E6 ROW is dominated by exotic grassland and planted vegetation associated with farming and urban land uses. Approximately 25 per cent of the proposed ROW supports native vegetation of varying quality. Eight different Ecological Vegetation Classes occur within the proposed ROW. The dominant native vegetation is Natural Temperate Grassland (78 percent) and Grassy Eucalypt Woodland (eight percent). Remaining vegetation occurs in wetlands, waterways and associated escarpments, or on the limited area of sedimentary upland.

Table 10 presents the loses as a result of likely clearing within the three transport corridors, together with the Habitat Hectare offset target. Further details can be found in Appendix 1 and Section 6.1.

TABLE 10. LOSSES WITHIN TRANSPORT CORRIDORS – OMR, E6 AND RRL

Footprint	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target
		No Native Vegetation 0	Low 0.01–0.30	Medium 0.31–0.60	High 0.61–1			
E6	Grassy Eucalypt Woodland		71	11		83	18	28
	Natural Temperate Grassland		1	3		5	2	3
	Other native vegetation		1	1		2	0	1
	No native vegetation	456				456	0	1
E6 Total		**456**	**73**	**16**		**545**	**20**	**32**
OMR	Grassy Eucalypt Woodland		9	33		42	15	26
	Natural Temperate Grassland		35	457	27	520	239	459
	Plains Grassy Wetland		1	3		3	1	3
	Other native vegetation		4	15		19	7	11
	No native vegetation	1,767				1,767	0	0
OMR Total		**1,767**	**49**	**508**	**27**	**2,351**	**262**	**498**
RRL	Natural Temperate Grassland		20	71	4	95	37	65
	Plains Grassy Wetland			1		1	0	1
	Other native vegetation			0		0	0	0
	No native vegetation	281				281	0	0
RRL Total		**281**	**20**	**72**	**4**	**377**	**38**	**67**
Grand Total		**2,504**	**143**	**596**	**31**	**3,273**	**320**	**597**

OMR – Outer Metropolitan Ring Transport Corridor
RRL – Regional Rail Link

6.7.5.2 FLORA

No flora species listed under the EPBC Act have been recorded within the proposed ROW. Four EPBC flora listed species have the potential to occur within the proposed ROW. These species include Adamson's Blown-grass (endangered), Clover Glycine (vulnerable), Curly Sedge (endangered) and Matted Flax-lily (endangered). .

6.7.5.3 FAUNA

No fauna species listed under the EPBC Act, have been recorded within the proposed ROW. Several fauna EPBC listed species have the potential to occur within the proposed ROW. These species include Dwarf Galaxias (vulnerable), Grey-headed Flying-fox (vulnerable), Growling Grass Frog (vulnerable), Striped Legless Lizard (vulnerable) and Swift Parrot (endangered).

6.7.6 REGIONAL RAIL LINK CORRIDOR (WEST OF WERRIBEE TO DEER PARK)

The Regional Rail Link is a 50km railway connection from west of Werribee to Southern Cross Station via the Melbourne-Ballarat railway, connecting at Deer Park. The Program is concerned with the west of Werribee to Deer Park section of the Corridor, which is approximately 30km long.

The alignment (west of Werribee to Deer Park) will be located as shown in the Program Report.

The planning process for the RRRL is discussed in Section 3.5 and in the Program Report.

6.7.6.1 INVESTIGATION OF ALTERNATIVE ALIGNMENTS

The determination of the preferred alignment option for the Regional Rail Link – West of Werribee to Deer Park was the result of a rigorous assessment of potential options.

Assessments from the specialist investigations including engineering, flora and fauna, hydrology, cultural heritage, social impact, etc were collated and presented at an alignment selection workshop. The outcome of this workshop was for specialist investigations to be undertaken on a particular alignment, which was subsequently further refined to produce the preferred alignment. The chosen alignment has the greatest potential to meet the overall project objective: "to reserve land for a high quality transit corridor servicing Melbourne's and Victoria's west".

6.7.6.2 ALIGNMENT SELECTION

A number of concept alignments were developed for assessment. These alignments were divided into those north and south of Leakes Road with several potential connections to the existing rail lines at each end. The north (prefix N) and south (prefix S) alignments, offered flexibility to provide alternative connectivity across Leakes Road and several alternative potential reservations between the Geelong and Ballarat Rail Corridors. All alignment options provided for ultimate development of four tracks if required.

Figure 42 illustrates the alignment options as assessed. As assessment of the options developed, two new alignment options (N1 – HAL02 and N1 – HAL02A) were produced following an Alignment Selection Workshop.

6.7.6.3 IMPACTS ON MNES

Although there will be broader environmental benefits generated by the project, there will also be local impacts on flora and fauna, waterways, natural landscapes and cultural heritage. Where possible the chosen alignment has aimed to avoid areas of known significance, and where impacts are anticipated mitigation strategies will be introduced to lessen impacts.

FLORA AND FAUNA IMPACTS

The Regional Rail Link – West of Werribee to Deer Park will impact on local flora and fauna. Although the environmental values of the area have been degraded by clearing and agriculture since European settlement, there are still important habitats containing significant flora and fauna species. The project has avoided larger areas of ecological significance found further west around Mount Cottrell, but it is difficult for a project of this scale to completely avoid flora and fauna impacts. The project will minimise flora and fauna impacts in both terrestrial and aquatic habitats and ensure that the requirements of the applicable Commonwealth and State legislation are met. Key impacts include:

- Removal of native flora and habitat areas through clearing and potential spread of noxious weeds and pests;
- Impacts on native fauna; and
- Potential damage to aquatic fauna habitat, of relevance to the Werribee River, Skeleton Creek and Lollypop Creek.

The project is predominantly within the Victorian Volcanic Plains Bioregion and the Werribee River basin as defined by the Department of Sustainability and Environment. The project traverses the Plains Grassland Ecological Vegetation Class (EVC 132), which is classified as endangered within the Victorian Volcanic Plain bioregion. The proposed alignment will impact on Natural Temperate Grassland of the Victorian Volcanic Plain which is a critically endangered ecological community listed on the EPBC Act.

The project has sought to avoid known areas of high ecological significance found further west towards Mount Cottrell. A preliminary flora and fauna assessment estimated that removal of 45ha of native vegetation, mainly in the Plains Grassland Ecological Vegetation Class. Subsequent estimates produced by the Department of Sustainability and Environment based on an updated project footprint including grade separations, station footprints and train stabling areas concluded that a total of 95ha of Natural

Temperate Grassland will be impacted. This loss will be managed by implementing the net gain policies in the Victorian Native Vegetation Framework and by applying relevant prescriptions approved by the Commonwealth Minister for the Environment.

Table 10 presents the losses as a result of likely clearing within the three transport corridors, together with the Habitat Hectare offset target. Further details can be found in Appendix 1 and Section 6.1.

Although the project does not intersect directly with a Ramsar site, the project crosses the Werribee River, Skeleton Creek and Lollypop Creek which drain into the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar sites. Construction and operation techniques will be employed to avoid impacts on these waterways or the Ramsar site downstream.

One EPBC Act listed flora species (Spiny Rice-flower) will be impacted by the alignment. There is suitable habitat within the broader study area for one other species (Large-fruit Groundsel), and this species is most likely to be encountered in close proximity to the Melbourne to Ballarat Railway. Two EPBC Act listed fauna species (Striped Legless Lizard and Growling Grass Frog) have previously been recorded from the broader study area, although up to an additional seven species could also occur. No listed migratory fauna species are recorded from within the corridor for the project, although thirty-one species have previously been recorded in the broader study area. Three additional migratory species are predicted to occur, or their habitat is predicted to occur, within five kilometres of the alignment. Detailed survey will be undertaken for all such species prior to detailed design and planning of construction.

The presence of Natural Temperate Grassland has been identified as the most significant ecological issue for the Regional Rail Link – West of Werribee to Deer Park alignment, although the project has sought to avoid the most significant areas of this ecological community in the Melton/Wyndham region found around Mount Cottrell and west of Wyndham Vale

Of all the alignments, the impact on the Plains Grassland community is greatest for N2. However, the existing land use approved for the Boral Quarry means that much of the grassland traversed by N2 has already been approved for development and the net impact of N2 could therefore be less than any of the N1 options. The project involves a minor area of the remaining extent of Natural Temperate Grassland and it was noted offsetting of any native vegetation removed as part of the project is possible for all alignment options.

The primary mechanism for mitigating the flora and fauna impacts is through adherence to the Environment Effects Act conditions determined by the Victorian Minister for Planning, the Victorian Government's Native Vegetation Framework (DNRE 2002), and relevant prescriptions for managing matters of National Environmental Significance once

approved by the Commonwealth Minister for the Environment. As a result of the Native Vegetation Framework, the options assessment has sought to avoid and minimise native vegetation loss through appropriate route selection, and then ensure native vegetation losses are suitably offset. Further mitigation measures will ensure the project minimises impacts on flora and fauna.

These include:

- Further targeted flora and fauna surveys to establish the precise impacts on key species, and whether additional prescriptions will be required to manage matters of national environmental significance;
- Detailed design to minimise vegetation and habitat loss, including reducing the footprint of the corridor to minimum extent practicable;
- Provision of fauna underpasses or overpasses (if appropriate) at key locations, particularly for watercourses draining into Ramsar sites;
- Use of best-practice design for crossing waterways to maintain aquatic habitats and for dealing with runoff; and
- Use of best-practice construction protocols to minimise impacts associated with soil disturbance, spread of weeds and pathogens and incidental damage to retained areas.

WATERWAY IMPACTS

Various waterways intersecting the Regional Rail Link – West of Werribee to Deer Park include the Werribee River, Skeleton Creek, Lollypop Creek, Cherry Creek, Davis Creek, Laverton Creek, Kororoit Creek, Kayes Drain and tributaries of these watercourses. As noted earlier, many of these waterways flow into Ramsar wetland sites on the western shores of Port Phillip Bay.

The infrastructure needed to traverse waterways, (such as bridges, culverts and pylons) will be located and designed to minimise impacts on the hydraulic patterns of the waterways and the habitats they support. Particular care will be taken to ensure that existing flood regimes are not impacted through careful design of embankments and structures where the railway crosses watercourses. Impacts on the environmental values of waterways will be further reduced by implementing best practice water sensitive design treatments for rail track and stormwater runoff and implementing an Environmental Management Plan during construction. In conjunction with mitigation measures to reduce impacts on flora and fauna, the project will not cause major impact to waterways.

Of the northern alignments, N1B was the preferred alignment as it crossed the least number of waterways and had the lowest Aggregate Potential Impacts on Waterway

and Floodplain Function Score. Alignment Option N1A has fewer waterway crossings, however it provides an alternative connection to the existing Ballarat railway for alignment options N1 and N1B. N2 and N1 both crossed one more waterway of ecological value, thereby increasing their impacts.

6.8 IMPACTS ON HERITAGE SITES AND COMMONWEALTH PROPERTIES

There are seven historic sites listed on the Register of the National Estate within the Melbourne North Investigation Area and three within the Melbourne West Investigation Area (Table 3). All are built structures and all will be sympathetically retained and protected as part of the Precinct Structure Planning process. All these sites will be progressively added to the relevant planning scheme, where that has not already occurred, with appropriate controls applied to protect their character.

In addition to these historic sites, the Craigieburn to Cooper Street Grasslands is registered as a site of natural significance on the register of the National Estate. The majority of this site is within the strategic assessment study area (Melbourne's north) and these areas will be protected from development and managed for their conservation values. The site includes the existing Craigieburn Grasslands Reserve. The Biodiversity Conservation Strategy for the Whittlesea Growth Area will document the management arrangements for areas of the registered site not already in a conservation reserve.

It is not considered likely that actions resulting from the Program will impact significantly on Heritage sites or Commonwealth properties.

6.9 INFORMATION SOURCES AND CONFIDENCE LEVELS

The assessment of impacts described in this report draws on a range of recent and historical information sources as outlined in Section 3.7. Definitive expertise has been sourced on key issues for which we have high levels of confidence.

As acknowledged in the report there are many issues for which it is known that information is incomplete and where additional information will be required to finalise aspects of the response. However the overall management process allows for such uncertainty. As this is a strategic assessment, we have confidence in the accuracy and reliability of information used to make the big decisions, in particular the proposed locations of the new Urban Growth Boundary, OMR/E6 Transport Corridor and Regional Rail Link. However where detailed information was not available to the standard required (i.e. in most areas except the well-surveyed Melbourne West

Investigation Area Investigation Area and western grasslands) significant fine tuning at the precinct level and development of site specific responses will occur in conjunction with additional information collection. This information collection is mandated as part of the Precinct Structure Planning process (e.g. flora and fauna surveys). In some cases this assessment report has committed additional information to be collected on key issues.

There are several plant and animal species that are identified in this report as being currently listed under the EPBC Act but for which a prescription has not been prepared for managing it as part of the Program. This is due to uncertainty about whether the species will actually be impacted. Surveys for all the following species will be undertaken prior to precinct design or transport planning where relevant, and if the species is detected a prescription will be developed in consultation with the Commonwealth. The list is as follows:

- Adamson's Blown-grass
- Austral Toadflax
- Australian Painted Snipe
- Basalt Peppercress
- Basalt Sun Orchid
- Button Wrinklewort
- Clover Glycine
- Cream Spider Orchid
- Dwarf Galaxias
- Frankston Spider Orchid
- Grassland Earless Dragon
- Green-striped Greenhood
- Large Fruit Fireweed
- Maroon Leek Orchid
- Metallic Sun Orchid
- Pale Swamp Everlasting
- Plains-wanderer
- Purple Diuris
- Regent Honeyeater
- River Swamp Wallaby Grass
- Small Golden Moths
- Sunshine Diuris
- Swamp Everlasting
- Swamp Fireweed
- Swift Parrot

Overall the information used is considered appropriate for the level of assessment.

PROPERTIES WHERE ACCESS TO PSP BIODIVERSITY SURVEYS HAS BEEN REFUSED

An agreed approach for properties that deny the Growth Areas Authority access to complete a biodiversity assessment is required. Unfortunately about 10 per cent of properties, sometime more, deny access to the GAA for it to complete biodiversity assessments in accordance with the *Biodiversity Precinct Planning Kit*.

The Precinct Structure Plan can attempt to draw a broad conclusion about the biodiversity values on these properties through modelling and aerial photography interpretation, but it can not satisfy the Kit's survey requirements. The Precinct Structure Plan is required to make urban structure and open space planning decisions

for these properties in the absence of this information. The Native Vegetation Precinct Plan will not apply to these properties.

Development of these properties should not be approved until a separate site specific referral under the EPBC Act is approved by the Commonwealth. This might delay the planning approvals process for these properties by at least 6 to 12 months due to seasonal biodiversity assessment requirements. A condition of this approval would be the requirement that these properties undertake site specific surveys in full accordance with the Biodiversity Kit prior to planning approval being granted for urban development at the owner's expense. It is considered that this is the only equitable and appropriate approach. It would not be equitable to 'reward' an owner who does not allow access to benefit for the streamlined assessment afforded under the Precinct Structure Planning process.

6.10 MANAGEMENT COMMITMENTS

The following section sets out the various commitments made by Victoria to manage impacts on matters of national environmental significance that are relevant to the Program. The table presents conservation activities for addressing these matters, as discussed throughout this report, together with the responsibilities of government agencies, councils and the private sector; timeframes; resourcing and performance measures. The details of the legal and other mechanism for delivery of each of these activities are described in the accompanying Program Report.

NOTES ON TABLE

Timing:

- Short term means the activity is expected to occur within the period 2010 to 2013.
- Medium term means the activity is expected to occur within the period 2014 to 2019.
- Long term means the activity is expected to occur beyond 2020.

NATURAL TEMPERATE GRASSLANDS

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To establish a reservation for 15,000ha grasslands (nature conservation reserve or National Park) outside of the Urban Growth Boundary in Melbourne's west.	Prepare amendment to relevant planning schemes to apply a Public Acquisition Overlay to land within the western grassland reserves.	Department of Planning and Community Development	Short term	Covered under existing allocations	Public Acquisition Overlay in planning scheme by 2010
	Publicly acquire land (10 year acquisition program by the State Government).	Department of Sustainability and Environment	Short to medium term	Required resources have been committed by the Victorian Government	Acquisition schedule provided to Department of the Environment, Water, Heritage and the Arts following the Victorian Government's gazettal of the planning scheme amendment Purchase and reservation under *Crown Land Reserves Act 1978* completed by 2020 (excluding quarries) (end stage 2)
To provide interim management of the Western Grassland Reserves before they are acquired, achieved by assisting landholders to manage threats and strengthening regulation to prevent degradation.	Amend local planning schemes to apply an Environmental Significance Overlay or other appropriate statutory planning controls to the western grassland reserves.	Department of Planning and Community Development	Short term	Covered under existing allocations	Appropriate planning controls in relevant local planning schemes by 2010
	Amend or make declarations under the *Catchment and Land Protection Act 1994* to legally protect grasslands on the Volcanic Plains grasslands from environmental weeds.	Department of Primary Industries	Short term	Covered under existing allocations	Declarations to lists or areas under the *Catchment and Land Protection Act 1994* gazetted by December 2010
	Prepare Interim Management Plan.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Interim Management Plan provided to the Department of the Environment, Water, Heritage and the Arts by 2010
	Undertake urgent works from December 2009 (weed control), then in accordance with the Interim Management Plan schedule with landholders and relevant local councils. Conduct on ground surveillance and enforcement.	Department of Sustainability and Environment	Short term	Required resources have been committed by the Victorian Government	Monitor and report on implementation of the Interim Management Plan in accordance with the reporting schedule Reports provided to Department of the Environment, Water, Heritage and the Arts every 6 months in 2010–2011 then annually until land acquired.

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To manage the western grasslands as conservation reserve or National Park for a range of particular vegetation and species requirements.	Establish expert advisory group and define performance standards for best practice adaptive management of native grassland and threatened species.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Performance standards for management, and monitoring methodology provided to DEWHA by June 2011
	Progressively survey and assess flora and fauna values on acquired parcels.	Department of Sustainability and Environment	Short to medium term	Covered under offset arrangements (underwritten by Victorian Government)	Flora and fauna survey undertaken on each newly acquired land parcel with report prepared for the Department of Sustainability and Environment on values and management issues.
	Prepare National Park or Reserve Management Plan that incorporates best practice adaptive management for the western grassland reserves.	Parks Victoria	Medium term	Covered under existing allocations	Prepare National Park or Reserve Management Plan by December 2012 following community consultation. Management Plan revised and updated by 2022
	Undertake works, manage and monitor park activities in accordance with the National Park or Reserve Management Plan and best practice performance standards. This includes undertaking detailed flora and fauna surveys for the Striped Legless Lizard, Plains-wanderer, Grassland Earless Dragon, Spiny Rice-flower, Large-fruit groundsel and other nationally listed species across whole reserve area.		Short to long Term	Required resources have been committed by the Victorian Government	Each land parcel managed by Parks Victoria according to best practice standards and management practices and procedures within 6 months of acquisition Annual reports from Parks Victoria provided to the Department of Sustainability and Environment including results of threatened species surveys and monitoring

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To identify and protect other grassland remnants on the Werribee Plains	Amend local planning schemes to apply appropriate statutory planning controls to remnant grasslands identified by Department of Sustainability and Environment mapping outside the Urban Growth Boundary and to relevant non-urban land within the Urban Growth Boundary.	Department of Planning and Community Development	Short term	Covered under existing allocations	Environmental Significance Overlays in relevant local planning scheme by June 2010
	New mapping program undertaken on private land to inform improved or expanded Environmental Significance Overlays.		Short term	Covered under existing allocations	Environmental Significance Overlays in relevant local planning scheme by June 2010
	Revise Environmental Significance Overlays as a result of new data.	Department of Planning and Community Development	Medium term	Subject to funding	Revised statutory planning controls in local planning schemes by 2015
To implement the prescription approved by the Commonwealth Minister for Environment for managing impacts on Natural Temperate Grassslands	Prepare Native Vegetation Precinct Plans and Conservation Management Plans as part of the precinct structure planning process following the methodology of the Biodiversity Precinct Planning Kit and detailed guidance.	Growth Areas Authority Growth area councils Department of Sustainability and Environment	Short term	Covered under existing allocations	Surveys undertaken according to Biodiversity Precinct Planning Kit methodology
	Monitor planning permits and enforce illegal clearing that is not in accordance with the requirements of the Native Vegetation Precinct Plan or Conservation Management Plan, or relevant approval document for transport infrastructure or other land use.	Growth area councils Department of Primary Industries	Ongoing	Covered under existing allocations	Offsetting according to Native Vegetation Management Framework. Grassland offsets located within proposed grassland reserves. Breaches reported to Department of Environment, Water, Heritage and the Arts as agreed

GRASSY EUCALYPT WOODLANDS

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To progressively secure the long-term protection of retained areas of Grassy Eucalypt Woodland on private land within the Hume-Whittlesea and Sunbury Growth Areas through implementation of the prescription approved by the Commonwealth Minister for Environment for managing impacts on Grassy Eucalypt Woodland and other strategic planning mechanisms	Amend Hume Planning Scheme and Whittlesea Planning Scheme to introduce appropriate statutory planning controls (Conservation zoning plus an Environmental Significance Overlay) to protect constrained land identified for conservation of Grassy Eucalypt Woodland.	Department of Planning and Community Development	Short term	Covered under existing allocations	Appropriate planning controls in Hume Planning Scheme and Whittlesea Planning Scheme by June 2010
	Prepare Biodiversity Conservation Strategy for the Northern Growth Areas that sets out the mechanism by which retained Grassy Eucalypt Woodland will be permanently protected and managed to improve its quality within the Growth Area.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Northern Biodiversity Conservation Strategy prepared by December 2009
	Prepare revised Growth Area Framework Plans for Hume and Whittlesea that identify conservation corridors and principles for managing the protection of Grassy Eucalypt Woodland.	Growth Areas Authority Department of Planning and Community Development	Short term	Covered under existing allocations	Revised Whittlesea Growth Area Framework Plan prepared by 2010 Conservation strategy reflected in revised Whittlesea and Hume Growth Area Framework Plans
	Prepare Precinct Structure Plans in accordance with the Growth Area Framework Plans and Precinct Structure Planning Guidelines (including requirements for biodiversity conservation). Prepare Native Vegetation Precinct Plans with the Precinct Structure Plans in accordance with Clause 52.16 of local planning schemes.	Growth Areas Authority Hume City Council Whittlesea City Council	Short term	Covered under existing allocations	Precinct structure planning results in the permanent protection and management of 80 per cent of Grassy Eucalypt Woodland in Hume and Whittlesea Growth Areas by 2025

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
	Monitor planning permits and enforce illegal clearing that is not in accordance with the requirements of the Native Vegetation Precinct Plan or Conservation Management Plan, or relevant approval document for transport infrastructure or other land use.	Growth area councils Department of Primary Industries	Ongoing	Covered under existing allocations	Offsetting according to Native Vegetation Framework. Grassy Eucalypt Woodland offsets located within proposed Northern Grassy Woodland reserves. Breaches reported to Department of Environment, Water, Heritage and the Arts as agreed
Establish a large (at least 1200ha) Grassy Eucalypt Woodland reserve (nature conservation reserve) south west of Whittlesea outside the Urban Growth Boundary	Prepare and consult on a proposal for a Grassy Eucalypt Woodland reserve concurrently with the preparation and public consultation of the revised Whittlesea Growth Area Framework Plan. The proposal is to identify the funding and acquisition mechanisms and potential statutory planning controls to be applied to the land.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Reserve proposal, acquisition and management approach and schedule provided to Department of the Environment, Water, Heritage and the Arts by 2010
	Implement agreed Grassy Eucalypt Woodland reserve proposal.	Department of Sustainability and Environment	Short to medium term	Funding generated from developer's offset requirements	Reports to Department of the Environment, Water, Heritage and the Arts on progress of reserve establishment in accordance with the acquisition schedule by 2012 and 2015 or as determined by approved Monitoring and Reporting Framework Reserve established and land manager appointed by 2020

GOLDEN SUN MOTH, SPINY RICE-FLOWER AND MATTED FLAX-LILY

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To determine the extent of the Golden Sun Moth to inform Sub-Regional Species Strategy and Precinct Structure Plans	Undertake targeted surveys for the Golden Sun Moth across its historic Victorian range for at least two seasons in accordance with the Biodiversity Precinct Planning Kit methodology. Survey period to be extended if required.	Growth Areas Authority (growth areas and periurban) Department of Sustainability and Environment (rural and regional)	Short term	Resources available and committed	New data provided annually to the Department of the Environment, Water, Heritage and the Arts for recovery planning purposes
	Prepare Sub-Regional Species Strategy for the Golden Sun Moth.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Sub-Regional Species Strategy for the Golden Sun Moth completed by June 2011 for Commonwealth approval
To implement the prescriptions approved by the Commonwealth Minister for Environment for managing impacts on Golden Sun Moth, Spiny Rice-flower and Matted Flax-lily	Prepare detailed guidance note for stakeholders as part of Sub-Regional Species Strategy outlining assessment and accounting process for the Golden Sun Moth, Spiny Rice-flower and Matted Flax-lily to assist precinct structure planning and other development approvals processes, and to track progress towards bioregional protection targets.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Guidance note published by 2010
	Provide regular reports on Victoria's progress towards meeting the '80 per centof confirmed highest priority sites' (as defined in prescriptions) for Golden Sun Moth, Spiny Rice-flower and Matted Flax-lily.	Department of Sustainability and Environment	Ongoing	Covered under existing allocations	Reports published every two years commencing 2010 and in line with Monitoring and Reporting Framework
	Prepare Native Vegetation Precinct Plans and Conservation Management Plans as part of the precinct structure planning process following the methodology of the Biodiversity Precinct Planning Kit and detailed guidance.	Growth Areas Authority Growth area councils Department of Sustainability and Environment	Short term	Covered under existing allocations	Surveys undertaken according to Biodiversity Precinct Planning Kit methodology

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
	Monitor planning permits and penalise illegal clearing that is not in accordance with the requirements of the Native Vegetation Precinct Plan or Conservation Management Plan, or relevant approval document for transport infrastructure or other land use.	Growth area councils	Ongoing	Covered under existing allocations	Breaches reported to Department of Environment, Water, Heritage and the Arts as agreed

SMALL GOLDEN-MOTHS ORCHID

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To protect areas of Clarke's Road grassland containing Small Golden Moths Orchid by applying appropriate planning controls and by land purchase or by securing private land management agreement/s	Amend the Melton Planning Scheme to introduce appropriate statutory planning controls (conservation zoning andEnvironmental Significance Overlay) to protect the Small Golden-Moths Orchid and other grassland values.	Department of Planning and Community Development	Short term	Covered under existing allocations	Appropriate planning controls in planning scheme by June 2010
	Reflect the values of Clarke's Road Grassland in the Biodiversity Conservation Strategy and Growth Area Framework Plan for this Growth Area, including identifying and consulting on potential reserve boundaries and determining the funding and acquisition mechanisms to be applied to the land.	Department of Sustainability and Environment Growth Areas Authority Department of Planning and Community Development	Short term	Covered under existing allocations	Growth Area Framework Plans in place by June 2011 reinforce protection of this area Provide reserve proposal together with acquisition and management approach to Department of the Environment, Water, Heritage and the Arts as part of Biodiversity Conservation Strategy for the Growth Area by March 2011
	Legal agreements prepared and negotiated with landowners (under s69 of *Conservation Forests and Land Act, Victorian and Conservation Trusts Act* or s173 agreements under the *Planning and Environment Act 1987.*	Department of Sustainability and Environment	Short to medium term	Covered under existing allocations	Land purchased or in private land management agreement by June 2012
To manage native grassland areas along Clarke's Road to improve their quality over the long-term and maximise habitat condition for threatened and other resident species, with particular emphasis on Small Golden-moths Orchid	Prepare a Reserve Management Plan for the Clarke's Road area.	Department of Sustainability and Environment Parks Victoria	Medium term	Covered under existing allocations	Conservation Management Plan in place that provides appropriate protection and management regimes for persistence of the Small Golden Moth at the Clarke's Road area in perpetuity
	Undertake works and monitor use of the reserve in accordance with the Conservation Management Plan. If not a public reserve, monitor planning permits and enforce any land management obligations in accordance with the requirements of the Conservation Management Plan and legal agreement.	Parks Victoria Department of Sustainability and Environment Department of Planning and Community Development	Medium term to ongoing	Resources available and committed	Performance standards for management and monitoring provided to Department of the Environment, Water, Heritage and the Arts by June 2011 Each land parcel managed by Parks Victoria or private landowner according to Conservation Management Plan and/or legal agreement

SOUTHERN BROWN BANDICOOT AND GROWLING GRASS FROG

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To protect important landscape/habitat areas of the Southern Brown Bandicoot and Growling Grass Frog	Undertake field surveys, population viability analyses and develop models for sub-regional planning, then prepare Sub-regional Species Strategies for conservation of Southern Brown Bandicoot and Growling Grass Frog to inform preparation of Biodivesrity Conservation Strategies and Growth Area Framework Plans, and provide guidance to urban development planning	Department of Sustainability and Environment	Short to medium term	Covered under existing allocations	Sub-regional Strategies for Growling Grass Frog reflected in Casey-Cardinia, Melton-Caroline Springs and Hume-Whittlesea Growth Area Framework Plans byJune 2011 Sub-regional Strategy for the Southern Brown Bandicoot reflected in Casey-Cardinia Growth Area Framework Plan by June 2011
	Implement key strategic management measures identified in the Sub-regional Species Strategies informing relevant Precinct Structure Plans.	Department of Planning and Community Development Department of Sustainability and Environment Growth Areas Authority	Short term	Funding to be sought when required	Priority existing habitat protected and mechanism for future management established for Growling Grass Frog and Southern Brown Bandicoot by March 2011
To implement Conservation Management Plans and prescriptions approved by the Commonwealth Minister for Environment for the Growling Grass Frog and Southern Brown Bandicoot	Prepare Conservation Management Plans as part of the precinct structure planning process following the methodology of the Biodiversity Precinct Planning Kit and responding to requirements of relevant prescriptions.	Growth Areas Authority Growth area council Developer	Short term	Covered under existing allocations	Conservation Management Plans prepared to the satisfaction of Department of Sustainability and Environment and consistent with Sub-Regional Species Strategy (once prepared) Monitoring reports provided to Department of Environment, Water, Heritage and the Arts at least every two years according to agreed schedule to demonstrate the effectiveness of management approaches for Southern Brown Bandicoot and Growling Grass Frog
	Monitor planning permits and enforce land management obligations that are not in accordance with the requirements of the Native Vegetation Precinct Plan and Conservation Management Plan.	Growth area councils	Ongoing	Covered under existing allocations	Performance reported to Department of Environment, Water, Heritage and the Arts as agreed

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To ensure the water quality of known and potential Growling Grass Frog habitat is maintained at the level necessary to contribute to their persistence across greater Melbourne	Incorporate best practice urban water management techniques through preparation of Integrated Water Management Plans as specified in the Precinct Structure Planning Guidelines for Precinct Structure Plans and/or equivalent process for transport infrastructure and other development planning.	Growth Areas Authority Growth area councils Developer	Short to medium term	Covered under existing allocations	Integrated Water Management Plans prepared in accordance with the Precinct Structure Planning Guidelines All precincts, transport and other infrastructure included within the Program developed in accordance with best practice urban water management
	Protect relevant habitat identified in the Sub-Regional Strategy or individual Conservation Management Plan from potential point source water quality contaminants by adherence to Environment Protection Authority guidelines and procedures.	Growth Areas Authority Growth area councils Developer Environment Protection Authority	Ongoing	Covered under existing allocations	All precincts, transport and other infrastructure included within the Program managed in accordance with published Environment Protection Authority guidelines and remediation procedures

STRIPED LEGLESS LIZARD

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To implement prescription approved by the Commonwealth Minister for Environment for the Striped Legless Lizard prior to detailed planning and construction (precinct planning and transport infrastructure and other development)	Undertake detailed surveys for Striped Legless Lizard. Prepare Conservation Management Plans and Biodiversity component of Precinct Structure Plans following the methodology outlined in the Biodiversity Precinct Planning Kit and responding.	Growth Areas Authority	Short to medium term	Covered under existing allocations	Surveys undertaken in accordance with the Biodiversity Precinct Planning Kit methodology Surveys undertaken prior to commencement of precinct planning All data provided to the Department of Sustainability and Environment within three months of submission to the Growth Areas Authority Precinct Structure Plan reflects relevant conservation management plan
	Prepare translocation protocol in consultation with the Striped Legless Lizard recovery team.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Protocol for translocation provided to Department of the Environment, Water, Heritage and the Arts by 2010
Manage and monitor populations in western grassland reserves and any populations translocated from or within the Program area		Parks Victoria Department of Sustainability and Environment	Medium to long term	Required resources have been committed by the Victorian Government (refer to Natural Temperate Grasslands above)	Monitoring results provided to national recovery team and to Department of the Environment, Water, Heritage and the Arts as per park management plan Community in vicinity of grassland reserves and translocated populations is provided with relevant information regarding consequences relating to control of domestic animals

AUSTRALIAN GRAYLING

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To protect and actively manage riparian vegetation along Cardinia Creek to improve vegetation quality and extent	Identify Cardinia Creek and land within the buffer in the revised Casey-Cardinia Growth Area Framework Plan as important for Australian Grayling conservation. Apply appropriate statutory planning controls (e.g. Environmental Significance Overlay) to land within the buffer area of Cardinia Creek.	Growth Areas Authority Department of Planning and Community Development	Short term	Covered under existing allocations	Appropriate planning controls in Cardinia Planning Scheme and Casey Planning Scheme by June 2010
	Prepare Conservation Management Plans for precincts that abut Cardinia Creek.	Growth Areas Authority	Short term	Covered under existing allocations	Protection/ management measures affording to instream Australian Grayling habitat and adjacent buffers.
	Precinct Structure Plans are developed to reflect relevant conservation management plan.	Growth Areas Authority	Short term		Protection/ management measures affording to instream Australian Grayling habitat and adjacent buffers.
	Undertake works consistent with the Conservation Management Plans.	Melbourne Water Casey City Council Cardinia Shire Council	Ongoing	Covered under existing allocations	Management consistent with Port Phillip and Westernport Regional River Health Strategy targets
To protect potential habitat for the Australian Grayling through enhanced water management measures	Incorporate best practice urban water management techniques through preparation of Integrated Water Management Plans as specified in the *Precinct Structure Planning Guidelines* for Precinct Structure Plans and/or equivalent process for transport infrastructure.	Growth Areas Authority Growth area councils Developer	Short term	Covered under existing allocations	Integrated Water Management Plans prepared in accordance with the Precinct Structure Planning Guidelines All precincts and transport infrastructure included within the Program developed in accordance with best practice urban water management
	Protect Cardinia Creek from potential point source water quality contaminants by adherence to Environment Protection Authority guidelines and procedures.	Growth Areas Authority Growth area councils Developer Environment Protection Authority	Ongoing	Covered under existing allocations	All precincts, transport and other infrastructure included within the Program managed in accordance with published Environment Protection Authority guidelines and remediation procedures

BUTTON WRINKLEWORT, LARGE-FRUIT GROUNDSEL

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To protect and manage all known populations on public land	Identify Truganina Cemetery grassland and land within the buffer (e.g. 200 m) in revising the Wyndham Growth Area Framework Plan.	Growth Areas Authority	Short term	Covered under existing allocations	Wyndham Growth Area Framework Plan in place by June 2011
	Determine the land management buffer for Truganina Cemetery grassland through precinct structure planning and the preparation of Native Vegetation Precinct Plans.	Growth Areas Authority Growth area council Developer	Short term	Covered under existing allocations	Precinct Structure Plan recognises the significance of Truganina Cemetery grassland
	Renegotiate current Public Authority Management Agreement for Truganina Cemetery to protect grassland and values of threatened species.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Management agreement sets out clear standards for managing grassland values
	Monitor threatened species populations and results of management interventions in Truganina Cemetery, rail reserves (within urban Growth Boundary) and western grassland reserves, adapting management approach as required.	Department of Sustainability and Environment (Truganina Cemetery); Parks Victoria (Western Grassland Reserves)	Ongoing	Covered under existing allocations	Monitoring results provided to Department of the Environment, Water, Heritage and the Arts as agreed under Monitoring and Reporting Framework

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To identify and protect where practicable populations on private land and additional populations on public land	Undertake surveys for these species consistent with the Precinct Structure Planning Biodiversity Kit as part of precinct, transport and other development planning.	Growth Areas Authority Growth area council Department of Transport / VicRoads Developer	Short to medium term	Covered under existing allocations	Surveys undertaken in accordance with the Biodiversity Precinct Planning Kit methodology Surveys undertaken prior to commencement of precinct planning All data provided to the Department of Sustainability and Environment within three months of submission to the Growth Areas Authority
	Develop a prescription for Large-fruit Groundsel based on its occurrence at the Rockbank site to inform the Growth Area Framework Planning, Precinct Structure Planning and transport planning processes. This prescription will guide mitigation and management decisions for the remainder of the Program including whether to retain the species on site.	Department of Sustainability and Environment	Short term	Covered under existing allocations	Prescription approved by the Commonwealth Minister for Environment
	Develop a prescription for Button Wrinklewort if new populations are located, to inform relevant planning process.	Department of Sustainability and Environment	Short to medium term	Covered under existing allocations	Prescription approved by the Commonwealth Minister for Environment Department of the Environment, Water, Heritage and the Arts

MAROON LEEK-ORCHID, SWAMP EVERLASTING

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To protect the Maroon Leek-orchid, Swamp Everlasting within the disused railway at Clyde	Investigate establishing the disused railway at Clyde as a potential conservation area through preparing the Biodiversity Conservation Strategy for the south-east and subsequent revised Casey-Cardinia Growth Area Framework Plan.	Department of Sustainability and Environment Growth Areas Authority	Short term	Covered under existing allocations	Biodiversity Conservation Strategy for south-east reflects values of disused railway line and provided for Commonwealth approval by March 2011
	Prepare Conservation Management Plan for the Clyde railway as part of preparing a Precinct Structure Plan for the area, which provides for the protection, management and monitoring of Maroon Leek-orchid and Swamp Everlasting.	Growth Areas Authority Casey City Council Developers	Short to medium term	Covered under existing allocations	Management plan in place prior to commencement of construction Precinct Structure Plan reflects Conservation Management Plan

LISTED SPECIES WITHOUT CURRENT PRESCRIPTIONS, AND SPECIES AND COMMUNITIES THAT MAY BE LISTED IN THE FUTURE

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To provide further data to inform the preparation of Precinct Structure Plans and transport infrastructure and to establish prescriptions for listed species without current prescriptions, and for species and communities that may be listed in the future	Conduct targeted surveys for all species listed in the *Strategic Impact Assessment Report* for which a prescription has not been prepared, prior to detailed planning and construction of program activities.	Department of Sustainability and Environment	Ongoing	Covered under existing allocations	Surveys undertaken in accordance with Biodiversity Precinct Planning kit standards Surveys undertaken prior to commencement of precinct planning All data provided to the Department of Sustainability and Environment within three months of submission to Growth Areas Authority
	Develop prescriptions for any species likely to be impacted through implementation of the Program.	Department of Sustainability and Environment	Ongoing	Covered under existing allocations	All new prescriptions to be provided to the Commonwealth Minister for Environment for approval prior to their application Approved prescriptions for any species likely to be impacted as a result of the Program must be in place prior to construction

MIGRATORY SPECIES, WATERWAYS, WETLANDS AND RAMSAR SITES

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
Protect and reestablish the area of former wetlands adjacent to Casey-Cardinia Growth Area for use as flood and water quality mitigation and biodiversity conservation	Investigate establishing a wetland area in conjunction with the preparation of the Biodiversity Conservation Strategy for the south-east and subsequent revised Casey-Cardinia Growth Area Framework Plan, including identifying the funding and acquisition mechanism.	Growth Areas Authority Melbourne Water	Short term	Funding not secured	Outcome of wetland investigation provided to Department of the Environment, Water, Heritage and the Arts by March 2011
	Prepare Management Plan for the wetlands.	Melbourne Water	Short term	Covered under existing allocations	Management Plan results in a major portion of the area being actively managed for biodiversity conservation, including threatened and migratory species
	Undertake works in accordance with the Management Plan.	Melbourne Water	Medium to long term	Funding not secured	Works undertaken in accordance with management plan
	Monitor threatened and migratory species, management activities and enforce compliance with the Management Plan.		Short to Medium term	Covered under existing allocations	Monitoring results provided to Department of the Environment, Water, Heritage and the Arts as part of 2,4 yearly (initially) then five yearly audit reports or as agreed in Monitoring and Reporting Framework
To manage habitat for migratory species in accordance with the prescriptions approved by the Commonwealth Minister for Environment established for precinct structure planning and infrastructure planning	Identify important wetlands and other habitat areas for migratory species as part of the Biodiversity Conservation Strategies prepared for each growth area.	Growth Areas Authority	Ongoing	Covered under existing allocations	Biodiversity Conservation Strategies identify important wetland areas for retention and management
	Prepare Conservation Management Plans and Biodiversity component of Precinct Structure Plans, including specifying the design and construction of wetland areas (where appropriate) and the management requirements for retained wetlands; incorporate requirements of relevant prescriptions.	Growth Areas Authority Growth area councils Developer	Short to medium term	Covered under existing allocations	Surveys undertaken in accordance with the Biodiversity Precinct Planning Kit Nationally significant migratory bird sites protected with a 200m buffer as part of Precinct Structure Plan

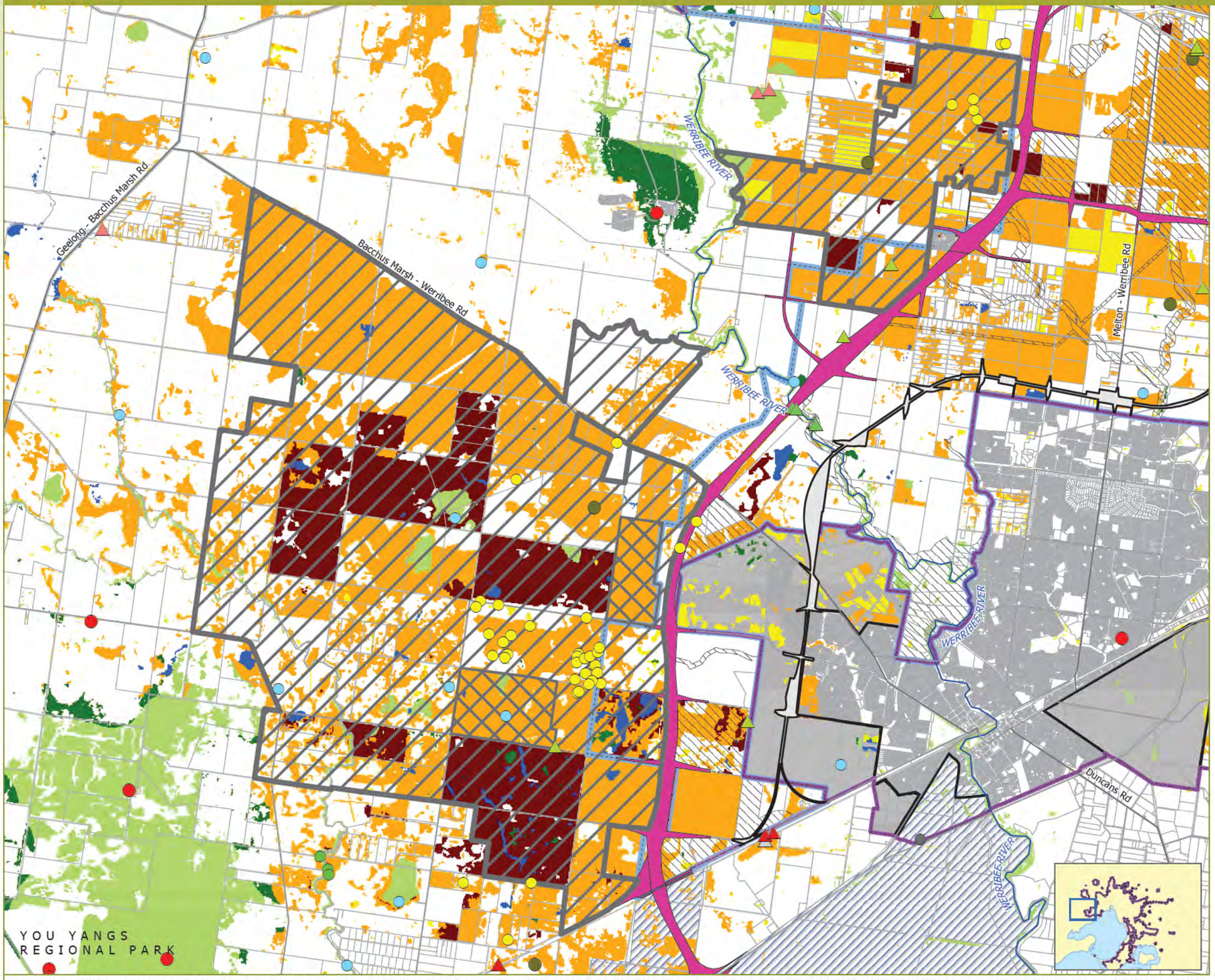
Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
	Undertake works in accordance with the Conservation Management Plan and conditions of any planning approval.	Growth area councils Developer	Ongoing	Covered under existing allocations	Wetlands within precincts suitably buffered from disturbances (including dogs and actively managed to retain or enhance values)
	Monitor and enforce any land management obligations in accordance with the conditions of planning approval.	Growth area councils	Ongoing	Covered under existing allocations	Breaches reported to Department of Environment, Water, Heritage and the Arts as agreed
To protect significant areas within Ramsar sites and downstream Ramsar sites through enhanced management measures	Incorporate best practice urban water management techniques through preparation of Integrated Water Management Plans as specified in the *Precinct Structure Planning Guidelines* for Precinct Structure Plans and/or equivalent process for transport infrastructure.	Growth Areas Authority Growth area councils Developer	Short term	Covered under existing allocations	Integrated Water Management Plans prepared in accordance with the Precinct Structure Planning Guidelines All precincts and transport infrastructure included within the Program developed in accordance with best practice urban water management
	Increase protection measures and monitoring of areas of Port Phillip Bay Ramsar site within 2km of new urban areas. Undertake control and management of feral and domestic animals to protect wetland sites and wildife from disturbance.	Parks Victoria	Ongoing	Covered under existing allocations	Process of updating Ramsar management plans incorporates specific measures to protect, monitor and adaptively manage these sites Dogs and pedestrians effectively excluded at least 200 metres from important shorebird sites (within 2km of urban areas) from December 2010 Communities in vicinity of Ramsar sites and upstream waterways are provided with relevant information regarding consequences relating to control of domestic animals and protection of wildlife
	Monitor and enforce land management obligations in accordance with planning permits.	Growth area councils	Ongoing	Covered under existing allocations	Breaches reported to Department of Environment, Water, Heritage and the Arts as agreed

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
	Monitor water quality entering Ramsar sites and prepare adaptive management response as required.	Independent reporter Environment Protection Authority	Ongoing	Covered under existing allocations	Water entering waterways upstream of Ramsar sites complies with published standards consistent with relevant State Environmental Protection Policy Remedial management plan to deal with potential water quality breaches prepared for Department of Environment, Water, Heritage and the Arts by 2010 Results of water quality testing, and compliance with proposed conservation outcomes submitted to Department of Environment, Water, Heritage and the Arts as part of independent monitoring and auditing of Program. Remedial action taken as necessary.
	Protect Ramsar sites and upstream waterways from potential point source water quality contaminants by adherence to Environment Protection Authority guidelines and procedures.	Environment Protection Authority Melbourne Water	Ongoing	Covered under existing allocations	All precincts, transport and other infrastructure included within the Program managed in accordance with published Environment Protection Authority guidelines and remediation procedures
To protect Ramsar site and downstream impacts associated with the OMR/E6 Transport Corridor	Provide specific measures for protecting and adaptively managing potential impacts on Ramsar values in the Environment Impact Report prepared for the OMR/E6 and translate these measures into the overarching environmental protection strategy and relevant Environmental Management Plans.	VicRoads		Covered under existing allocations	Mechanism for protecting Ramsar site values included in report to Commonwealth as agreed in Monitoring and Reporting Framework

HERITAGE

Objective	Action	Responsible Agency	Timing	Resources	Performance Measures
To protect all known sites on the Register of National Estate and to protect sites of Aboriginal cultural heritage	Retain and protect sites of heritage significance through the precinct structure planning process and implement appropriate statutory controls.	Growth Areas Authority Growth area councils Developer	Short to medium term	Covered under existing allocations	All known sites on the Register of the National Estate referenced in relevant local planning schemes with appropriate controls in place by 2010
	Prepare Cultural Heritage Management Plan though the precinct structure planning process.	Growth Areas Authority Growth area councils Developer	Short to medium term	Covered under existing allocations	Cultural Heritage Management Plan in place for precincts
To manage all known sites on the Register of National Estate and to protect sites of Aboriginal cultural heritage	Undertake activities in accordance with the Cultural Heritage Management Plan and Precinct Structure Plan.	Growth area councils Developers	Ongoing	From land manager	To be agreed with the Department of Environment, Water, Heritage and the Arts
	Monitor use and enforce any land management obligations that apply with statutory planning controls and Cultural Heritage Management Plan.	Department of Planning and Community Development	Ongoing	From land manager	To be agreed with the Department of Environment, Water, Heritage and the Arts

FIGURE 36. PROPOSED WESTERN GRASSLAND RESERVES



Department of Sustainability and Environment

Plains Grassland
Indicative Vegetation Quality
- Low
- Medium
- High

Native Vegetation
- Grassy Eucalypt Woodland
- Plains Grassy Wetland
- Wetland habitat
- Other native vegetation
- Artificial Impoundment
- Non native vegetation

EPBC listed flora*
- Button Wrinklewort
- Clover Glycine
- Large-fruit Groundsel
- Spiny Rice-flower
- Werribee Blue-box

EPBC listed fauna*
- Grassland Earless Dragon
- Grey-headed Flying-fox
- Growling Grass Frog
- Striped Legless Lizard
- Swift Parrot
- Golden Sun Moth

*Only includes spatially accurate records since 1990

- Proposed OMR
- Proposed RRL
- Urban Growth Boundary
- Proposed Urban Growth Boundary
- Original Investigation Areas Boundary
- Proposed Non-urban areas (development avoided)
- Proposed Precinct Structure Planning Areas
- Ramsar areas
- Propoerty boundaries
- Proposed Grasslands Reserves
- Quarries within Southern Reserve

Data Source:
Merged dataset from various sources including: modelled native vegetation data from the DSE Corporate Spatial Data Library (2005) supplemented by site based and rapid native vegetation assessments conducted during 2008/09 by the Growth Areas Authority and DSE.

Map Production by:
Biodiversity & Ecosystem Services, DSE

Map Production Date:
5 November 2009

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Victoria The Place To Be

FIGURE 37. MODELLED HABITAT SUITABILITY FOR STRIPED LEGLESS LIZARD *(Delma impar)*

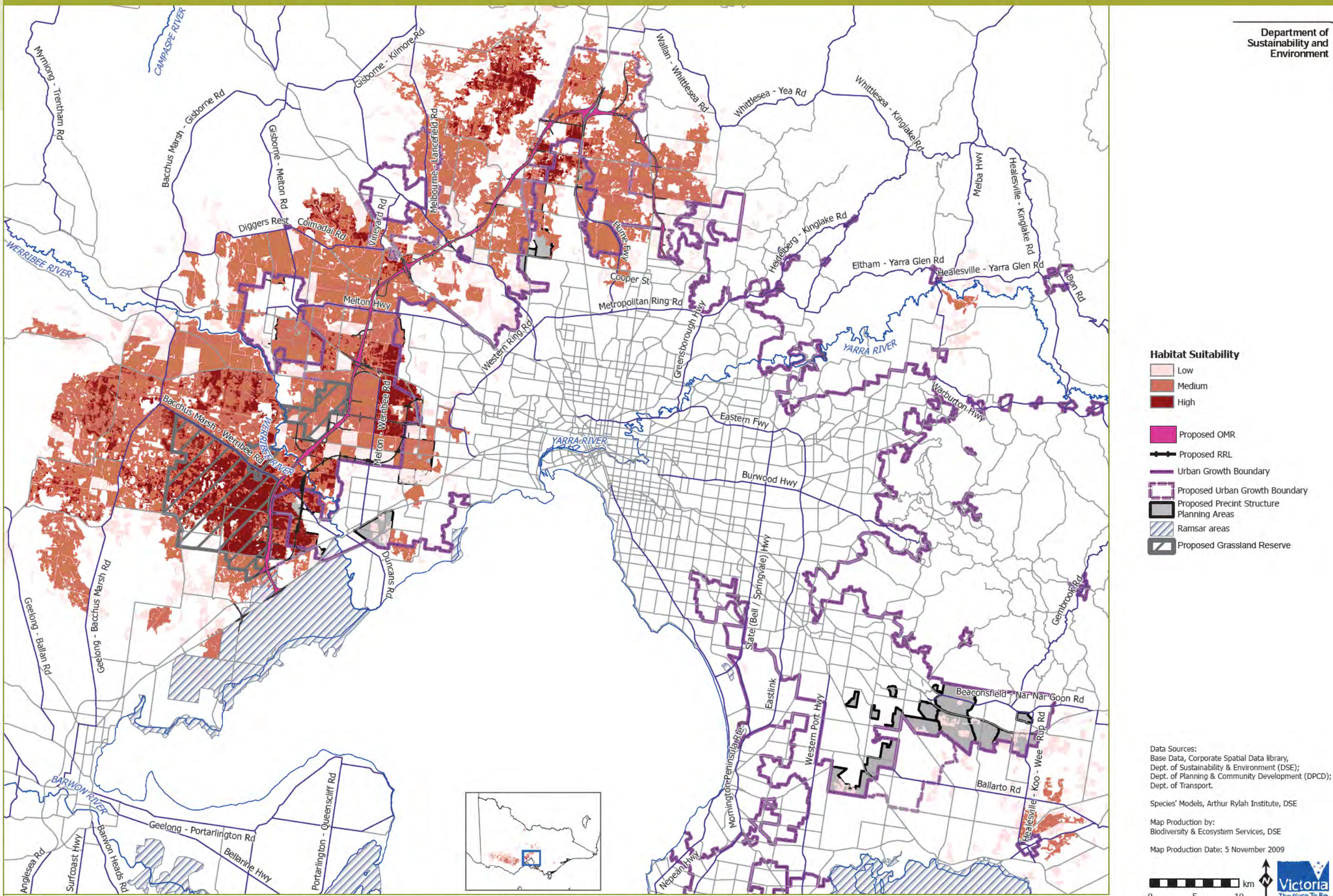

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FIGURE 38. SPECTRUM OF CONTRIBUTION TO SPECIES PERSISTENCE FOR GOLDEN SUN MOTH *(Synemon plana)* HABITAT

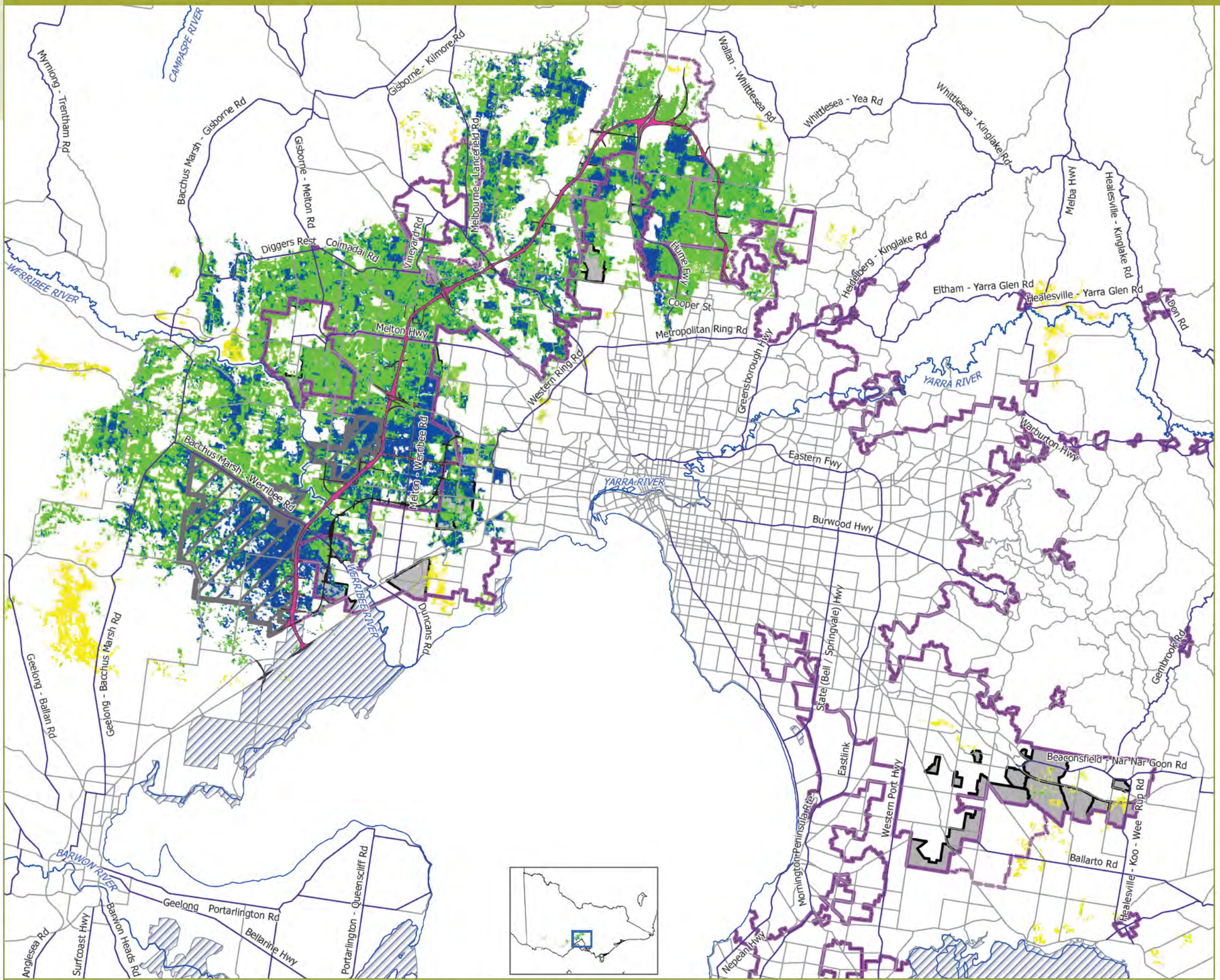
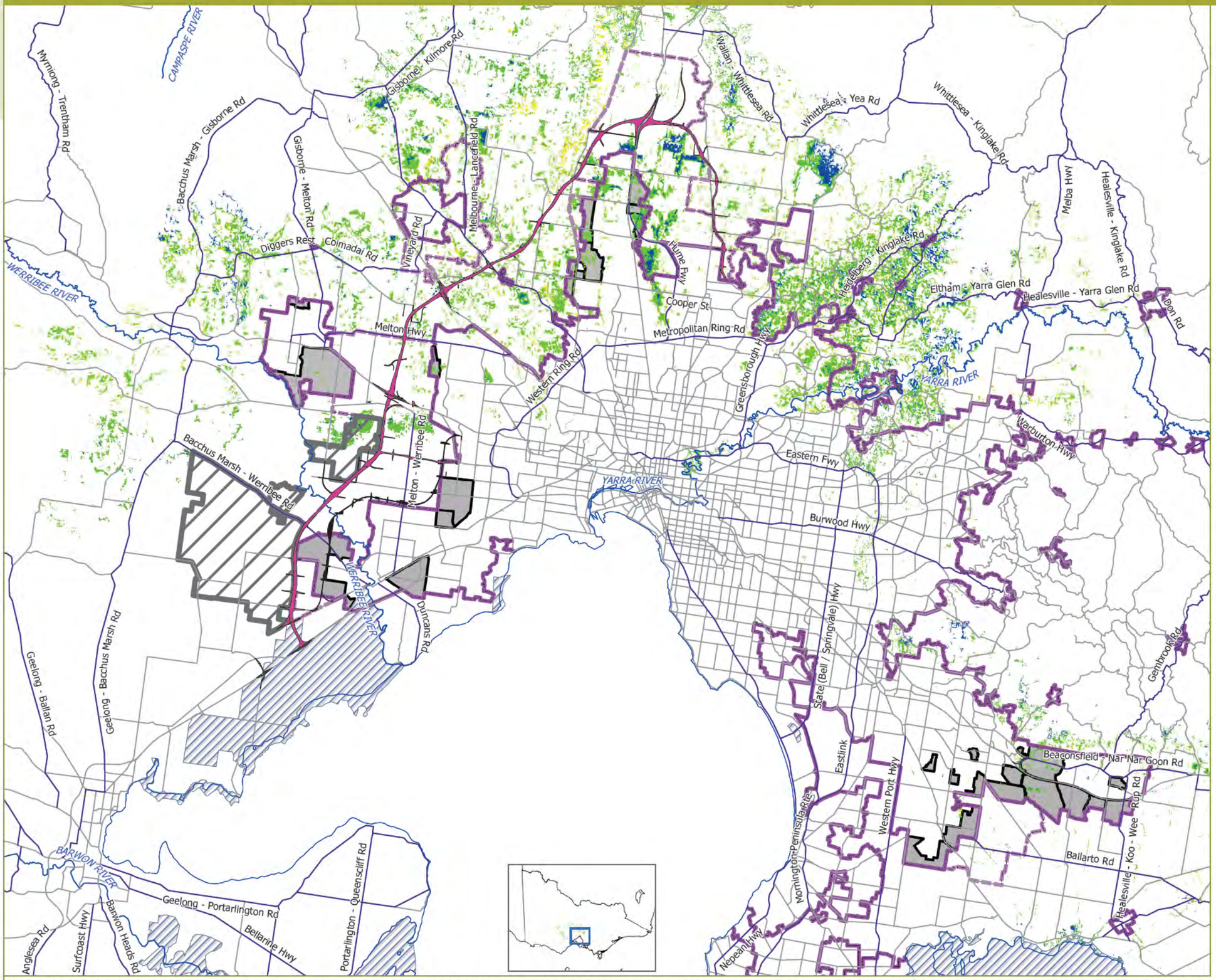


FIGURE 39. SPECTRUM OF CONTRIBUTION TO SPECIES PERSISTENCE FOR MATTED FLAX-LILY *(Dianella amoena)* HABITAT



Department of Sustainability and Environment

Contribution to species persistence

- Low
- Medium
- High
- Proposed OMR
- Proposed RRL
- Urban Growth Boundary
- Proposed Urban Growth Boundary
- Proposed Precinct Structure Planning Areas
- Ramsar areas
- Proposed Grassland Reserve

Data Sources:
Base Data, Corporate Spatial Data library, Dept. of Sustainability & Environment (DSE); Dept. of Planning & Community Development (DPCD); Dept. of Transport.

Species Data:
Distribution Model, Arthur Rylah Institute, DSE
Persistence Analysis, Biodiversity & Ecosystem Services, DSE

Map Production by:
Biodiversity & Ecosystem Services, DSE

Map Production Date: 5 November 2009

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Victoria The Place To Be

FIGURE 40. SPECTRUM OF CONTRIBUTION TO SPECIES PERSISTENCE FOR SPINY RICE-FLOWER *(Pimelea spinescens ssp. spinescens)* HABITAT

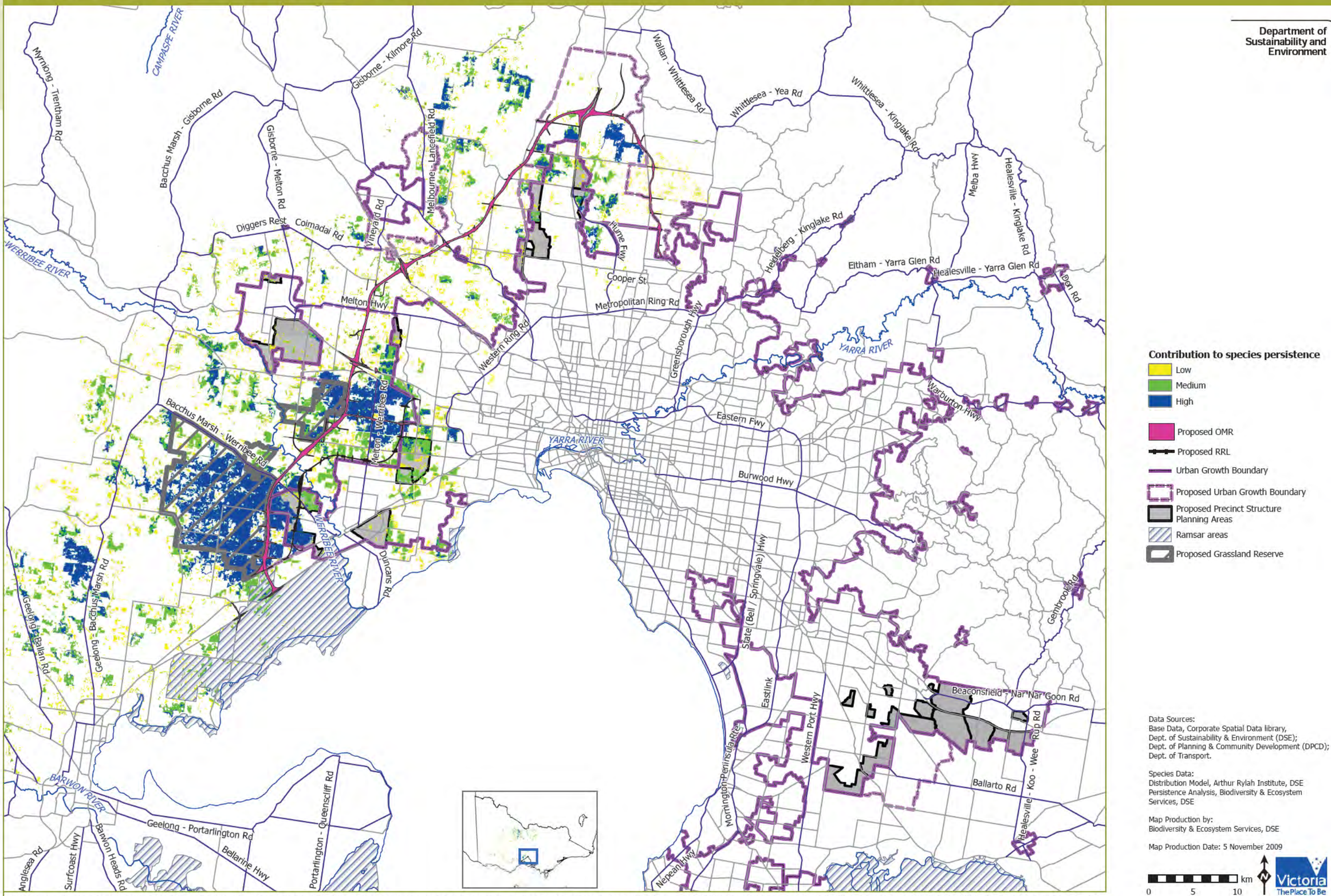

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FIGURE 41. MODELLED HABITAT SUITABILITY FOR SOUTHERN BROWN BANDICOOT *(Isoodon obesulus obesulus)*

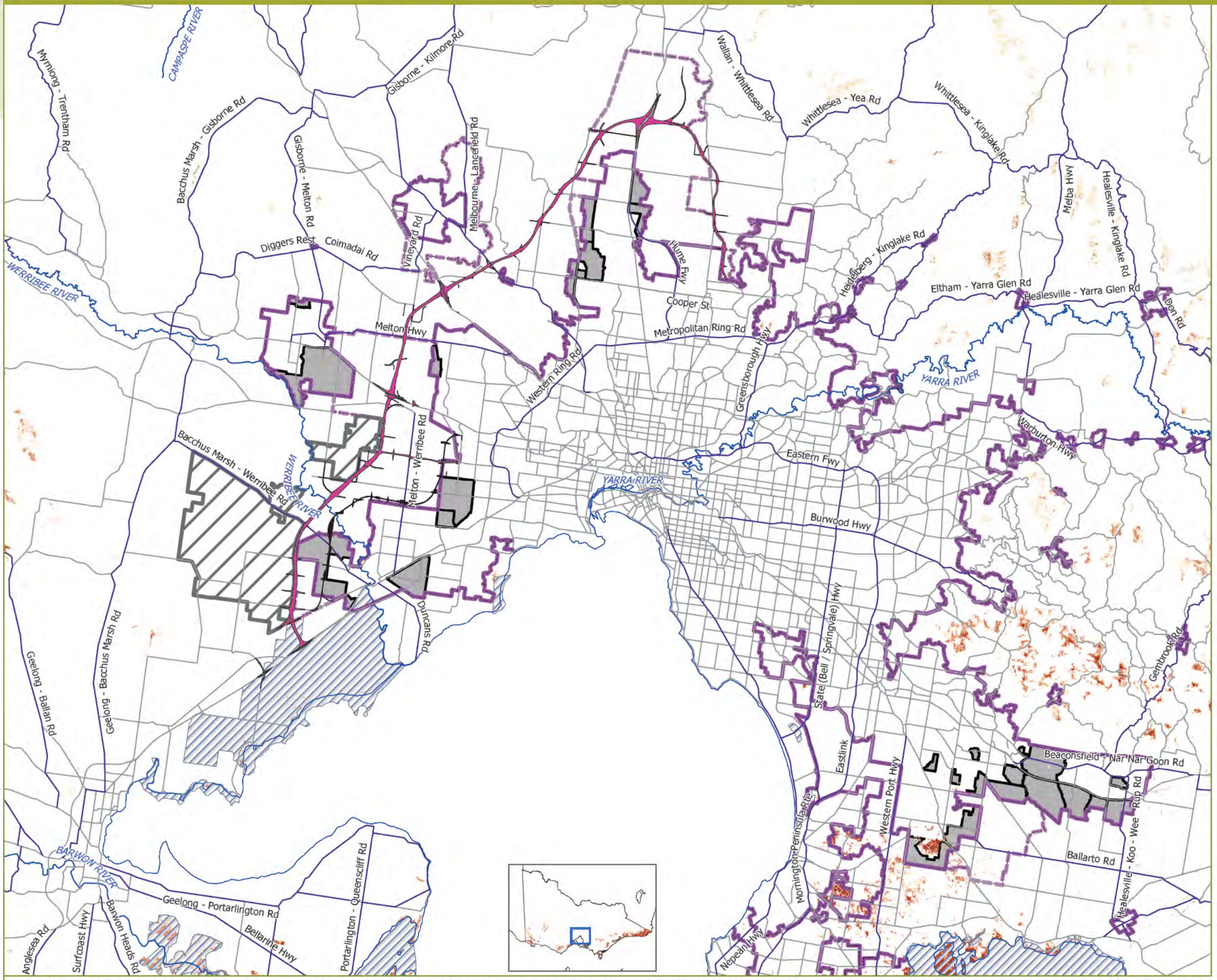
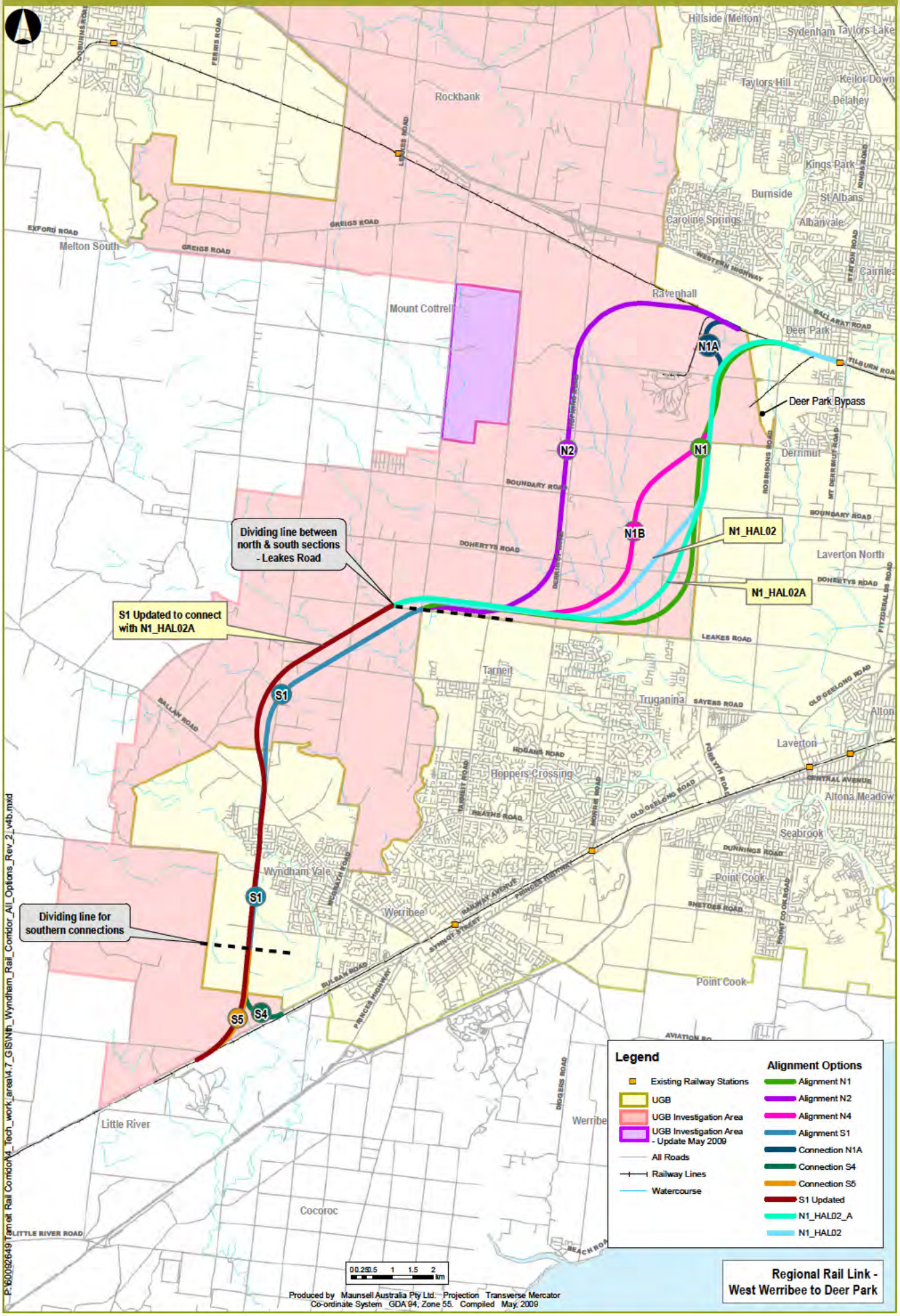


FIGURE 42. ALIGNMENT OPTIONS



7 AUDITING, REPORTING AND REVIEW

Three key components need to be monitored to ensure that the prescriptions in this document and other management measures are being followed and to gather information to assess the achievement of stated outcomes. They are:

- The actual Program and its components and whether any changes become necessary;
- The areas excluded from or retained within the Urban Growth Boundary for conservation purposes; and
- The Precinct Structure Planning process, including Native Vegetation Precinct Plans.

An independent auditor will be appointed to assess how well the *Precinct Structure Planning Guidelines* support the protection of matters of national environmental significance under the EPBC Act. Audit reports will be provided to the State and Commonwealth governments every two years. They will also be used to inform the review of the *Precinct Structure Planning Guidelines* which are scheduled to occur every five years.

Key areas retained for conservation purposes, such as the Merri Creek corridor, Grassy Eucalypt Woodland sites and western grassland reserves will be assessed and monitored according to a standard protocol for native vegetation and threatened species being developed by Department of Sustainability and Environment. This monitoring protocol and methodology will be developed to the satisfaction of the Commonwealth.

Responsibility for undertaking this monitoring will rest with Department of Sustainability and Environment for the grassland reserves and public land. The Growth Areas Authority will ensure that monitoring arrangements for retained areas of private land are clarified as an outcome of the Precinct Structure Planning process.

Audit reports on outcomes of vegetation condition and threatened species monitoring will be provided as part of audit reports to the State and Commonwealth governments every five years.

Management plans to be developed for some species, such as the Growling Grass Frog, will set out the monitoring requirements and reporting arrangements.

As outlined in the 'Project purpose and description' it is intended that the objectives of the Program would be implemented through amendments to the Victoria Planning Provisions and the Planning Schemes relevant to the Program.

Clause 12 of the *Victoria Planning Provisions* will contain the main objectives of the Program, which will be implemented through planning scheme amendments to the relevant planning scheme's municipal strategic framework.

Under the provisions of the P&E Act, planning schemes need to be strategically reviewed regularly: this happens every four to five years, to coincide with the council program. The Minister for Planning oversees the review of planning schemes on this regular basis, which will ensure that the implementation of the Program through municipal strategic statements is monitored and reviewed.

While there is no regular review period imposed on the Victoria Planning Policy, reviews of relevant planning schemes can be used to inform State government policy.

Finally, Victoria will provide an annual report to the Commonwealth on progress of each of the management commitments in Part 3 of the Program report (Section 6.10).

Part 4 of the Program Report sets out the detailed arrangements for monitoring and reporting on all aspects of the Program.

The following section sets out the basic Ideas and proposals In the design of the ecological monitoring and adaptive management regime.

MONITORING, REPORTING AND ADAPTIVE MANAGEMENT

A critical component of the Program will be to track the implementation process and be able to assess and report on the progress and effectiveness of various planning, management and mitigation interventions for achieving required biodiversity outcomes. This will require the design, collection and analysis of baseline and monitoring data that will both be able to quantify progress towards desired outcomes and enable changes in strategy and management over time in response to monitoring data, new information and /or emerging issues.

To achieve this, the Victorian Government will:

1. By 2012, collect relevant species and vegetation data from proposed growth areas to inform sub-regional conservation planning and precinct structure plans that will enable:
   - better assessment of species population viability and habitat quality, and subsequent quantification of the potential impacts of development on species persistence;
   - development of improved methods to mitigate these impacts including improved species offsetting approaches; and
   - design of a satisfactory reserve network within the proposed growth areas (using appropriate software). This will clearly identify areas and their component biodiversity attributes to be retained up to an absolute area limit and will include considerations of functional connectivity to other habitat within and outside the growth areas. It will also identify the required protection and preferred management to achieve desired biodiversity outcomes.

2. By 2012, confirm the presence of EPBC-listed flora and fauna species within various proposed development areas and where applicable arrange for salvaging of individuals or reproductive material for storage, propagation / captive breeding and / or translocation to habitat within in secured reserves in accordance with Commonwealth and Victorian Government-agreed protocols.
3. By 2011, develop a standard monitoring protocol for detecting changes in vegetation and species populations arising from site-based interventions. This protocol will employ quantitative and repeatable measures of the site attributes of interest, ensure that sampling within sites is sufficient to detect changes of interest and ensure adequate plot replication (where relevant) across sites under similar starting conditions and management interventions.
4. Applying the standard protocol, monitor sites subject to management or planning interventions seeking to maintain / improve vegetation quality and species persistence and report to State and Commonwealth Governments on trends over time and the effectiveness of these interventions. This may include monitoring:
   - changes arising from the creation of habitat for species such as Growling Grass Frog;
   - changes from management interventions within existing habitat, such as the Western Grassland Reserve (see below for more detail) and other key areas for retention such as Merri Creek corridor, Clarkes Road Grassland and Truganina Cemetery and any future Grassy Eucalypt Woodland reserves;
   - the effectiveness of management interventions on sites containing populations of key plant species such as Spiny Rice-flower, Matted Flax-lily, Small Golden-moths, Button Wrinklewort and Large-fruit Groundsel.
   - the effectiveness of translocation efforts within reserved areas; and / or
   - the effectiveness of planning overlays and/or compliance activities to reduce the loss and decline of habitat on private and public land outside the formal reserved areas.
5. By 2011, develop a dynamic reserve management planning approach incorporating a spatial decision-support system to inform on-going management within reserved areas that takes account of site characteristics and biodiversity objectives coupled with potential management interventions and their likely impact on all biodiversity in the context of surrounding land use and ecosystem function / dynamics.
6. Applying the principles of adaptive management, periodically incorporate monitoring data (once every three to five years) and new and emerging

science and information into the reserve management planning approach to inform changes to site management within reserved areas. Required changes to management may arise from a combination of monitoring data analysis (i.e. trends in species populations and / or habitat at a site); new or improved understanding of species distribution, habitat requirements and / or behaviour; development of new management techniques; or identification of a new or emerging threat (e.g. establishment of a newly recorded weed species with a high risk of spread or changed land use in the vicinity of a reserve that may affect species movement).

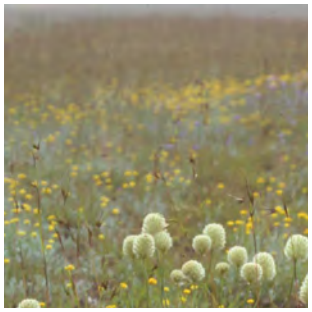
MANAGEMENT OF THE WESTERN GRASSLAND RESERVE – DEVELOPING AND APPLYING A SPATIAL DECISION-SUPPORT TOOL FOR ADAPTIVE MANAGEMENT PURPOSES.

Designing and implementing an adaptive management approach for the Western Grassland Reserves will be critical to achieving desired biodiversity outcomes. While the general principles of grassland management in south eastern Australia are reasonably well understood, there are very few, if any, known examples of incorporating adaptive management principles into practical spatial decision-support systems to inform on-ground management interventions in the context of broader ecosystem function and dynamics.

Designing a spatially and temporally dynamic decision-support system that connects site based decisions to site and broader ecosystem outcomes will be particularly critical for the Western Grassland Reserve which will:

- need to meet a range of biodiversity objectives sometimes requiring management interventions that may be in conflict;
- be progressively established over 10 years and require on-going management thereafter;
- exist in a mixed tenure landscape with a range of current and future land uses that may positively or negatively impact on biodiversity outcomes within the reserve over time;
- need to apply management that responds quickly to new information such as monitoring data, emerging science and models, new and emerging threats, and new and emerging management technologies; and
- need to appropriately incorporate the uncertainties of management interventions on biodiversity objectives into the decision-making process.

8 CONCLUSION



As set out in the Terms of Reference, the EPBC Act permits the Commonwealth Minister for the Environment to approve the taking of actions or classes of actions in accordance with an *endorsed* policy, plan or program (section 146(B)). The effect of such a decision is that the approved actions or class of actions would not need further approval from the Minister under the Act.

When deciding whether to endorse a policy, plan, or program the Minister must be satisfied that the assessment report adequately addresses the impacts to which the agreement relates and that any recommendations to modify the policy, plan or program have been responded to appropriately.

In determining whether or not to endorse the Program, the Minister will have regard to the extent to which the Program meets the objectives of the EPBC Act. In particular, the Minister will seek to be satisfied that it:

- Protects the environment, especially matters of national environmental significance;
- Promotes ecologically sustainable development;
- Promotes the conservation of biodiversity; and
- Provides for the protection and conservation of heritage.

The Department of Sustainability and Environment believes that the Program meets each of these objectives, because the Program and Final Report should:

- Prevent actions that have an impact on matters of national environmental significance from being taken in any location of high biodiversity or heritage value; or where impacts can not be avoided, then the Program will involve impacts that are less than significant;
- Provide for effective management, mitigation or offset of the likely impacts; and
- Contain an effective system of adaptive management that is independently audited and publicly reported.

The Department of Sustainability and Environment does not believe that the Program will impact on heritage matters. Wherever possible the Program has avoided impacts on important biodiversity matters. Where impacts are likely and these are significant at a site (or assumed to be significant) a range of mitigation measures will be undertaken to reduce impacts below a significant level and, in some cases, provide a net positive impact on the species or the asset. Management commitments are clearly spelled out and provide for adaptive management responses. Independent auditing and review is also provided.

The Commonwealth Minister for the Environment will also consider the extent to which the Program and its associated Final Report adequately incorporates:

- The precautionary principle;
- Other principles of ecologically sustainable development;
- Intergenerational equity; and
- Matters the Minister considers to have a high likelihood of being potentially eligible for listing as matters of national environmental significance.

The Department of Sustainability and Environment believes that the Program and its related mitigation measures have taken these principles into account. The measures take a long term view and the precautionary principle is built into the assessment of potential impacts. Where relevant, a worse-case scenario has been considered. Several matters that are not yet listed under the EPBC Act have been included in this assessment.

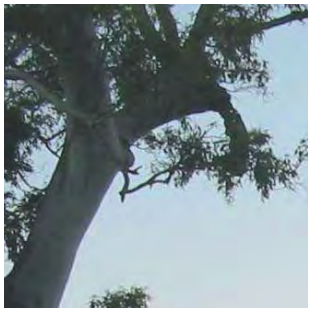
In arriving at a decision to approve an action or a class of actions the Commonwealth Minister for the Environment must act in accordance with his obligations, including giving consideration to:

- Issues relevant to any matter protected by a provision of the Act; and
- Social and economic matters.

REASONABLE ASSURANCE

Victoria has a comprehensive legislative and policy framework to manage land use and environmental impacts within Victoria. Part 2 of the Program Report outlines how the legislative processes, policies and guidance will be used to implement the Program; and how these processes will be used to ensure that actions affecting matters of national environmental significance that result from the Program will be managed through these processes.

9 REFERENCES



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10 APPENDICES

APPENDIX 1:
STRATEGIC IMPACT ASSESSMENT: VEGETATION LOSSES AND GAINS FROM THE PROPOSED PROGRAM AND GAINS GENERATED FROM THE WESTERN GRASSLAND RESERVES

Note: Due to 'rounding', figures that appear in the following tables may differ slightly from those that appear in the text.

OVERALL VEGETATION LOSSES AND GAINS

GAINS FROM PROPOSED GRASSLANDS RESERVES

Vegetation	Area (ha) by Habitat Score			Total Area (ha)	Gain (Habitat Hectares)
	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1		
Grassy Eucalypt Woodland	1	21	19	41	13.3
Natural Temperate Grassland	108	7,375	2,609	10,091	4,145.4
Plains Grassy Wetland	9	132	1	142	58.3
Other native vegetation	2	222	21	245	Not calculated
No native vegetation	0	0	0	3,886	Not calculated
Totals	**120**	**7,750**	**2,650**	**14,405**	**4,217**

*Based on determination of Conservation Significance using Ecological Vegetation Class x Habitat Score only as per Victoria's Native Vegetation Framework (and does not include requirements for threatened species habitat) – see Determining offset requirements for vegetation and threatened species in Section 6.1.4.

LOSSES FROM DEVELOPMENT

Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target
	No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1			
Grassy Eucalypt Woodland		466	242		708	188	300
Natural Temperate Grassland		897	3,696	72	4,665	1,921	3,599
Plains Grassy Wetland		6	69		75	30	58
Other native vegetation		549	489	2	1,040	315	480
No native vegetation	40,167				10,167	0	0
Grand Total	**40,167**	**1,918**	**4,496**	**74**	**46,654**	**2,454**	**4,437**

LOSSES FROM URBAN DEVELOPMENT BY INVESTIGATION AREA

LOSSES WITHIN PROPOSED EXTENSION TO THE URBAN GROWTH BOUNDARY

Investigation Area	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target
		No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1			
Melbourne North (excluding Sunbury)	Grassy Eucalypt Woodland		232	62		294	69	107
	Natural Temperate Grassland		167	145	0	313	108	180
	Plains Grassy Wetland		0	2		2	1	1
	Other native vegetation		21	28		49	16	27
	No native vegetation	8,680				8,680	0	0
Melbourne North (excluding Sunbury) Total		**8,680**	**421**	**237**	**0**	**9,338**	**194**	**315**
Melbourne North (Sunbury)	Grassy Eucalypt Woodland		60	85		144	47	79
	Natural Temperate Grassland		10	19		30	10	17
	Plains Grassy Wetland			1		1	0	1
	Other native vegetation		3	2		5	2	2
	No native vegetation	2,748				2,748	0	0
Melbourne North (Sunbury) Total		**2,748**	**73**	**107**		**2,928**	**59**	**99**
Melbourne South-East	Other native vegetation		214	115		329	91	133
	No native vegetation	3,597				3,597	0	0
Melbourne South-East Total		**3,597**	**214**	**115**		**3,926**	**91**	**133**
Melbourne West	Grassy Eucalypt Woodland		9	1		11	2	3
	Natural Temperate Grassland		430	2,464	41	2,935	1,236	2,344
	Plains Grassy Wetland		0	61		62	26	50
	Other native vegetation		18	34		51	16	25
	No native vegetation	8,539				8539	0	0
Melbourne West Total		**8,539**	**457**	**2,560**	**41**	**11,598**	**1,280**	**2,423**
Grand Total		**23,565**	**1,165**	**3,019**	**41**	**27,790**	**1,624**	**2,969**

LOSSES WITHIN CURRENT URBAN GROWTH BOUNDARY (PROPOSED PRECINCT STRUCTURE PLANNING AREAS)

Investigation Area	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target
		No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1			
Melbourne North	Grassy Eucalypt Woodland		71	50		121	34	53
	Natural Temperate Grassland		2	75	0	77	37	72
	Other native vegetation		37	41		78	25	40
	No native vegetation	1,864				1,864	0	0
Melbourne North Total		**1,864**	**111**	**166**	**0**	**2,140**	**95**	**166**
Melbourne South-East	Other native vegetation		216	203	2	421	132	199
	No native vegetation	6,118				6,118	0	0
Melbourne South-East Total		**6,118**	**216**	**203**	**2**	**6,539**	**132**	**199**
Melbourne West	Grassy Eucalypt Woodland		13	1		14	3	4
	Natural Temperate Grassland		230	461	0	692	253	458
	Plains Grassy Wetland		5	1		5	1	2
	Other native vegetation		35	50		85	26	41
	No native vegetation	6,106				6,106	0	0
Melbourne West Total		**6,106**	**283**	**512**	**0**	**6,902**	**283**	**506**
Grand Total		**14,088**	**610**	**881**	**2**	**15,581**	**510**	**870**

LOSSES WITHIN TRANSPORT CORRIDORS

Footprint	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares	Offset Target
		No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1			
E6	Grassy Eucalypt Woodland		71	11		83	18	28
	Natural Temperate Grassland		1	3		5	2	3
	Other native vegetation		1	1		2	0	1
	No native vegetation	456				456	0	0
E6 Total		**456**	**73**	**16**		**545**	**20**	**32**
OMR	Grassy Eucalypt Woodland		9	33		42	15	26
	Natural Temperate Grassland		35	457	27	520	239	459
	Plains Grassy Wetland		1	3		3	1	3
	Other native vegetation		4	15		19	7	11
	No native vegetation	1,767				1,767	0	0
OMR Total		**1,767**	**49**	**508**	**27**	**2,351**	**262**	**498**
RRL	Natural Temperate Grassland		20	71	4	95	37	65
	Plains Grassy Wetland			1		1	0	1
	Other native vegetation			0		0	0	0
	No native vegetation	281				281	0	0
RRL Total		**281**	**20**	**72**	**4**	**377**	**38**	**67**
Grand Total		**2,504**	**143**	**596**	**31**	**3,273**	**320**	**597**

OMR – Outer Metropolitan Ring Transport Corridor
RRL – Regional Rail Link

VEGETATION RETAINED WITHIN NEW URBAN GROWTH BOUNDARY (EXCLUDED FROM URBAN DEVELOPMENT)

Note. These figures exclude any vegetation likely to be removed within existing quarries.

OVERALL VEGETATION

Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares
	No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1		
Grassy Eucalypt Woodland		527	316	1	843	232
Natural Temperate Grassland		306	2,211	158	2,674	1,237
Plains Grassy Wetland		0	16		16	7
Other native vegetation		221	500	19	740	274
No native vegetation	9,916				9,916	0
Grand Total	**9,916**	**1,054**	**3,042**	**177**	**14,190**	**1,750**

VEGETATION BY INVESTIGATION AREA AND CONSTRAINT TYPE

Notes: Type denotes proposed zoning of land as described in the Program Report.
Farming Zone in this case includes quarry buffers, utility easements and other areas of constrained land with few biodiversity values
Rural Conservation Zone = private land protected due to its biodiversity (or other) values. All land denoted RCZ will also have an Environmental Significance Overlay applied.
Public Conservation Resource Zone = secure conservation reserves
Public Use Zone 7 = proposed parkland (conservation and recreation)
Other parks = open space not necessarily with or for biodiversity conservation (e.g. sports fields).

Investigation Area	Type	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares
			No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1		
Melbourne North (excluding Sunbury)	Farming Zone	Grassy Eucalypt Woodland		112	77		189	56
		Natural Temperate Grassland		17	110	0	128	49
		Plains Grassy Wetland		0	5		5	2
		Other native vegetation		2	21	0	23	10
		No native vegetation	1,683				1,683	0
	Existing Quarry	Grassy Eucalypt Woodland		32	27		59	16
		Natural Temperate Grassland		18	40		59	20
		Other native vegetation		1	11	2	14	7
		No native vegetation	571				571	0
	Rural Conservation Zone	Grassy Eucalypt Woodland		305	139	1	444	115
		Natural Temperate Grassland		152	203	1	357	116
		Plains Grassy Wetland			0		0	0
		Other native vegetation		10	55	0	65	28
		No native vegetation	2,119				2,119	0
	Public Conservation Resource Zone	Grassy Eucalypt Woodland		1	4		6	2
		Natural Temperate Grassland		0	165	2	168	88
		Other native vegetation		1	57	11	69	37
		No native vegetation	125				125	0
	Urban Floodway Zone	Grassy Eucalypt Woodland		1	1		2	1
		Natural Temperate Grassland			0		0	0
		Other native vegetation		3	15	0	17	7
		No native vegetation	390				390	0
	Other parks	Grassy Eucalypt Woodland		1	1		2	1
		Other native vegetation			1		1	0
		No native vegetation	19				19	0
Melbourne North (excluding Sunbury) Total			**4,906**	**655**	**933**	**19**	**6,513**	**555**

Investigation Area	Type	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares
			No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1		
Melbourne North (Sunbury)	Farming Zone	Grassy Eucalypt Woodland		2	1		3	1
		Natural Temperate Grassland			1		1	0
		No native vegetation	150				150	0
	Existing Quarry	Grassy Eucalypt Woodland		3	7		10	3
		Other native vegetation		1	9		10	4
		No native vegetation	243				243	0
	Rural Conservation Zone	Grassy Eucalypt Woodland		67	53		121	35
		Natural Temperate Grassland		0	4		4	1
		Other native vegetation		18	36		54	18
		No native vegetation	1,007				1,007	0
	Public Conservation Resource Zone	Grassy Eucalypt Woodland		1	2		3	1
		Natural Temperate Grassland		0	0		1	0
		Other native vegetation		3	16		19	7
		No native vegetation	74				74	0
	Urban Floodway Zone	Grassy Eucalypt Woodland		1	2		3	1
		Natural Temperate Grassland		0	1		2	1
		Other native vegetation		1	1		1	0
	Other parks	No native vegetation	72				72	0
		No native vegetation	9				9	0
Melbourne North (Sunbury) Total			**1,556**	**97**	**133**		**1,786**	**72**
Melbourne South-East	Farming Zone	Other native vegetation		29	147		176	65
		No native vegetation	406				406	0
	Quarry	Other native vegetation		2	41		43	17
		No native vegetation	61				61	0
	Rural Conservation Zone	Other native vegetation		17	7		24	6
		No native vegetation	17				17	0
	Public Conservation Resource Zone	Other native vegetation		0	2		2	1
		No native vegetation	0				0	0
	Urban Floodway Zone	Other native vegetation		78	11		89	24
		No native vegetation	175				175	0
	Other parks	Other native vegetation			0		0	0
		No native vegetation	17				17	0
Melbourne South-East Total			**675**	**126**	**208**		**1,009**	**112**

Investigation Area	Type	Vegetation	Area (ha) by Habitat Score				Total Area (ha)	Habitat Hectares
			No Native Vegetation 0	Low 0.01 - 0.30	Medium 0.31 - 0.60	High 0.61 - 1		
Melbourne West	Farming Zone	Grassy Eucalypt Woodland		0			0	0
		Natural Temperate Grassland		57	284	30	371	159
		Other native vegetation		2			2	0
		No native vegetation	625				625	0
	Existing Quarry	Natural Temperate Grassland		3	714	6	724	406
		Plains Grassy Wetland			4		4	2
		No native vegetation	548				548	0
	Rural Conservation Zone	Grassy Eucalypt Woodland		0	0		0	0
		Natural Temperate Grassland		32	555	56	642	291
		Plains Grassy Wetland			4		4	2
		Other native vegetation		52	67	4	124	42
		No native vegetation	920				920	0
	Urban Floodway Zone	Grassy Eucalypt Woodland		1			1	0
		Natural Temperate Grassland		22	96		118	46
		Plains Grassy Wetland		0	4		4	1
		Other native vegetation		1	3	0	4	1
		No native vegetation	632				632	0
	Other parks	Natural Temperate Grassland		3	1		5	1
		Other native vegetation		2	1		3	1
		No native vegetation	28				28	0
	Public Use Zone 7	Natural Temperate Grassland		0	33	62	95	57
		No native vegetation	21				21	0
Melbourne West Total			**2,775**	**176**	**1,766**	**158**	**4,874**	**1,010**
Grand Total			**9,911**	**1,054**	**3,040**	**177**	**14,182**	**1,749**

APPENDIX 2:
SPECIES DISTRIBUTION MODELLING: OVERVIEW OF METHODOLOGY AND ASSUMPTIONS

INTRODUCTION

Species distribution modelling (SDM) has become a fundamental tool for ecological and biogeographical research and an increasingly important tool for biodiversity management and conservation. Species distribution models are used to predict the geographic range of a species from occurrence (presence; or presence/absence) records for particular taxa (dependent variable) and relevant environmental data (independent variables) recorded from the same sites. Two types of model output are common: binary results where sites are classified as either part of the distribution of the species or outside their distribution; and continuous results where sites are given a 'probability' of being part of a species' distribution. Species distribution modelling is essentially a binary classification problem with two training classes, presence and absence.

The species modelling framework that has been adopted by Department of Sustainability and Environment is the consequence of extensive trialling and evaluation of many current SDM modelling methods/algorithms, training data selection methods and pseudo-absence generation, selection and allocation methods.

METHODS

EXEMPLARS – TEST AND TRAINING DATA

Two species modelling processes were developed – one to train models with reliable presence and absence data and another to train models for which there is only reliable presence data. The former was used to build models from vetted data from the Victorian Flora Information System – a database of largely vascular plant records and the latter process was employed to build models from vetted data extracted from the Victorian Wildlife Atlas – a database of vertebrate animal records. Where there are sufficient records of a species models are routinely built with a training dataset of 70 per cent of both presence and absence (or pseudo-absences – see below) records and the remaining data is used to test model accuracy.

PLANT SPECIES

Real data – both presence and absence – were used to build vascular plant SDMs. Plant species distribution data were extracted from the Victorian Department of Sustainability and Environment's vegetation and plant species database – the Flora Information System (FIS). The FIS is a large repository of both:

1. Vegetation sample plots or quadrats that have been collected from across the Australian State of Victoria – an area of approximately 22 million hectares. These samples have been collected by some 100's of botanically competent field workers over the last 30 years in both a systematic and ad-hoc fashion. "Homogeneous" areas of vegetation were sampled employing a range of

quadrat sizes depending on the plant community being sampled. Quadrat sizes varied in accordance with the concept of minimal area. Generally quadrats in grassland and shrublands are 100m^2 in size and quadrats in mallee, forest and woodland are typically 900m^2 in size. All vascular plants growing in or extending over the sample space were recorded as present. Species absence from the quadrat site may be inferred for prominent perennial plant species, from their lack of detection; and

2. Additional 'incidental' observations of plant species with or without a voucher lodged at the National Herbarium of Victoria.

The following modelling protocols have been adopted for all vascular plants following a detailed investigation of the response of model accuracy to prevalence (the ratio of presence records to absence records):

> If the number of presence records for a particular species is >10 but <=100 the number of absence records randomly selected was five times the number presence records.

> If the number of presence records for a particular species is >100 but <=200 the number of absence records randomly selected was four times the number presence records.

> If the number of presence records for a particular species is >200 but <=500 the number of absence records randomly selected was three times the number presence records.

> If the number of presence records for a particular species is >500 but <=1000 the number of absence records randomly selected was two times the number presence records.

> If the number of presence records for a particular species is >1000 the number of absence records randomly selected was equal to the number presence records.

Two plant species listed under the EPBC Act were selected for analysis.

1. Matted Flax-lily *Dianella amoena*
2. Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*

FAUNA SPECIES

Real and pseudo-absence data were used to build fauna SDMs. Animal distribution data were extracted from the Victorian Department of Sustainability and Environment's fauna species database – the Victorian Fauna Display (VFD). The VFD is a large repository of site records for fauna species. Records have been collected from across

the Australian State of Victoria and in some cases adjacent areas of neighbouring states. These samples have been collected by some 1000's of scientists and naturalists over many years using a range of survey techniques although most contributions used for modelling are from the last 50 years.

Training fauna SDMs using site observations is different to modelling vascular plant data using site inventories as a consequence of universal but species specific detection uncertainties for most if not all animals (vertebrates and invertebrates). As such constructing binary models for fauna species rather than distance measures for presence only models for fauna involved the derivation of 'pseudo-absence' records. Exhaustive testing was carried out on representative animal taxa to establish robust techniques for allocating pseudo-absences across the State. A one-class Mahalanobis distance method (MD) was used to exclude the allocation of pseudo-absences from sites environmentally similar to the presence sites. Outside this MDS defined envelope (thresholded to contain 90 per cent of presence sites), 50 per cent of the pseudo-absences were randomly allocated to urban areas and 50 per cent of pseudo-absences were randomly allocated to the remainder of the State of Victoria. The following modelling protocols have been adopted for all vertebrates following a detailed investigation of the response of model accuracy to prevalence (the ratio of presence records to pseudo-absences):

- If the number of presence records for a particular species is >20 but <=100, the number of random pseudo-absence records generated was 3 times the number presence records.
- If the number of presence records for a particular species is >100, the number of random pseudo-absence records generated was 5 times the number presence records.

SITE DATA VETTING AND ENVIRONMENTAL VARIABLES USED

All data used for modelling is from a single extraction of point data from the VFD and the Victorian FIS from early 2009. The geographic co-ordinates of all sites used in the modelling is known with some certainty (reported spatial error is +/- 100 m) and as such, many environmental (climatic, radiometric, topographic) and spectral variables from the same locations have been extracted from a 'stack' of data themes stored in a Geographic Information System (see Appendix 1). Principal Components Analysis was used to transform the number of correlated variables into a smaller number of uncorrelated variables called principal components. Six Principal Components were extracted from the combined climate, radiometric and terrain variables and a further four Principal Components were extracted from the combined vegetation models and satellite imagery.

Five animal species listed under the EPBC Act were selected for analysis.

1. Growling Grass Frog *Litoria raniformis*
2. Plains-wanderer *Pedionomus torquatus*
3. Southern Brown Bandicoot *Isoodon obesulus obesulus*
4. Striped Legless *Lizard Delmar impar*
5. Golden Sun-moth *Synemon plana*

MODELLING

The MD method (Clark et al. 1993) was used to assist in the allocation of pseudo-absences for the fauna models. MD uses an algorithm to define the ecological niche of a species on the basis of site records and coincident ancillary environmental data. MD ranks all potential sites (characterised by the same environmental variables) by their Mahalanobis distance from a vector that is the expression of the mean environmental conditions at the sites where the species was recorded (Tsoar et al. 2007). It is a particularly useful method to quantitatively determine the difference between sites with known attributes and sites with unknown attributes using covariate data. It is a widely employed statistical tool in ecology and remote sensing, particularly for classification, similarity analyses and species modelling particularly where presence only data is available (Townsend Peterson et al. 2003). The usefulness of modelling of this nature is related to the degree to which sample records (from herbaria, museums and other curated Government datasets) reflect the environmental 'preferences' of the species concerned. MD establishes a signature state by interrogating the environmental values (predictor variables) at the location of each site record. Mahalanobis distances were based on the mean and variance of these predictor variables and the covariant mix of all the variables and therefore take advantage of the covariance among variables. The region of constant Mahalanobis distance around the mean forms a hyper-ellipsoid in a multi-dimensional space commensurate with the number of predictor variables. Mahalanobis distance is calculated as:

$$D2 = (x-m)TC-1(x-m)$$

Where:

D2 = Mahalanobis distance
x = vector of data
m = vector of the mean values of independent (or predictor) variables
C-1 = the inverse covariance matrix of independent variables
T = transposition of the vector

Random Forest (RF) was used to create SDMs. RF is a new ensemble technique in data mining. It was designed to produce accurate predictions while limiting overfitting of the data (Breiman 2001). In RF, bootstrap samples are drawn to construct multiple trees, each tree is grown with a randomized subset of predictors, a large number of

trees (500 to 2000) are grown, the trees are grown to maximum size without pruning, and aggregation is produced by averaging the trees (Prasad, Iverson & Liaw 2006). The R Package randomForest (version 4.5–22) was used to build the model in this study, which was developed by Andy Liaw and Matthew Wiener, based on original Fortran code written by Leo Breiman and Adele Cutler. Exploratory analysis shows that the default values for the parameters worked well for our problems. That is, 500 trees were grown in each forest (i.e. model) and 3 (the closest integer to the square root of 10 – the number of independent variables used) environmental variables were randomly chosen at each node to split. But we used different weights for the two classes — n_1 for absence and n_0 for presence — to make the total weight balanced for the two classes, where n_0 and n_1 are the number of training sites for the two classes: absence and presence, although exploratory analysis shows that this parameter does not matter much.

When the best SDM is applied to the stack of the relevant environmental variables the result is a map or surface that reflects the probability that a given pixel is part of the respective species' distribution. Models were thresholded to produce a binary view such that at least 95 per cent of the presence records were included within the resulting environmental envelope. While the resultant maps are useful great care must be taken when using these maps for planning purposes. Models reflect – often in perverse ways – the vagaries and biases in the input or site data. By and large these data are dated, spatially crude and highly biased.

POST PROCESSING

As the models are a general view of habitat suitability on a pixel by pixel basis, one cannot interpret the results in terms of species persistence. This requires detailed knowledge of a range of species specific parameter distributions – for example carrying capacity of sites, dispersal capacity, fecundity, susceptibility to (genetic, epidemiological, natural) catastrophes and the interplay of these.

In the absence of these data the Department of Sustainability and Environment has taken several of the EPBC listed species:

- Growling Grass Frog *Litoria raniformis*
- Plains-wanderer *Pedionomus torquatus*
- Southern Brown Bandicoot *Isoodon obesulus obesulus*
- Striped Legless *Lizard Delmar* impar
- Golden Sun-moth *Synemon plana*
- Matted Flax-lily *Dianella amoena*
- Spiny Rice-flower *Pimelea spinescens* subsp. *spinescens*

and has sought to further process the models to further (albeit) discriminate sites in terms of their temporal and spatial context.

INDIVIDUAL SPECIES ASSUMPTIONS

This section briefly summarises the known or estimated parameters relevant to spatial and temporal population dynamics for each of the seven species selected.

STRIPED LEGLESS LIZARD *Delmar impar*

The habitat for this species is primarily grasslands and open woodlands – it shelters in tussocks, under rocks, soil cracks and in the burrows of other small animals (Smith & Roberson 1999).

Home range requirements of Striped Legless Lizard: conservatively 0.5ha per animal (Smith and Robertson 1999) based on movement estimates determined by Kutt (1993) (overlap of home range between sexes not described).

Dispersal: Reluctant to cross open areas without grass tussock cover (Dorrough 1995). Assume sealed road is a more or less absolute barrier to Striped Legless Lizard dispersal in the medium term. Obviously water and urban fabric is a barrier. Have also assumed that regions excluded from the thresholded model are unsuitable for dispersal.

PLAINS-WANDERER *Pedionomus torquatus*

The habitat for Plains-wanderer is primarily grasslands sparse, lowland native grasslands from which they obtain all of their annual life cycle needs from (Baker-Gabb 1988). Plains-wanderer has been rarely seen in the Melbourne region in recent decades. However, it is widely accepted that grassland habitat for Plains-wanderer can be maintained and in many cases improved with site management – usually via stock exclusion in drought and strict grazing control in wet years to maintain suitable grassland structure (NSW NPWS 2002).

Range of population densities encountered approximately 18ha shared per pair (Baker-Gabb *et al.* 1990).

Birds are rarely found within 200m of woodland or tree areas – presumably due to predation (NSW NPWS 2002).

Birds can fly long distances – but this is rarely recorded – tends to be sedentary. As such, connectivity does not equate to physical contiguity of habitat except for areas less than 20ha (notional minimal breeding habitat area). Small areas of habitat proximal to larger regions may be useful as temporary foraging or resting areas.

Foxes are an important and effective predator in more productive areas (Baker-Gabb 1995). Fox predation as a threat is diminished in core Plains-wanderer habitat – extensive

and 'droughty' clay plains without surface water and of limited suitability to rabbits and other rodents. Elevated fox predation is expected to extend twokilometres from edge of Urban and Irrigated areas.

GOLDEN SUN MOTH *Synemon plana*

Generally lowland grasslands and open woodlands exceedingly widespread but rarely observed or more accurately limited reliable records. Historically, the distribution of the Golden Sun Moth corresponded with native temperate grasslands and woodlands across South-eastern Australia. Feeds on *Austrodanthonia* spp and possibly other grass taxa. See also Braby & Dunford 2006; Gilmore et al. 2008.

Home range requirements: Unknown – many thousands of individuals can be supported in very small areas. One population estimate of 10,000 individuals was made at a site of 400m^2 area (DEC 2007). Department of the Environment, Water, Heritage and the Arts (2009) suggests habitat areas less than 0.25ha are "unlikely to contribute to the ecological health of the species" – this was the threshold used to exclude small areas from the model.

Dispersal: Males can fly and winds will disperse some males. Females sedentary and virtually flightless. As a consequence – despite the gift of flight – Golden Sun Moth is a very poor disperser to new or unoccupied disjunct habitat. Prior to settlement temperate woodlands were more or less continuous across South Eastern Australia on plains and foothills and this may explain why long distance dispersal was not really an acute selection pressure on this species. Areas surrounded by barriers of up to 200m are effectively isolated (Clarke & O'Dwyer 2000).

SOUTHERN BROWN BANDICOOT *Isoodon obesulus obesulus*

Range of lowland moist temperate habitats with high veg cover at or near the ground.

Home range area is highly variable 0.5–9ha per individual recorded in a range of studies in varying habitats (DEC 2006). We have adopted a home range area per individual of 0.5 hectare and have therefore assumed optimal habitat is universal.

Dispersal: No absolute barriers. Succumbs to predation in open country – mainly foxes, but also cats and domestic animals. Dispersal through suburbs is **highly unlikely** and dispersal through rural residential is considered *unlikely*. In the absence of human assisted dispersal, good dispersal habitat (which is rare and discontinuous in the Melbourne area) is as least as important as remaining prime habitat areas in the medium to long term for this species' local persistence.

SPINY RICE-FLOWER *Pimelea spinescens* subsp. *spinescens*

Lowland grassland plant species, specialising in low rainfall regions. Most remaining populations are to be found on roadsides, cemeteries and rail reserves. Several populations on freehold are known in the study area and additional populations will be located as urban expansion brings more surveys to freehold grasslands.

Unknown to what extent inbreeding depression and population dynamics is particularly important consideration in the medium term for the conservation of long-lived plant species such as *Pimelea spinescens*. It is more likely that site management or the absence of useful commensal organisms are more critical immediate concerns. Most populations will benefit from improved site security and site management.

Dispersal: Dispersal is by passive fall and pollination is effected by insects. As a consequence this species may maintain genetic contact sufficient to genetically enrich small isolated populations but is unlikely to spread readily across unsuitable habitat types such as roads and urban areas. Such areas represent real barriers to dispersal. Frequent burning provides recruitment opportunities for the Spiny Rice-flower. This species probably germinates in autumn or spring. Plants also re-sprout after fire. The species has been observed to regenerate from seed readily following appropriate fire events, even in severe drought. The species is thought to be extirpated by cropping, herbicide application (boom spraying) and intensive grazing but persist in relatively weed infested areas provided inter tussock space is maintained.

As such, the key to selecting the best places for reservation for this species is a detailed knowledge of the occurrence of the species. While many populations are known, no systematic survey of the species has been conducted across its range or in the Melbourne area. As the species continues to be recorded in grasslands subject to planning permit applications in the Melbourne area it may be reasonable to suppose populations additional to those that are known may yet be found. The model identifies areas suitable for Pimelea spinescens on the basis of climate, soils, terrain and satellite imagery. It cannot identify regions that have been subjected to once off cropping, boom spraying of herbicide or severe grazing. These are some of the caveats on the interpretation of the modelling. Given that we do not know the intimate details on land use (so important to plant conservation) if we assume all parcels with “habitat” to have at least a small population – persistence is simply improved with area retained and controlled.

MATTED FLAX-LILY *Dianella amoena*

Widespread lowland species typically found in woodlands and open forests on a range of substrates.

Dispersal: Dispersal is largely carried out by frugiverous birds (possibly some reptile dispersal) and pollination is largely effected by native bees. Whether fruit is regularly taken and effectively dispersed by birds in peri-urban areas is not known. As seed is bird dispersed we can assume some connectivity over non-habitat. Therefore we have selected an arbitrary figure of 200m (a distance within which a large proportion of seed is voided by birds) and have removed all areas that are not connected to 'habitat regions' of more than 1,000ha.

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APPENDIX 3: MAPPING THE SPECTRUM OF CONTRIBUTION TO SPECIES PERSISTENCE FOR GOLDEN SUN MOTH *Synemon plana* AS PART OF THE STRATEGIC IMPACT ASSESSMENT REPORT FOR MELBOURNE'S FUTURE GROWTH.

Biodiversity and Ecosystem Services Division, Department of Sustainability and Environment.

SPECIES DISTRIBUTION MODELLING: OVERVIEW OF METHODOLOGY

SALIENT INFORMATION FOR SPATIAL TEMPORAL DYNAMICS

Climatic range is restricted to South East Australia. Generally found in native grasslands and open wood-lands, particularly corresponding to *Austrodanthonia* spp. With soils ranging from sandy loams and clays with a pH between 5.3 and 7 (O'Dwyer and Attiwill 1998).

Home range requirements are unknown as thousands of individuals may be supported in very small areas (i.e. observed 10000 individuals in 400m^2). DEWHA (2009) suggests that habitat <0.25ha "unlikely to contribute to the ecological health of the species" (White, 2009).

Synemon plana life cycle is poorly known. Adults live 1–4 days and do not feed. Females are largely stationary, and males will not fly >100m from areas of suitable habitat. Therefore habitat separated by distances >200m is assumed distinct. Genetic distance strongly correlates to geographic distance, and may be a measure of habitat fragmentation (Clarke and O'Dwyer 2000).

In terms of habitat maintenance and subsequent contribution to species persistence, it was considered that management of native vegetation is more likely to contribute to longer-term habitat maintenance and improvement than management of non-native vegetation habitat (i.e. habitat consisting mostly of weeds) where the management outcomes are less certain and the risks of unregulated "habitat loss" greater. Habitat dominated by weeds also poses some conflicts under legislation where land owners may be required to control or remove 'listed noxious weeds' that may otherwise provide habitat for Golden Sun Moth. As such, a minimum site condition score (sensu. Parkes et al. 2003, DSE 2004) was used to threshold sites of poor condition but dominated by native grass cover from sites dominated by introduced weeds.

SOURCE DATA

- Modelled habitat probability from Department of Sustainability and Environment Arthur Rylah Institute (White 2009)
- Department of Sustainability and Environment Native Vegetation Extent 2005
- Department of Sustainability and Environment Native Vegetation Modelled Site Condition 2005
- VicMap Roads dataset
- VicMap urban extents dataset

LINEAGE

1. Thresholded the habitat probability model to 0.35 to create a statewide binary model that contains 95 per cent of the recorded samples of *Synemon plana.*
2. Removed all habitat from the model with <0.25ha contiguous area.
3. Removed all areas from the map intersecting with urban areas and roads.
4. Grouped habitat into distinct regions. Regions are considered the same if there is <200m between potential habitat areas.
5. Ranked habitat pixels (25 x 25m) into classes based on whether the pixel is within a region (as defined in [4]) that contains the following hectares of potential habitat:

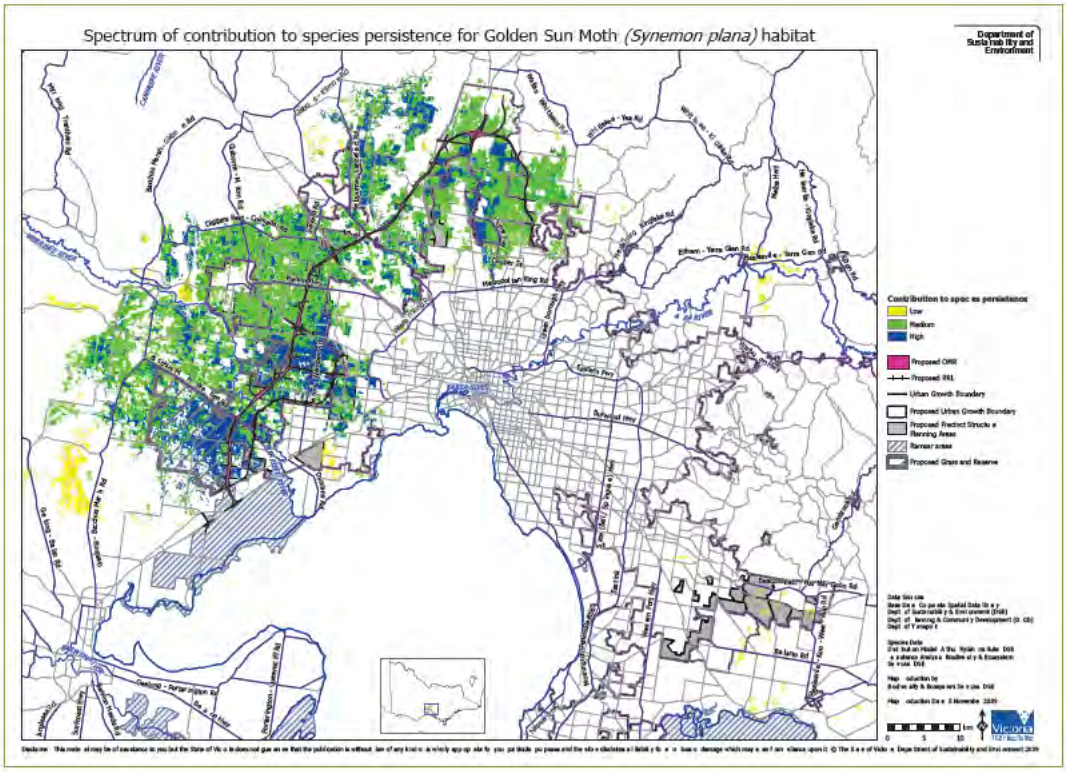
Area (ha) of potential habitat	Ranking
>100,000	4
10,000 – 100,000	3
1,000 – 10,000	2
100 – 1,000	1
<100	0

6. Compared this ranked habitat to the native vegetation extent and modelled site condition where the modelled site condition is ≥0.2. The model was divided into three classes of "contribution to species persistence" shown in the following table:

Habitat within native vegetation with modelled site condition ≥0.2?	No	Yes
Habitat Region Ranking		
4	Medium	High
3	Medium	High
2	Low	Low
1	Low	Low
0	Does not contribute to species persistence	

OUTPUT MAP

The map of the modelled habitat of *Synemon plana* in the Melbourne region of Victoria divided into three classes of "contribution to species persistence": Low; Medium; and High.



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APPENDIX 4:
MAPPING THE SPECTRUM OF CONTRIBUTION TO SPECIES PERSISTENCE FOR MATTED FLAX-LILY *Dianella amoena* AS PART OF THE STRATEGIC IMPACT ASSESSMENT REPORT FOR MELBOURNE'S FUTURE GROWTH.

Biodiversity and Ecosystem Services Division, Department of Sustainability and Environment

SPECIES DISTRIBUTION MODELLING: OVERVIEW OF METHODOLOGY

Refer to Appendix 1 – Delivering Melbourne's Newest Sustainable Communities – Strategic Impact Assessment Report for EPBC Act 1999. The State of Victoria, DSE, East Melbourne 2009.

SALIENT INFORMATION FOR SPATIAL TEMPORAL DYNAMICS

Widespread lowland species typically found in woodlands and open forests on a range of substrates.

DISPERSAL

Dispersal is largely carried out by frugiverous birds (possibly some reptile dispersal) and pollination is largely effected by native bees. Whether fruit is regularly taken and effectively dispersed by birds in peri-urban areas is not known.

As seed is bird dispersed we can assume some connectivity over non-habitat. Therefore we have selected an arbitrary figure of 200m (a distance within which a large proportion of seed is likely voided by birds) and have removed all areas that are not connected to 'habitat regions' of more than 1,000ha.

In terms of habitat maintenance and subsequent contribution to species persistence, it was considered that management of higher quality native vegetation is more likely to contribute to longer-term habitat maintenance and improvement than management of lower quality vegetation or areas dominated by weeds where the management outcomes are less certain and the risks of unregulated "habitat loss" greater. Habitat dominated by weeds also poses some conflicts under legislation where land owners may be required to control or remove 'listed noxious weeds' that may otherwise provide habitat for Matted Flax-lily. As such, areas of habitat were further ranked according to their modelled site condition score (sensu. Parkes et al. 2003, DSE 2004).

SOURCE DATA

Modelled habitat probability from Department of Sustainability and Environment Arthur Rylah Institute (White 2009)

- Department of Sustainability and Environment Native Vegetation Extent 2005
- Department of Sustainability and Environment Native Vegetation Modelled Site Condition 2005
- VicMap Roads dataset
- VicMap urban extents dataset

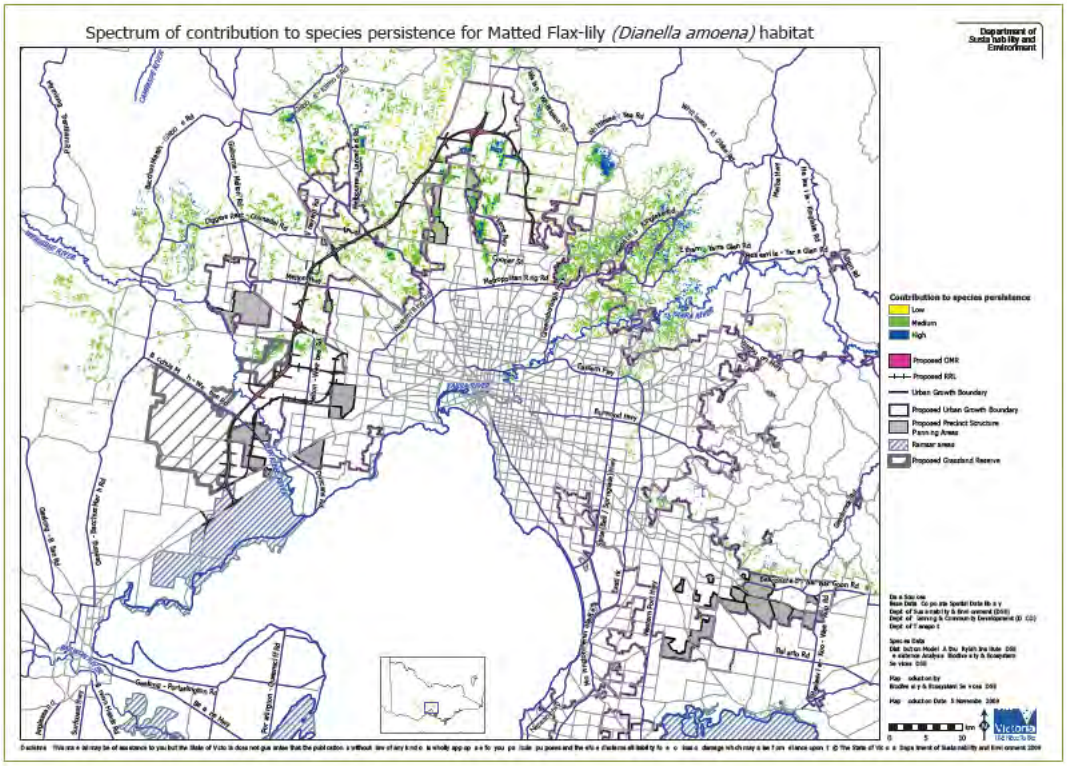
LINEAGE

1. Threshold the habitat probability model to 0.38 to create a binary model that contains 95 per cent of the recorded samples of *Dianella amoena*.
2. All habitat less than 200m apart considered contiguous.
3. Identify contiguous habitat of 1,000ha or more.
4. Removed all areas less than one hectare in size outside 1,000ha contiguous habitat areas identified in "3" above.
5. For the all remaining habitat, assign the following ranking based on modelled native vegetation site condition:

Modelled Site Condition	Contribution to species persistence class
≥0.4	High
0.20-0.39	Medium
<0.20	Low

OUTPUT MAP

A map of the modelled habitat of *Dianella amoena* in the Melbourne region of Victoria. The map is divided into three classes of "contribution to species persistence": Low; Medium; and High.



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APPENDIX 5:
MAPPING THE SPECTRUM OF CONTRIBUTION TO SPECIES PERSISTENCE FOR SPINY RICE-FLOWER *Pimelea spinescens* ssp. *spinescens* AS PART OF THE STRATEGIC IMPACT ASSESSMENT REPORT FOR MELBOURNE'S FUTURE GROWTH.

Biodiversity and Ecosystem Services Division, Department of Sustainability and Environment

SPECIES DISTRIBUTION MODELLING: OVERVIEW OF METHODOLOGY

Refer to Appendix 1 – Delivering Melbourne's Newest Sustainable Communities – Strategic Impact Assessment Report for EPBC Act 1999. The State of Victoria, Department of Sustainability and Environment, East Melbourne 2009.

SALIENT INFORMATION FOR SPATIAL TEMPORAL DYNAMICS

Lowland grassland plant species, specialising in low rainfall regions. Most remaining populations are to be found on roadsides, cemeteries and rail reserves. Several populations on freehold are known from the study area and additional populations will be located as urban expansion brings more surveys to free-hold grasslands.

Not sure that inbreeding depression and population dynamics is particularly important consideration in the medium term for the conservation of long-lived plant species such as *Pimelea spinescens*. It is more likely that site management or the absence of useful commensal organisms are more critical immediate concerns. Most populations will benefit from improved site security and site management.

DISPERSAL

Dispersal is by passive fall and pollination is effected by insects. As a consequence this species may maintain genetic contact sufficient to genetically enrich small isolated populations but is unlikely to spread readily across unsuitable habitat types such as roads and urban areas. Such areas represent real barriers to dispersal. Frequent burning provides recruitment opportunities for the Spiny Rice-flower. This species probably germinates in autumn or spring. Plants also re-sprout after fire. The species has been observed to regenerate from seed readily following appropriate fire events, even in severe drought. The species is thought to be destroyed by cropping, herbicide application (boom spraying) and intensive grazing but it may persist in relatively weed infested areas provided inter tussock space is maintained.

As such, the key to selecting the best places for reservation for this species is a detailed knowledge of the occurrence of the species. While many populations are known no systematic survey of the species has been conducted across its range or in the Melbourne area. As the species is often recorded in grasslands subject to approval for destruction in the Melbourne area it may be reasonable to suppose populations additional to those that are known may yet be found. The model identifies areas suitable for Pimelea spinescens on the basis of climate, soils, terrain and satellite imagery. It

cannot identify regions that have been subjected to once off cropping, boom spraying of herbicide or severe grazing. These are some of the caveats on the interpretation of the modelling. Given that we do not know the intimate details on land use (so important to plant conservation) if we assume all parcels with "habitat" to have at least a small population – persistence is simply improved with area retained and controlled.

In terms of habitat maintenance and subsequent contribution to species persistence, it was considered that management of higher quality native vegetation is more likely to contribute to longer-term habitat maintenance and improvement than management of lower quality vegetation or areas dominated by weeds where the management outcomes are less certain and the risks of unregulated "habitat loss" greater. Habitat dominated by weeds also poses some conflicts under legislation where land owners may be required to control or remove 'listed noxious weeds' that may otherwise provide habitat for Spiny Rice-flower. As such, areas of habitat were further ranked according to their modelled site condition score (sensu Parkes et al. 2003, DSE 2004).

SOURCE DATA

- Modelled habitat probability from DSE Arthur Rylah Institute (White 2009)
- Department of Sustainability and Environment Native Vegetation Extent 2005
- Department of Sustainability and Environment Native Vegetation Modelled Site Condition 2005
- VicMap Roads dataset
- VicMap urban extents dataset

LINEAGE

1. Thresholded the habitat probability model to 0.376 to create a binary model that contains 95 per cent of the recorded samples of *Pimelea spinescens* subsp. *spinescens*.
2. Removed all areas from the map intersecting with urban areas and sealed roads.
3. Grouped habitat according to contiguity (i.e. no breaks in habitat cover).
4. Ranked contiguous habitat into the following categories based on area:

Area (ha) of contiguous habitat	Ranking
>1000	6
500–1000	5
100–500	4
50–100	3
25–50	2
1–25	1

5. Ranked modelled native vegetation site condition into the following categories:

Modelled Site Condition	Ranking
≥0.35	3
0.20–0.34	2
<0.20	1

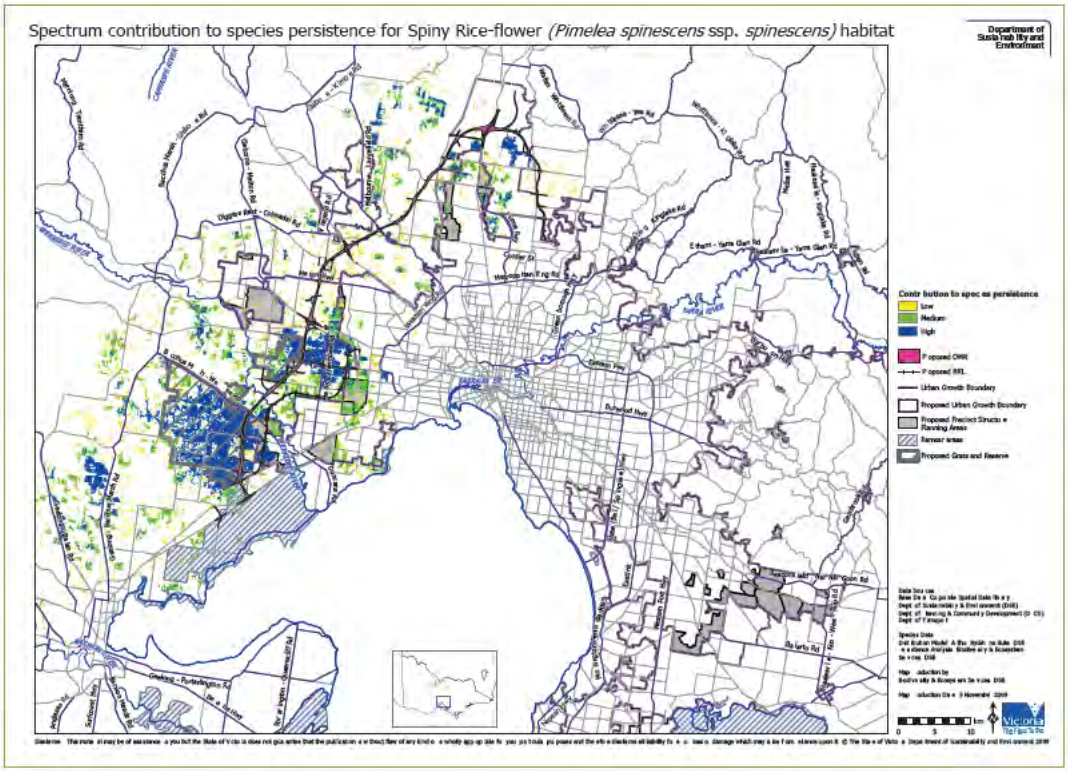
6. Combined habitat area classes with site condition classes and classified species persistence into three classes, as follows:

Site Condition Rank / Habitat Area Rank	3	2	1
6	High	High	Medium
5	High	High	Medium
4	High	Medium	Medium
3	High	Medium	Medium
2	Medium	Medium	Low
1	Medium	Low	Low

7. As a result habitat in the high category constitutes close to 25 per cent of suitable habitat area, medium is about 50 per cent and low makes up the other 25 per cent.

OUTPUT MAP

A map of the modelled habitat of *Pimelea spinescens* in the Melbourne region of Victoria. The map is divided into three classes of "contribution to species persistence": Low; Medium; and High.



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APPENDIX 6:
SUMMARY OF NATIVE GRASSLAND RESERVE PRIORITISATION APPROACH

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This note summarises the spatial prioritisation approach used to strategically locate native grassland reserve(s) to the immediate west of Melbourne. Refer to Figure 1 for the final solution used by the Department of Sustainability and Environment to inform the reserve design process.

INPUT DATA

The following spatial datasets were used to inform the prioritisation processes.

- *Grassland extent and condition* – calibrated from the modelled Department of Sustainability and Environment's state vegetation condition layer (NV2005_QUAL1) using site data collected in the target area during 2008/09 (i.e. vegetation type, extent, condition), including those collected by the Victorian Growth Areas Authority and Department of Sustainability and Environment.
- *Planning Unit layer* – Cadastral property boundaries. Used to potentially inform implementation decisions regarding the prioritising of individual properties. A threshold was set to only include properties greater than five hectares.
- *Natural water resources layer* – layer showing combined spatial information on wetlands, streams and 1 in 100 year flood prone areas. Used for the purposes of incorporating "refugia" into the reserve design.
- *Land use layers* – urban (including residential, industrial, roads, rail) and agricultural (consisting on irrigated agriculture and dry land agriculture). A range of urban layers were used to explore the effect of different current and possible future urban land use scenarios on the reserve design.
- *Existing conservation areas* – areas currently managed primarily for nature conservation including public reserves, local government reserves and private land offset areas. Used to ensure that the final reserve design was well integrated with existing reserves.
- *Public land* – areas of crown land not managed primarily for nature conservation or "non-developable" easements such as unused road reserves, transmission lines etc. This information is used to generate a preference layer for the spatial prioritisation (see below).

All input data derived from ESRI grid format with a 50m pixel resolution.

APPROACH

ZONATION

The Zonation conservation planning tool (Moilanen and Kujala, 2006) was used to assign each pixel in the study area a prioritised value between 0 and 1, with 1 representing highest conservation value. The algorithm used by Zonation to prioritise pixels is a reverse stepwise heuristic which iteratively removes cells from the landscape in an order that minimises marginal loss of (Moilanen et al. 2005) while maintaining connectivity. The algorithm is based on the principle that minimizing the loss of conservation value while cells are removed, results in the greatest conservation value in the remaining areas. Priority areas of any given size can be determined by selecting pixels in the Zonation solution above a given threshold value.

AGGREGATION

Extra aggregation was obtained in the solution using the boundary quality penalty (BQP) feature built into Zonation (Moilanen and Wintle 2007). When using the BQP, the conservation value of a given pixel of grassland is adjusted based on the amount and quality of grassland in a surrounding square area with a radius of 500m. The conservation value of pixels surrounded by a high proportion of grassland is increased, while conversely, the pixel value will be reduced if surrounded by a low proportion of grassland. This results in increased aggregation of the Zonation solution around the areas with highest quality grassland.

LAND USE IMPACT

The impact of surrounding land use on pixel conservation value was applied in the context of these land uses being a source of weeds with a risk of spread. Land use layers showing the locations of urban and agricultural areas (consisting on irrigated agriculture and dry land agriculture) were used for this purpose.

Regardless of the mode of seed dispersal, seeds of terrestrial plants usually fall in a continuous leptokurtic distribution (normal with high peak) with the mode under or near the parent plant and decline with distance (Howe 1989). The impact is high at or near the interface and approaching a negligible value at the edge of the distribution. However, occasional long distance dispersal of invasive species has potentially important ramifications for weed management (Trakhtenbrot et al. 2005).

To account for the impact of weeds near urban and agricultural areas, kernel smoothing of the landuse maps was used to generate a “halo” of influence where weeds could potentially impact the condition of grassland. The shape of the kernel was defined using a high kurtosis / Super Gaussian (Pearson type IV) function with the standard deviation (SD) set such that 3 x SD = 500m.

PREFERENCE LAYER

Zonation allows a cost or preference layer to be used, when calculating the marginal loss value of a given cell. In simple terms, the preference layer can be thought of as providing information on where preferences would lie in the landscape with **grassland conservation value (and other factors) being equal**.

The preference layer was generated by combining the following layers:

1. The weed influence of urban and agricultural areas combined into a single weed source layer (urban areas were given twice the weed impact as agricultural areas). Areas away from these landuses are preferred to those that are closer.
2. The natural water resources layer: areas overlapping or close to wetlands / streams / flood prone areas are preferred to those that are more distant.
3. The public land layer: areas overlapping or close to unused road reserves or transmission lines are preferred to those that are more distant.

EXISTING CONSERVATION AREAS

Zonation allows a mask layer to be used where existing conservation areas can be specified. These areas are then taken into account during the prioritisation process, along with the other factors such as aggregation and land use impact. The current approach used an existing conservation areas layer (see above) to account for these locations in study area.

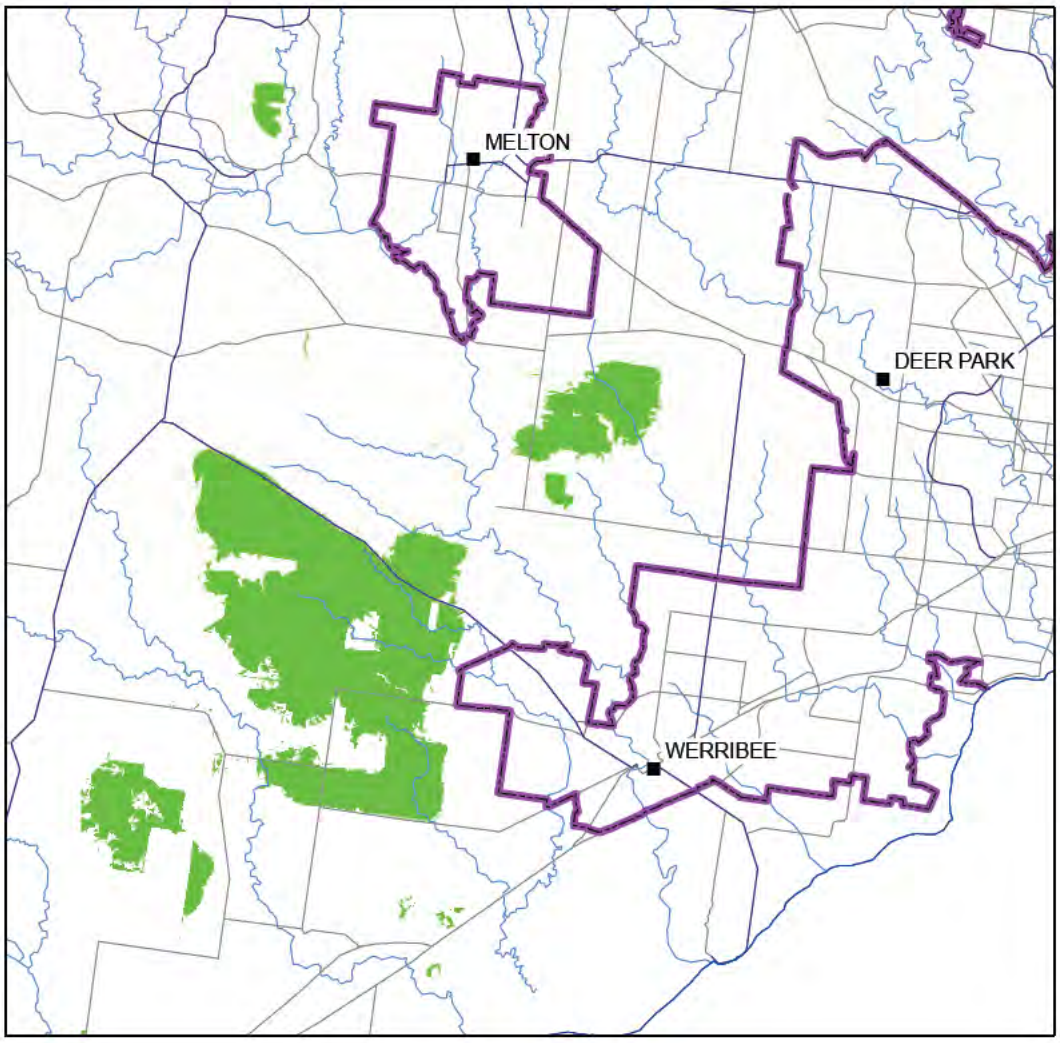
PLANNING UNITS

Zonation can also run prioritising whole land parcels instead of pixels. This can be useful when considering properties for purchase, though it does not use the BQP aggregation and is not as biologically relevant. For the current project, both parcel and pixel prioritisations were made and after consultation with Department of Sustainability and Environment, it was decided to proceed with the final solution based on the pixel prioritisation.

RESULTS

Zonation was run with all the settings described above and, on advice from the Department of Sustainability and Environment, a target area threshold of 12,000ha was applied and priority areas of these sizes were determined from the Zonation pixel solution illustrated in Figure 1.

FIGURE 1. FINAL ZONATION SOLUTION – OPTIMISED LOCATION FOR A 12,000HA GRASSLAND RESERVE TO THE WEST OF MELBOURNE



ACKNOWLEDGMENTS

Research presented here was undertaken with support from the Australian Research Council through the Linkage Projects scheme and through the Commonwealth Environment Research Facility (Applied Environmental Decision Analysis).

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APPENDIX 7:
PROJECTIONS OF FUTURE GRASSLAND EXTENT-CONDITION CHANGE IN THE WEST OF MELBOURNE

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The aim of the investigation was to model the future extent and condition of native grasslands in the west of Melbourne under a number of possible scenarios. The approach aims to quantify and illustrate the net benefit (if any) of a strategic grassland reserve to the west of Melbourne to offset likely clearing of native grasslands within proposed Melbourne development areas.

For this study we modelled 24 years into the future using 12 time steps of two years duration. This approximates the period during which proposed development is likely to occur.

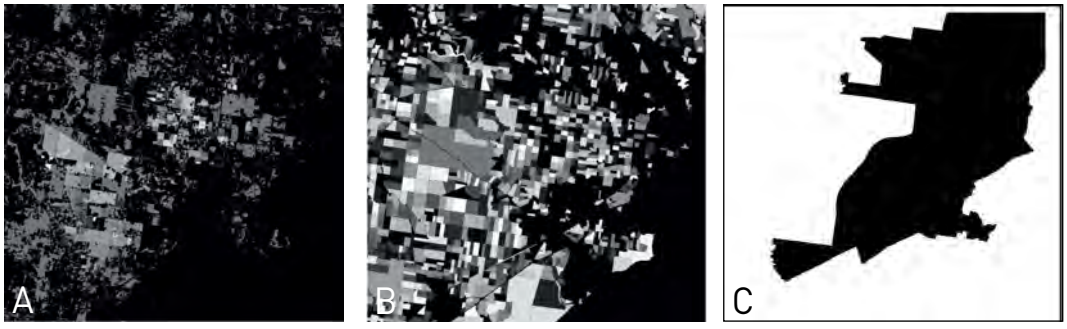
MODELLING GRASSLAND CONDITION CHANGE

STARTING CONDITION (2009)

The relative starting condition of grasslands across the study area is illustrated in Figure 1. Each cell represents grassland condition within a 50x50m pixel. This condition model was calibrated from the modelled Department of Sustainability and Environment state vegetation condition layer (NV2005_QUAL1) using site data collected in the target area during 2008/09 (i.e. vegetation type, extent, condition) including those collected by the Victorian Growth Areas Authority and the Department of Sustainability and Environment.

Figure 1(a) shows the grassland extent and quality in the study area (lighter colours are higher quality and black areas contain no grassland). Figure 1(b) shows land parcels in study area (only land parcels greater than 20ha were used (due to issues with the processing time associated with large numbers of very small parcels). Figure 1(c) shows the mask depicting the development and offset scenario used, where development areas are shown black and offset areas (non-developable areas that overlap with any grassland) are shown white.

FIG 1 (A) SHOWS THE GRASSLAND EXTENT AND QUALITY IN THE STUDY AREA (LIGHTER COLOURS ARE HIGHER QUALITY AND BLACK AREAS CONTAIN NO GRASSLAND). (B) SHOWS LAND PARCELS IN STUDY AREA (C) SHOWS THE MASK DEPICTING POTENTIAL DEVELOPMENT AREAS (BLACK) AND POTENTIAL OFFSET AREAS (NON-DEVELOPABLE WHITE AREAS THAT OVERLAP WITH ANY GRASSLAND).

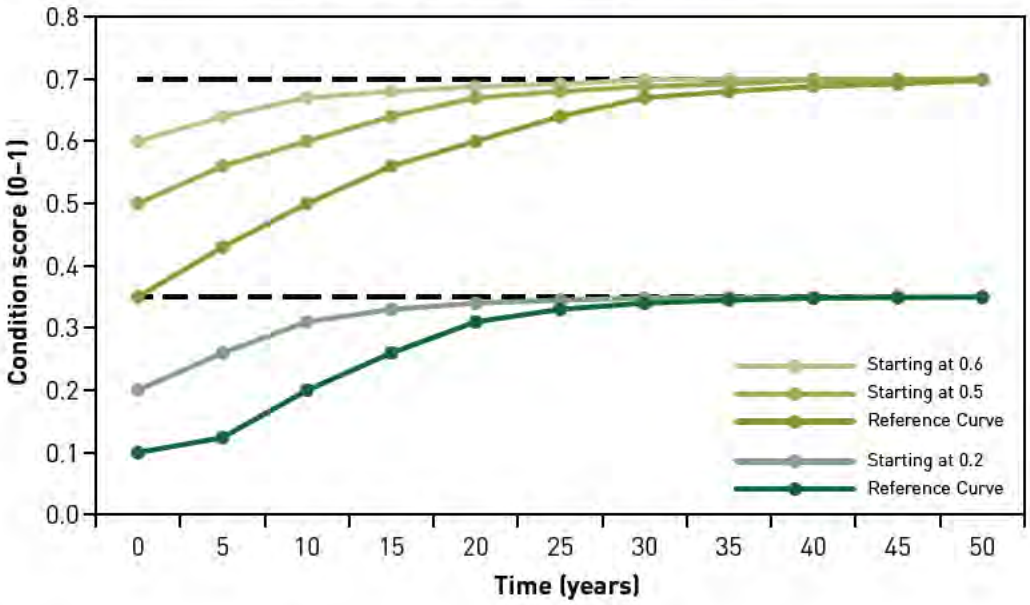


MODELLING FUTURE CONDITION

All grassland was assumed to be either "actively managed" (permanently protected offset within or outside a "public reserve"); "not actively managed" (remaining grassland on private land subject to entitled uses and uncontrolled threats); or "developed" (no longer grassland).

Future grassland condition was calculated using the curves shown in Figures 2 and 3. The two reference curves in Figure 2 show how the condition of an actively managed grassland pixel will change over a given time period depending on its initial condition. If its score is below 0.35 (against a benchmark condition state of 0.7), then it will asymptote towards a condition value of 0.35. If it starts above 0.35 it will asymptote towards a value of 0.7. This was rule was designed to capture the fact that once a patch of grassland falls below a certain condition it is likely to be very difficult to fully restore it and aligns with observations made by the Department of Sustainability and Environment grassland ecologists in sites around Melbourne over the past 10–15 years. It should be noted that some variance has been factored in that allows for some sites <0.35 to "jump" to the higher recoverability curve, particularly where surrounded by higher condition pixels.

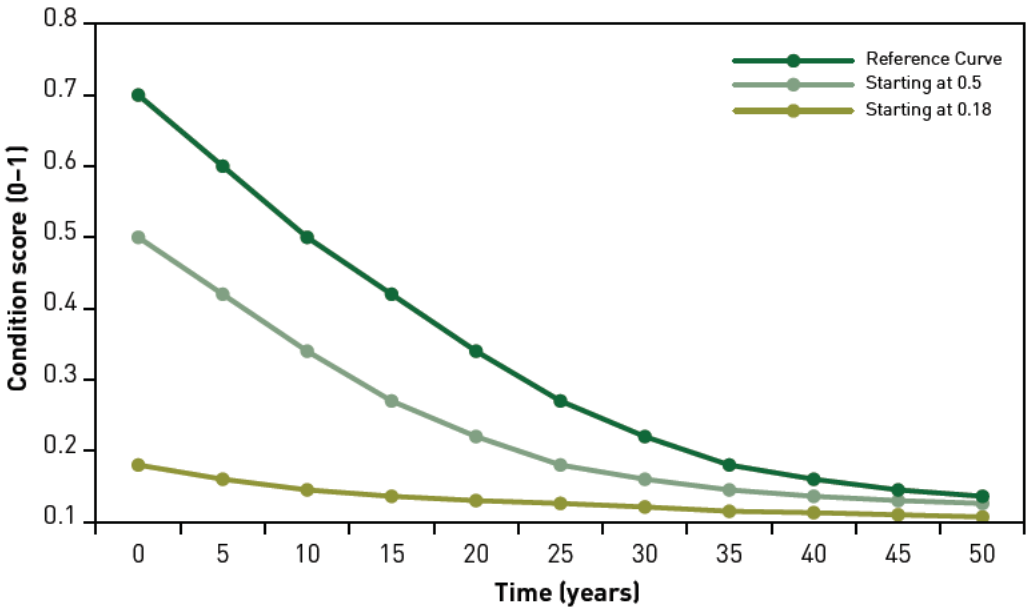
FIG. 2 CONDITION CHANGE OVER TIME FOR ACTIVELY MANAGED GRASSLANDS.



The reference curves in Figure 3 show how the condition of a given pixel of grassland will degrade over time if it is not actively managed. This assumes a range of entitled uses such as grazing but also factors in the spread of various environmental weeds that landholders are not required to manage under existing legislation. In both actively managed and unmanaged cases the reference curves define how the condition will

change for any given starting value and the other curves show this same trajectory for different starting conditions.

FIG. 3 CONDITION CHANGE OVER TIME FOR NOT ACTIVELY MANAGED GRASSLANDS.



For each time step, the condition of all pixels of grassland was evolved using the curves in Figures 2 and 3. After this the condition score or each pixel was randomly fluctuated by five per cent of its value to model stochasticity of the condition change process. Finally smoothing was applied to give some spatial autocorrelation to the condition change to ensure that adjacent grassland pixels did not vary greatly from each other due the random variation approach applied. This assumes that most co-located pixels within a parcel will be affected similarly under a future land use-management scenario.

SCENARIOS MODELLED

- *No land use change* – in this scenario there is no development and no grassland is actively managed. Thus all grassland in the study area declines in condition over time due to unmanaged threats.
- *Randomly located offsets* – here development occurs gradually over the 24 years at a rate such that all parcels are developed within 24 years. Parcels are selected for development by randomly choosing parcels within development area (Figure 1(c)). As each parcel is developed an offset is implemented for that parcel. The offset is chosen using the following procedure:
  - make a list of all the land parcels in the potential offset area that have a summed grassland condition score equal or greater than the summed grassland condition of the parcel being developed.

- select one of these parcels randomly.
- if the summed condition off the offset is greater then the summed condition of the developed parcel, the offset quantity left over is stored and can be used to further offset another parcel.
- it is assumed that all offsets are located within the study area (Figure 1(a)).

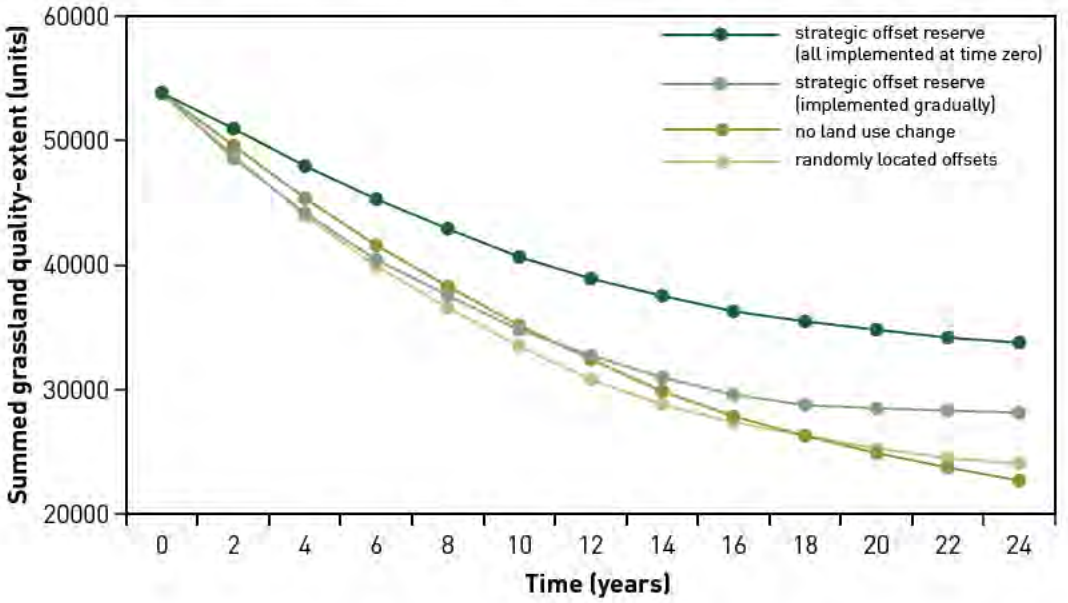
> *Strategic offset reserve (implemented gradually)* – here strategic offsets (informed by the Zonation reserve prioritisation output – see Appendix 2) are implemented gradually over time such that the complete strategic offset reserve is in place after approximately 20 years. Development occurs in the same way as *the randomly located offsets* scenario. Offsets are chosen for each parcel developed in the same way as with the *randomly located offsets* scenario, but the list of land parcels available for offset is constrained to an area specified by the Zonation prioritisation. The total area for the locations of strategic offsets is set to approximately 11,000ha.

> *Strategic offset reserve (all implemented at time zero)* – here strategic offsets (informed by the Zonation prioritisation) are all set in place at "time zero". Development occurs in the same way as *the randomly located offsets* scenario. The total area of the offsets is set to be approximately 11,000ha.

RESULTS

Results are shown by plotting the grassland condition summed over each pixel in landscape as a function of time – see Figure 4. Curves are shown for each of the 4 scenarios above.

FIG. 4 MODELLED NATIVE GRASSLAND QUALITY – EXTENT UNDER VARIOUS FUTURE SCENARIOS



The results illustrate the difference between the four approaches. The results support the use of offsets to achieve net benefits over time (see – *no land use change* and *random offset* curves) and show the added benefit of a strategic grassland offset reserve. The greatest benefit occurs when creating the offset reserve as early as possible in the process, as shown in the *strategic reserve (all implemented at time zero)* curve.

ACKNOWLEDGMENTS

Research presented here was undertaken with support from the Australian Research Council through the Linkage Projects scheme and through the Commonwealth Environment Research Facility (Applied Environmental Decision Analysis).