Sites of Biological Significance in Knox

2nd Edition

Volume 1

A Report to
Knox City Council

by

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of

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Preface

This second edition has been updated to account for six years of change since the first edition in 2004. There have been substantial changes in Knox's native vegetation and fauna, as well as in the Victorian Department of Sustainability & Environment's assessment of the significance of many species of indigenous flora and fauna.

Site Changes

A reinvestigation of some sites was prompted by observations that they had been damaged since 2004, such as along the route of the EastLink road during its construction. One site was reinvestigated because Council had extensively revegetated it to compensate for lost habitat elsewhere in the municipality. Other sites were reinvestigated because they were on residential land subject to possible development, or because changes were apparent on aerial photographs taken since 2004.

The author visited and inspected sites 3-5, 10, 15-17, 27, 29, 33, 34, 40-47, 49, 51, 52, 55, 56, 59-62, 64-67, 69, 70, 78, 80, 81, 85, 89-91, 95, 98, 100, 102, 106, 109 and 111 in 2007-2010 to provide updated information in this edition. These inspections varied from a broad-ranging, two-day ecological survey (around the new Waterford Valley golf course) to an hour or so of redefining site boundaries or updating species lists. The author drove past, or walked beside, most of the other sites to confirm that their condition had not outwardly changed since 2004. Aerial photographs were checked for changes at nearly all sites.

As explained in the introduction of Volume 2, two of the sites of biological significance identified in the first edition have been completely destroyed since 2004 and eighteen sites (mostly of State significance) have been reduced in extent due to clearing. Many other sites have changed significantly in their ecological condition, mostly adversely. Destructive land management and the effects of prolonged drought on swampy habitat have been profound in some sites (Lorimer 2007a). Plant species and vegetation communities that rely on swampy conditions have generally suffered severely during the drought, particularly since 2007.

One new site of State significance has been introduced to this second edition: Site 12b – Mortiboy Reserve, The Basin.

Changes in Planning Status

Knox City Council's reviews of the Boronia central activity area and the Dandenongs Foothills Policy Area prompted reconsideration of how habitat in these areas should be treated under the Knox Planning Scheme. The introduction of Schedule 1 to the Environmental Significance Overlay has also affected the treatment of the southwestern corner of Site 81.

Changes in Significance Ratings

The ratings of the significance level of sites have been reassessed according to the Department of Sustainability & Environment's standard criteria (Amos 2004), which were published after the first edition of the present report. This has resulted in a small upgrade of the significance rating of several sites.

The ratings of flora species for their risk of extinction within Knox have been reassessed according to the international standard IUCN 'Red List' criteria of the International Union for the Conservation of Nature (2001, 2003, 2008). This has resulted in many raised threat ratings compared with the criteria adopted in the first edition, which were based on the federal *Environment Protection and Biodiversity Conservation Act 1999*. The Victorian Department of Sustainability & Environment is in the process of applying the Red List methodology to its ratings at the state level, which will lead to an escalation of the state-level threat ratings of many of Knox's flora species, even relatively common ones like Kangaroo Grass.

The department updated its threat ratings for fauna in 2007 using the Red List criteria, and this second edition has been updated to account for this.

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- The National Herbarium of Victoria for providing a listing of plant specimen records from in and around Knox.
- The Department of Sustainability & Environment for permitting use of flora and fauna data from the central databases in Victoria, which the department curates. These databases, the 'Flora Information System' and the 'Victorian Fauna Database', are copyright to the State of Victoria, Department of Sustainability & Environment.
- Many landowners who granted permission to visit their properties.

…and **Rik Brown**, who did some of the fieldwork and draft site descriptions for the first edition:

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Some of the aerial photography in Volume 2 was supplied by Sinclair Knight Merz (SKM), 2003.

Executive Summary

Purpose

The Sites of Biological Significance study was specifically foreshadowed in the *'Knox 2001 – 2010 Sustainable City Strategy'*. The study has three main purposes:

(1) To gain a broad overview of native vegetation and wildlife in Knox, including their biological significance, threats and opportunities for improvements;

(2) To identify, carefully assess and document all sites in Knox that are so important to native flora and fauna that they warrant special recognition and protection; and

(3) To recommend ways of looking after, enhancing and monitoring Knox's natural vegetation and other habitat, including through amendments to the Knox Planning Scheme.

Study Approach

The study has three main parts:

- Scientific investigation of the current state of nature in the municipality, including flora, fauna, ecological communities, and the sites where these things occur. Fieldwork focused on vegetation (including records of approximately 26,000 observations of plants), but incidental observations of fauna were also recorded (over one thousand records). Flora and fauna records were added from sources outside the study, where those records have good credentials. The data has been analysed by computer;
- Identification of issues that are positively or adversely affecting the natural flora and fauna in Knox, based on the fieldwork observations; and
- Recommendations for improving the positive influences on the natural environment, and reducing the adverse effects. These involve the Knox Planning Scheme, public education, management of reserves, recovery plans for threatened species, and many other subjects.

Principal Findings

The study found that native vegetation or areas with indigenous tree cover occupy less than five percent of the municipality. But within this small fraction of Knox, some exciting discoveries were made.

The survey work uncovered more biologically significant sites, and more species of plants and animals, than anyone expected. The highlights were discoveries of sites of state-wide biological significance that were not previously known to be significant at all. There have also been discoveries of many plant species not previously recorded in the municipality (or within hundreds of kilometres, in some cases).

The sites' biological significance has been assessed using the Department of Sustainability & Environment's standard, objective criteria. The seventy-seven most significant sites rank at the State level (with one exception at National level), and occur on both public and private land. To find so many sites of State significance was quite unexpected.

The most common reason for sites to qualify for State significance is the presence of a vegetation type (or Ecological Vegetation Class) that is officially listed as endangered, particularly Valley Heathy Forest and Swampy Woodland. Most occurrences of native vegetation in Knox include an endangered or vulnerable Ecological Vegetation Class.

The study compiled a database of over 35,000 new records that show where each plant species is found in Knox, and how abundant they are at each site. These records have been melded with over 8,000 others from the Victorian Department of Sustainability & Environment. Altogether, these records include 472 indigenous species of fern and flowering plant (not including subspecies, varieties, hybrids and so on). Of these, twenty-seven can be confidently presumed to be long extinct in Knox and many others are suspected of having become extinct in Knox in the past decade, mainly due to drought and quarrying.

Analysis of the database shows that the indigenous flora of Knox is not well conserved:

- One hundred and eighty-five plant species, or 41% of all of Knox's surviving indigenous plant species, are Critically Endangered in Knox, i.e. they fall into the highest risk category for local extinction. This is an indication that scores of species could die out in Knox over the next decade – a remarkably rapid collapse of biodiversity – unless corrective action is taken. Some of these species are threatened state-wide.
- In the other two categories of locally threatened species (i.e. Endangered and Vulnerable), there are another 190 species, bringing the total proportion of indigenous plant species that are locally threatened to 84%.
- Eighty-one of the 117 sites identified in this study contain at least one plant species that is Critically Endangered with extinction in Knox or more widely. The loss of any one of these eighty-one sites is likely to either render a species extinct from the municipality (or more widely), or significantly increase the risk of this happening.
- Every one of the 112 sites recommended to be protected by a planning scheme overlay contains at least one locally threatened species.
- Sixty-two plant species that are Critically Endangered with local extinction have never been recorded in a reserve, making private land and properties like the Healesville Freeway Reservation critical for the survival of these species in Knox.

It is not surprising that there have been local extinctions of plants and animals during Knox's development, but a massive increase in the rate of local extinctions could be imminent unless countermeasures are taken. Consequently, Council is taking corrective measures such as active habitat management, funding of a management plan for locally threatened plants, supporting community conservation efforts, and amending the Knox Planning Scheme to better protect native vegetation and wetland habitat. With such measures, Council's goal of permanently retaining all presently existing indigenous fauna and flora species in Knox is still realistic.

Some of the threatened species that are not represented in reserves are highly reliant on sites owned by government, such as schools, roadsides, utility installations or freeway reservations. In many cases, private residential land is critical – particularly in the cases of the quarries in the Lysterfield Hills.

All of the threatened Ecological Vegetation Classes in Knox are represented in reserves managed for conservation. However, occurrences outside these reserves are also highly important to conserve.

A significant proportion of the fauna species found in Knox are listed as threatened or near-threatened state-wide.

It is therefore important for Knox City Council to regulate land uses that raise the risk to threatened species and vegetation communities, and to make sure the controls are applied to appropriate areas. Overlays in the Knox Planning Scheme are the primary way that this can be done.

Ninety-seven sites have been identified as worthy of, and suited to, protection under the Environmental Significance Overlay. Another fifteen sites are recommended for the Vegetation Protection Overlay. Each site is described in detail in Volume 2.

These overlays are proposed to completely replace the existing Schedules 1 and 3 of the Vegetation Protection Overlay in the planning scheme. This would not significantly change the total area covered by overlays, but there are substantial numbers of properties proposed to be relieved from overlays and others that are proposed to be covered for the first time.

At the lower end of the biological significance scale, four sites or groups of sites are not recommended for planning scheme overlays, because their vegetation is adequately protected by the baseline 'Native Vegetation Retention' provisions that appear as Clause 52.17 of planning schemes throughout Victoria.

Positive and Negative Trends

There are encouraging signs of change by the public, Council and other agencies; for example:

- Widespread planting of indigenous species to encourage wildlife and enhance the local landscape;

- Enthusiastic community participation in management of bushland reserves; and
- Council's commitments to conservation, such as its excellent management of bushland reserves, the 'Gardens for Wildlife' program and the 'Biodiversity Buddies' program of grants and rate rebates.

Council is well positioned to encourage these trends; for example, through its 'Biodiversity Buddies' incentives program and by providing practical support to 'Friends' groups that have working bees in Council reserves.

This report reveals the urgency and importance of such measures, because despite the positive signs on the human side, the natural environment is in decline in much of Knox.

Drought has caused major changes in native vegetation in Knox in recent years (Lorimer 2007a). The effects have included decline in tree health and decimation of the populations of some previously abundant indigenous flora species such as Blackwood, Tree Everlasting and Ivy-leaf Violet. Plants of swampy ground have been worst affected. The Bureau of Meteorology advises that the drought is symptomatic of long-term climate change, so further adverse impacts on vegetation should be expected.

As predicted in the first edition of this report, construction and widening of main roads has been a major cause of ecological deterioration in Knox since 2004, particularly as a result of the EastLink construction project. Two sites of State significance were completely destroyed by road construction projects during that time and others have been reduced in area. Quarrying in the Lysterfield Hills has also had substantial adverse impact.

Over the same period, drought has helped to suppress the invasion of environmental weeds, keeping the weeds' ecological impacts less than drought and vegetation clearing.

In coming years, climate and the amount of clearing for roads and land development will be the main determinants of the relative severity of drought, clearing and weeds. These are very hard to predict.

An Outline of the Recommendations

Chapter 6 of this volume lists 48 specific, prioritised recommendations to Council, written in such a way as to make it easy to monitor implementation. In addition, recommendations that apply to individual sites are given in the descriptions of those sites in Volume 2. It is not possible to summarise all of the detailed recommendations, so the following should be taken as just a broad overview.

A planning amendment is proposed to change the Municipal Strategic Statement and local planning policies and to cover the 112 identified significant sites with overlays as discussed above. Such an amendment would be exhibited for public comment prior to final consideration by Council. A planning panel may also be appointed by the Minister for Planning to advise Council about unresolved objections to the amendment, if there are any.

If the amendment is ultimately adopted, its implications need to be well understood and respected by the affected community. There are therefore some proposals for public education in this report, including a brochure and possible seminar.

Under the proposed amendment, a permit would be required for removal, destruction or lopping of most native vegetation in the affected sites (subject to various exemptions). This is because removal and destruction of native vegetation is one of the greatest threats to nature in Knox.

Another threat of comparable magnitude is from environmental weeds, and nine of the most serious weed species have been identified for special attention by Council (see Table 6, p. 35). It is recommended that Council and the Department of Primary Industries conduct a publicity campaign and on-ground works to control these species.

Quality Assurance

The utmost care has been taken to ensure that the findings and recommendations of this study can stand up to scientific and legal scrutiny, including in the Victorian Civil and Administrative Tribunal.

The most basic safeguard against faulty or misleading results is that extensive survey work was carried out. This study is possibly the most in-depth investigation of nature conservation of a municipality, ever – at least in Australia.

This is reflected in the detailed descriptions given for the identified sites, their significant flora and fauna populations, and detailed justifications for the level of significance assigned on the basis of objective criteria developed by the Department of Sustainability & Environment. (Normally, reports such as this give little written justification of the levels of significance that are assigned). Computer analysis of the field data (tens of thousands of records of plants and animals) has been done to provide statistics of the distribution of rare and uncommon species, so that there is minimal chance that the report claims a species to be significant when it is not warranted by the data. There are many examples of species purported by others to be significant which have found in this study to be actually widespread and secure.

As an additional quality assurance measure, it is recommended that Council have this report independently peer-reviewed by experts.

Periodic Review

Sites of biological significance can either lose or gain significance over time, as indicated by the changes in this report since the first edition in 2004. The issues affecting nature conservation at the municipal scale can also change. It is suggested that this report be updated in approximately five years.

1. Introduction

1.1 Purpose of the Study

This study was specifically foreshadowed in the *'Knox 2001 – 2010 Sustainable City Strategy'*. It has three main purposes:

(1) To gain a broad overview of native vegetation and wildlife in Knox, including their biological significance, threats and opportunities for improvements;

(2) To identify, carefully assess and document all sites in Knox that are so important to native flora and fauna that they warrant special recognition and protection; and

(3) To recommend ways of looking after, enhancing and monitoring Knox's natural vegetation and other habitat.

A major use for this information is to help amend the Knox Planning Scheme to contain an up-to-date, sound, clear and effective basis for protecting the municipality's native biodiversity. (Biodiversity is the variety of species, communities and genetic diversity). The Scheme's Local Planning Policy Framework could be updated to better reflect the matters in (1) above, as described in Section 4 below. The sites identified in (2) point to the need for substantial changes in the Scheme's overlays. Many sites are private land, and the landowners may be directly affected by the findings of this study. In some cases, properties are recommended to be released from restrictive provisions in the Planning Scheme.

There are also various steps that can be taken outside the Planning Scheme to look after natural vegetation. For example, the development and implementation of management plans for Council bushland reserves can yield benefits for biodiversity (Section 4.1.1).

1.2 How to Use This Report

The sites of biological significance identified in this study are listed, mapped and described in Volume 2. For readers who simply want to see whether a particular property or area has biological significance, or to read an assessment of a site, it may be adequate to go directly to the key map or site inventory on page 2 of Volume 2, determine the site number, and turn to the corresponding section in the text. There are 113 fully described sites and four briefer summaries of sites (or groups of sites) that are not recommended for special recognition in the Planning Scheme. The key map only shows the 112 sites that are recommended for planning scheme overlays plus sites 89 and 111, which were previously recommended for overlays but have since been cleared.

To fully appreciate the basis for the assessments that have been made of the sites and the individual species, read Chapters 2 and 3 of this volume, which describe the survey, its methods and main findings.

Sites 1 to 114 are recommended to come under entirely new overlay provisions in the Knox Planning Scheme, except Site 111 (which was cleared in 2010). Readers who are interested in what the application of overlays would mean should look at Section 5.5.

Readers who want to check on the rarity or other significant features of an indigenous animal or plant species, or the severity of an environmental weed, will find an overview in Sections 3.4 and 3.5 and tabulated inventories in the appendices of Volume 1. The appendices are also useful for translating between scientific and common names. Other technical terms are explained in the Glossary (p. 109).

A detailed discussion of issues related to nature conservation in Knox is given in Chapter 4. There is a list of recommended actions in Chapter 6.

1.3 Background about the Municipality of Knox

The municipality of Knox has a population of approximately 155,000 and its centre lies 27 km east-southeast of central Melbourne, on the fringe of the metropolis. A locality map appears in Figure 1, showing the main suburbs of Bayswater, Boronia, Ferntree Gully, Upper Ferntree Gully, Knoxfield, Lysterfield, Rowville, Scoresby, The Basin, Wantirna and Wantirna South. The easternmost extremity is in Sassafras.

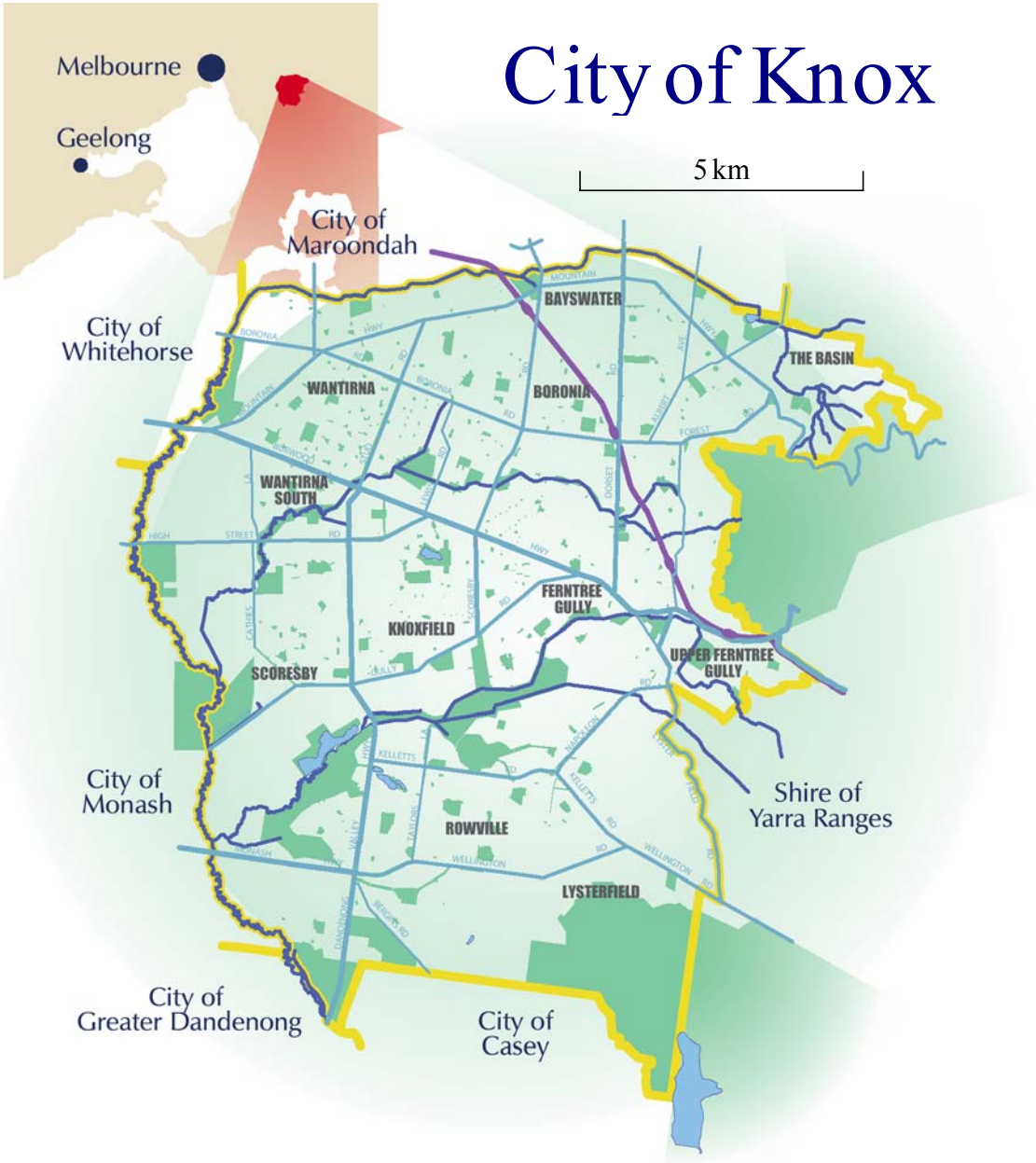


Figure 1. Locality map of Knox. The yellow lines are municipal boundaries, the Belgrave railway line is in violet and the green patches represent public open space.

Knox's 114 square kilometres have varied land use, comprising significant areas of commerce, industry, reserves of various kinds (including nature reserves) and residential areas of low to medium density. Some of the residential areas incorporate native vegetation. Much of the municipality is rather flat and sparsely treed but parts are steeply hilly with tall forest. It includes large areas of rapid urban growth, and substantial areas of rural land that existed a decade ago have since been converted almost wholly to urban development.

The study reported here found that remnant native vegetation or areas with natural tree cover occupy less than five percent of the municipality. There is even less if one excludes sites with only a handful of hardy native plant species and little chance of natural regeneration.

1.4 Governmental Context of This Study

Table 1 summarises policies, agreements, strategies etc., from global to local, that relate to this study, and which have been taken into account during the preparation of this report and its recommendations.

Table 1. Summary of governmental policies, strategies etc. related to this study.

Jurisdiction	Strategy, Policy or similar instrument	Relationship to matters in this study
Global	United Nations Convention on Biological Diversity (1993) – 'The Rio Convention'	• Provides a framework for global action to '*conserve and sustainably use biological diversity for the benefit of present and future generations'* (i.e. make biodiversity serve human values); • Contains guiding concepts, such as the precautionary principle (see Glossary, p.112) and that each country is responsible for the conservation and sustainable use of its biological resources; • Does not include actions to be taken at the local level.
	Japan and China Migratory Bird Agreements (JAMBA & CAMBA)	Some listed migratory bird species occur seasonally in Knox, as indicated in Appendix D and Vol.2 of the present report. JAMBA and CAMBA somewhat raise the levels of protection for these species.
National	Intergovernmental Agreement on the Environment (IGAE) of 1992, signed by first ministers of the federal, state and territory governments	Provides a framework for cooperation between levels of government to achieve environmental outcomes. Under the heading, '2.4 Responsibilities And Interests Of Local Government', it states: *'2.4.1 Local Government has a responsibility for the development and implementation of locally relevant and applicable environmental policies within its jurisdiction in cooperation with other levels of Government and the local community'.* The IGAE also establishes general principles such as the Precautionary Principle (see Glossary, p.112) and consistency of data gathering throughout Australia.
	National Strategy for Ecologically Sustainable Development (1992), signed by first ministers of the federal, state and territory governments.	Provided the impetus and broad context for the National Strategy for … Biodiversity (see below); It also reiterates the Precautionary Principle of the IGAE.

Jurisdic-tion	Strategy, Policy or similar instrument	Relationship to matters in this study
National	National Strategy for the Conservation of Australia's Biodiversity (1996)	The present study represents local implementation of many of the national-scale objectives of this Strategy. For example, the Strategy states, *'There is a need for more knowledge and better understanding of Australia's biological diversity'*, and it has the objective (in section 1.5.2) to *'Promote the conservation of biological diversity in urban areas by:* *'(a) encouraging retention of habitat;* *'(b) improving strategic planning and infrastructure coordination so as to enhance [biodiversity]…;* *'(d) encouraging action by local governments to retain and improve natural ecosystems…'* The Strategy also provided some impetus for *Victoria's Biodiversity Strategy* and the Victorian Native Vegetation Framework (see below).
	National Framework for the Management and Monitoring of Australia's Native Vegetation (published 2000)	A joint initiative of federal, state and territory governments to coordinate their respective approaches toward a goal of reversing the decline of native vegetation in extent and quality. The Victorian Native Vegetation Framework (see below) was prepared in conformity with this document, and it is a major instrument for conserving Knox's native vegetation in accordance with the recommendations of the present report.
	Environment Protection and Biodiversity Conservation Act 1999	Provides legal protection against development proposals for certain threatened species and migratory species that are found in Knox, as documented in the present report. Also identifies land clearance as a key threatening process. The Precautionary Principle is employed within the Act. There are no requirements on local government, but the Act can help Council to prevent certain environmentally harmful developments.
	National Objectives And Targets For Biodiversity Conservation 2001–2005	Includes the following targets for state and federal jurisdictions, and which rely on recommendations of the present report for effective local implementation: • *'By 2001, all jurisdictions have mechanisms in place, including regulations, at the State and regional levels that prevent decline in the conservation status of native vegetation communities as a result of land clearance'*; • *'By 2001, all jurisdictions have clearing controls in place that will have the effect of reducing the national net rate of land clearance to zero';* • *'By 2003, all jurisdictions:* ·*have clearing controls in place that prevent clearance of ecological communities with an extent below 30% of that present pre-1750; and* · *'have programs in place to assess vegetation condition'*.
State	*Flora and Fauna Guarantee Act 1988*	The FFG Act has negligible direct influence on conservation of flora or fauna in Knox. However, it provided a basis for *Victoria's Biodiversity Strategy* – see below.
	Victoria's Biodiversity Strategy (1997)	This strategy provided the context and basis for the Native Vegetation Framework, which is more specifically and directly relevant to the Knox study

Jurisdic-tion	Strategy, Policy or similar instrument	Relationship to matters in this study
	The Victorian Native Vegetation Framework (NRE 2002a and supporting documents)	The report you are reading uses methods to describe and assess natural habitat that are prescribed in the Framework, and provides information that should assist greatly in implementation of the Framework.
	Catchment and Land Protection Act 1994	This Act led to the preparation of Regional Catchment Strategies, the Catchment Management Authorities and the regional strategies and plans listed below.
	Victoria Planning Provisions (VPPs), which form a substantial part of the Knox Planning Scheme	The town planning measures recommended in this report must conform to the VPPs. See Chapter 5 below.
Regional	*Port Phillip and Western Port Regional Catchment Strategy*	This strategy has as one of its five goals, *'To protect the diversity and extent of natural ecosystems and species'*. The present study and its recommendations are intended to achieve just that.
	Port Phillip and Westernport Native Vegetation Plan of 2007	An incorporated document in the VPPs.
	Dandenong Catchment Action Plan of 1999	In agreement with the present study, the Catchment Plan identifies that the key pressure for the catchment is loss and degradation of native vegetation and habitat, and that *'The key outcomes for the catchment will be:* • *'enhanced condition of native vegetation communities* • *'extended native vegetation coverage* • *'protection of key areas of wildlife habitat* • *'protection of soil and water quality'*.
Municipal	*'Knox Vision 2025'*	The *Knox Vision 2025* includes the goal that Knox will be known for its sustainable natural environment, including: • *'a green and leafy image enhanced through planning controls, community initiatives and the planting of appropriate vegetation'.* Associated aims include: • *'Further identifying sites of biological significance and seek to protect and enhance through linking these to other sites of significance and best practice in bushland management.* • *'Achieving no further extinctions of fauna or flora species or ecological vegetation classes'.* Some of these objectives arose from the first edition of the present report. This second edition provides further, updated information in support of planning controls, planting advice and reducing the risk of local extinctions of flora, fauna and vegetation classes.
	Knox 2001 – 2010 Sustainable City Strategy; *Knox 2008/2018 Sustainable Environment Strategy*	The present study was specifically foreshadowed in the Sustainable City Strategy and the Sustainable Environment Strategy refers to implementing findings of the study, e.g. preventing local extinctions, fostering habitat corridors and increasing habitat hectares.
	Knox City Council: Council Plan 2009-2013	This study gives support to the following Council Plan strategies: • *'Protect sites of biological significance and prevent further extinction of flora and fauna.* • *'Improve management of pest animals and weeds.* • *'Establish a network of habitat corridors to join sites of biological significance.'*
	Knox Planning Scheme	See Chapter 5 below.

1.5 The Study Approach

This study has four main parts:

- Scientific investigation;
- Identification of issues affecting nature;
- Development of town planning mechanisms to support protection and proper management of biodiversity and habitat; and
- Determination of other practical ways to improve the prospects for maintaining biodiversity and habitat.

The first and largest part comprised a scientific survey of the current state of nature in the municipality (flora, fauna, ecological communities, and the threats that they face), based on fieldwork and a survey of literature and historical information. As discussed in Chapter 2, this included a very detailed field study of the vegetation (particularly native vegetation), whereas fauna were investigated only through literature, observations of other people, and observations made incidentally during the vegetation survey.

Flora and fauna data were transferred to a computer and analysed to determine the abundance and distribution of species and ecological communities in Knox. The results of the survey work are summarised in Chapter 3. Broader-scale data from the Department of Sustainability & Environment provided similar information in a bioregional and state-wide context.

The second part of the study aims to identify what is positively or adversely affecting the natural flora and fauna in Knox. This relies heavily on the results of the field survey, which specifically looked for positive and negative influences on the natural environment.

The third and fourth areas of investigation listed above aim to devise options for improving the positive influences on the natural environment and reducing the adverse effects. The likely costs and benefits of the options have been weighed up against those of inaction to come up with recommendations.

2. Scientific Methods

2.1 Extent of Coverage

No biological study ever aims to survey every organism from the largest tree down to the smallest bacterium. A decision has to be made about what can be surveyed within the available budget and time to provide the best indication of overall biodiversity and ecological wellbeing. This study adopted the usual approach of starting with a detailed survey of the vegetation (excluding mosses, algae, fungi and other lower life-forms) and the habitat that the vegetation provides for native fauna. Fauna were not specifically surveyed, but birds, mammals, frogs, reptiles and butterflies were recorded whenever they were detected during the fieldwork. The two people who conducted the vegetation survey, Dr Graeme Lorimer and Mr Rik Brown, tried to be as observant of wildlife as possible while carrying out their other duties, and observational records were sought from other sources.

The main reasons for the emphasis on surveying vegetation rather than fauna in this study were that:

- The type and condition of vegetation largely determines the richness and wellbeing of fauna; and
- Only a fraction of the total fauna can be observed in any short-term study like this.

The fieldwork excluded much of Knox's parts of the Dandenong Ranges National Park, Lysterfield Lake Park and the Dandenong Valley Parklands, because biological conservation of these areas is the responsibility of Parks Victoria. Nevertheless, pre-existing biological information from these areas was obtained and consideration was given to interactions between these areas and the rest of Knox, such as the parks' importance in conserving certain species and the influences that neighbouring land can have on the parks.

For the rest of Knox, our aim was to investigate every accessible area of natural or semi-natural habitat larger than the size of a typical house allotment. However, some areas of habitat could not be visited.

The largest and probably the most significant areas of unsurveyed habitat are some of the properties within a contiguous expanse of forest cover in The Basin, east of Wicks and Sheffield Roads and abutting the Dandenong Ranges National Park. Many landowners there did not provide permission to inspect their land, and in any case there are far too many hectares to inspect all of them in fine detail. Instead, a representative sample of the properties was inspected in fine detail and the data were extrapolated to other properties by viewing them from the boundaries and making use of aerial photographs, topographic maps and geological maps.

The other area of substantial size that could not be inspected was the part of the Lysterfield Hills owned by Boral and Pioneer, where quarries operate. Permission was not obtained to visit this land, but some third-party information was available.

For sites that could be visited, fieldwork was conducted mostly from November 2001 to November 2003. This was a period of drought, or even extreme drought for the most intensive period, which means that some species of plants and animals were detected less frequently than they would be in a normal year, and perhaps missed altogether.

2.2 Survey of Literature and Pre-existing Information

Dr Lorimer has years of flora and fauna records from some sites. In addition, historical records from other sources were sought to minimise the risk of overlooking any species, and to determine what species may have become locally extinct.

The most reliable source of historical records of plants was the computer catalogue of specimens at the National Herbarium of Victoria. These records are generally reliable because nearly all specimens have been identified by expert botanists who recheck their determinations when taxonomy (essentially, the naming of species) changes. However, collectors of specimens sometimes mislabel the collection locations, and occasionally specimens have obsolete or erroneous identifications.

Some of the herbarium records are well over a century old.

The other main source of old records of plants was the *Victorian Naturalist* journal. Paget (1985) researched all issues of the journal from its inception in the 1880s, seeking plant information about Knox and its surroundings. He found and quoted forty-seven articles about the Field Naturalists Club of Victoria's excursions to the district, between 1890 and 1976. After adjusting obsolete plant names, it appears that numerous plant species were observed in Knox that have not been recorded since the 1940s or earlier. The present author has been careful to discount any dubious records, of which there were rather few.

The standard text, *'Flora of Melbourne'* (Gray and Knight 2001), contains suburb-by-suburb records of indigenous plant species, both historical and recent. Among the historical records for suburbs within Knox are several mentions of orchid species that are not substantiated by any other source material investigated in the present study. These are all treated here as plausible (given that there are extant or verified records of the species close to Knox) but they cannot be given full weight.

The recent records of plant species in *'Flora of Melbourne'* were used as a guide to the regional rarity of species found in Knox. We saw in the field almost all plant species recorded for Knox in '*Flora of Melbourne'*, except about ten which are presumed extinct (Section 3.4).

Beauglehole (1983) provided a very authoritative list of plant species in many parts of the Melbourne region. His field records include a 1982 list for Lysterfield Lake Park, which was checked for species that may be present in Knox and not recorded by others. Another list for the park by Cook (1994) was used the same way.

The Flora Information System of the Department of Sustainability and Environment (DSE) contains records of plants in Knox from many sources, including some erroneous records. It does not differentiate between wild plants and planted specimens. The records served as indicators of locations where unusual species should be sought, but unusual records have not accepted when they could not be verified from reliable primary sources or confirmation in the field. The same approach was taken to other plant lists in 'grey literature' such as management plans. Only species that the present author deems plausible are included in the inventory of Appendix A, with annotation to indicate that they are unconfirmed.

This applies in the particular case of records of flora and fauna in the Dandenong Valley Parklands, which is important because the parklands were inspected only rather superficially in this study. Data were obtained from unpublished lists of Lorimer, Paget, Adams & Simmons and others. Apart from the records of Lorimer, these lists were found to contain some questionable records. Because of this, and given the undoubtedly very significant habitat that the parklands contain, it is quite likely that there are plant species present there which are not yet recorded in Knox (or at least, not reliably).

The Department of Sustainability & Environment maintains a computer inventory of fauna records called the Atlas of Victorian Wildlife. This was a major source of fauna records.

Some of the department's BioMaps also show locations where rare or threatened species of flora or fauna have been recorded, and these were used as prompts for checking in the field. Some of these records were found to be unreliable due to false locations or false identifications.

Several residents and groups provided species lists of fauna in Knox, or in one case extending slightly beyond Knox into Upwey (see Acknowledgments, p.iii). The expertise and care of these contributors in preparing their lists was excellent and the records have been accepted as reliable after careful scrutiny by the author.

A few additional records were found in the 'Knox Wildlife Atlas', a database maintained by Knox City Council. Any records that appeared questionable or that probably arose from escaped animals were not accepted.

A literature survey was conducted to investigate previous studies' classifications of vegetation communities and habitat types. A specification for this project was to relate the vegetation to the classification scheme of 'Ecological Vegetation Classes', or EVCs, that is routinely employed by the Department of Sustainability and Environment. Unfortunately, the only published work that has tried to use this system of classification in Knox is the 'BioMap' project of Oates and Taranto (2001), whose authors warn that their mapping was only a 'first draft' that had not been subjected to the intended degree of ground-truthing. It was found to be unreliable. More reliable information was obtained from an unpublished vegetation mapping study by Frood (in preparation) for the Dandenong Ranges National Park, but the area covered is just outside Knox's eastern boundary.

The Department of Sustainability & Environment has estimated the current and pre-European extent of each EVC within each bioregion, in hectares. The figures are likely to be fairly robust to inaccuracies in the mapping of EVCs, due to the summation of areas within whole bioregions. From these figures, the department has applied a formula given in the National Native Vegetation Framework and the Victorian Native Vegetation Framework (NRE 2002a) to determine the 'conservation status' of each EVC in each bioregion, using categories of 'Presumed Extinct', 'Endangered', 'Vulnerable', 'Depleted', 'Rare' and 'Least Concern'. These categories and the underlying data appear on the CD-ROM that accompanies the Port Phillip and Westernport Native Vegetation Plan (PPWCMA 2006). They are used in determination of each site's biological significance level (Section 2.6).

The Department of Sustainability & Environment maintains a 'BioSites' database of sites of biological significance (NRE 2002b). This database was searched for records within Knox. The only ones present were for Koolunga Native Reserve in Ferntree Gully and Liverpool Road Retarding Basin in Boronia. Both records are incomplete and provided no assistance to the present study. This is because the database is in its infancy and negligible effort had been exerted on sites in Knox. The present study can provide a great deal of data to go into the BioSites database.

2.3 Finding Potential Sites of Significance

Potential sites of biological significance were sought throughout the municipality on both public and private land. Sites that were already identified in the Knox Planning Scheme as a result of the study by Water Ecoscience (1998) served as a starting point, and all of these were inspected.

Digital aerial photographs with a resolution of 60 cm were scrutinised to locate any other treed areas larger than a typical house allotment. The list of such sites was combined with the personal knowledge of the authors, Council staff and others to obtain an initial list of over 150 sites that were either known to be significant or warranted inspection.

Several additional sites were detected in the course of the inspections, which involved travelling along probably every road in Knox where natural or semi-natural vegetation could be found.

2.4 Site Inspections

Fieldwork for the first edition of this report was done mostly between November 2001 and November 2003 by Dr Graeme Lorimer and Mr Rik Brown. Follow-up fieldwork as summarised on page vii was done by Dr Lorimer during 2007-2010. The tasks undertaken were to:

- Map site boundaries, matching property boundaries as far as possible;
- Map the parts of each site covered with different EVCs and, where appropriate, different floristic communities within EVCs;
- Describe the vegetation structure and composition within each vegetation type in detail so that the correct EVC name could be reliably determined and justified (Section 2.4.1);
- Record a thorough inventory of species of indigenous plants and environmental weeds within each vegetation type, and often within each separate area of each vegetation type (Section 2.4.2);
- Record the severity of environmental weeds using a four-level scale (Section 2.4.3);
- Record the population status of each species that is rare or threatened in Knox (typically population size, security and threats);
- Assess and describe the ecological condition of the vegetation within each vegetation type, sometimes with a map to show areas of different ecological condition;
- Record all birds, frogs, butterflies (not skippers) and native mammals observed during the survey;
- Record wildlife signs and habitat features;
- Record other attributes relevant for a Statement of Significance under the Planning Scheme;

- Indicate other threats to the significant attributes of the site (e.g. dieback, garden waste dumping, over-frequent slashing);
- Provide management recommendations for conserving the significant attributes;
- Provide monitoring recommendations.

All records of flora and fauna at each site will be lodged with the Department of Sustainability and Environment's Arthur Rylah Institute, which is the central repository for such data in Victoria. The information recorded was also designed to facilitate simple entry into the Department of Sustainability & Environment's BioSites database of biologically significant sites, which has negligible data for Knox at present.

2.4.1 Delineation of Vegetation Types

One of the first tasks in assessing each site was to determine boundaries between different types of vegetation and to characterise each type in detail. A list was compiled of all species of indigenous plants and environmental weeds within each type of vegetation, and other information was recorded as indicated on the following excerpt from the field data sheet that was used:

Geology, soil & topographic determinants: .....
Uppermost trees (species, height, density): .....
Lower trees / large shrubs (species, height, density): .....
Vines / climbers: .....
Shrubs: .....
.....
Ferns: .....
Ground flora – dominant species: .....
.....
Ground flora – other abundant species: .....
.....
Ground flora – total % coverage by all species: ..... Richness: .....
Non-dominant character spp and indicator spp: .....
.....
Understorey partitioning between heathy shrubs, other shrubs, grassy spp., tough sedges &c: .....
.....
How mesic or xeric; What limiting factor?: .....
Visibility (typical distance within which one can readily see a person walking): .....
Percentage in ecological conditions A to D: .....
Likely deviations from natural state: .....
.....
.....

These data should be adequate to determine and justify the appropriate designation of EVC applied to each area, particularly by reference to Appendix A, published descriptions of the EVCs (e.g. Oates and Taranto 2001, Commonwealth and Victorian Regional Forest Agreement Steering Committee 1997) and the Department of Sustainability and Environment's 'benchmark' descriptions of EVCs within each bioregion.

2.4.2 Detection and Recording of Plant Species

Botanists of the Department of Sustainability & Environment generally record plant species in an area by surveying vegetation intensively within sample plots ('quadrats') of about 30 m × 30 m, and more superficially over the majority of the land (e.g. Gullan *et al*., 1979). This is a sensible method for the vast areas that they

often study, but to do so in the much smaller and patchier sites of this study would result in overlooking a significant proportion of the plants present.

This study therefore involved a concerted attempt to record all detectable indigenous plant species on each site, with the exception of some private land that could only be inspected from the boundary. For almost every site, a separate list of plant species (indigenous and environmental weeds) was compiled for each habitat type within the site.

Introduced species were recorded with differing degrees of thoroughness depending on the state of the vegetation. Only serious weeds were noted where few indigenous plants remained, whereas full lists of weeds were compiled for the most intact vegetation.

2.4.3 Weed Severity

The severity of each species of environmental weed recorded at each site was rated according to a four-level scale:

'**Very Serious'**: Currently becoming denser and/or more widespread, to the extent that the vegetation's current value for indigenous flora or fauna is expected to suffer a very serious reduction within the next few years if new measures are not introduced to control this species. This excludes weeds that have already done such damage but are no longer actively and very seriously replacing the remaining indigenous flora and fauna;

'**Serious'**: Seriously diminishing the vegetation's value for indigenous flora or fauna by causing active deterioration or preventing ecological recovery, or else likely to become very serious (as defined above) within 5-10 years if preventative action is not taken;

'**Moderate'**: Not as serious as above, but still causing (or likely to cause in future) significant diminution of the vegetation's value for habitat or protection of land and water, either by causing active deterioration or preventing ecological recovery;

'**Insignificant'**: Not representing any significant ecological threat, e.g. weeds that are expected not to spread beyond the edges of paths and tracks.

This is very similar to the scale of Carr *et al.* (1992), except that it is more explicit about whether the harm being caused is present or potential, and it makes provision for plants that are currently causing moderate (not serious) harm with no indication of becoming serious in future. The 'Moderate' category above corresponds to Carr *et al*'s 'P' (potentially serious) category and the 'Insignificant' category above corresponds to Carr *et al*'s 'N' (not a threat) category.

Note that the past effects of environmental weeds are not taken into account in this exercise. For example, consider an area that has been reduced to just vestiges of indigenous flora due to decades of competition by pines and has reached a rather stable state. Although the accumulated effect of the pines may have been very serious, this was in the past and a 'Very Serious' rating would be inappropriate under the approach adopted here. However, if the observer believes that the indigenous habitat could recover if the pines were removed, then a 'Serious' designation could be applied because the pines are a serious impediment to the future value of the site for flora or fauna.

This system of rating environmental weeds across the municipality provides a scientific basis for assessing which species are presently causing greatest ecological harm or threat. This is more useful for developing policy and strategies than a classification scheme that takes into account how much harm has been caused by each species in the past (e.g. those based on percentage cover of weed species).

2.4.4 Vegetation Quality and Condition

Habitat Scores

During the conduct of this project, the Department of Sustainability & Environment produced the 'Habitat Hectares' method (DSE 2004) for measuring what the department calls 'vegetation quality'. It yields a 'habitat score' based on the vegetation's ecological condition, the presence of logs and hollow-bearing trees, the extent

of contiguous native vegetation and connectivity to other areas of native vegetation. Habitat scores play a critical role in the Victorian Native Vegetation Framework (NRE 2002a).

A habitat score can only be validly determined for an area, called a 'habitat zone', that supports a single Ecological Vegetation Class (EVC) and that is fairly uniform in its ecological characteristics, taking into account tree density, diversity of plant sizes and forms, weediness, degree of plant regeneration, organic litter cover and presence of logs. The zone must also be at least 1,000 m² in area for the Habitat Hectares method to work, and there must be a 'benchmark' that describes characteristic features of the relevant EVC in its natural state. Sites of biological significance in Knox typically have more than ten such zones.

Ideally, habitat scores would have been determined for each part of each site investigated in the present study, but:

- The method and its technical details were not available until most of the work had been done;
- Many zones measure less than the required 1,000 m² for valid application of the Habitat Hectares method, due to small-scale patchiness in vegetation quality; and
- Determination of habitat scores roughly doubles the time taken to inspect the sites.

Consequently, habitat scores were determined for a minority sites in this study. In the case of a few sites, the absence of habitat score data means that the significance ratings (Local, Regional, State and National) are less certain than they would otherwise be. These cases are highlighted in the relevant sections of Volume 2.

Ecological Condition

To overcome the limitations of the Habitat Hectares method, a simpler and more qualitative method of rating vegetation condition was used, following Lorimer *et al*. (1997). This maintained consistency with several earlier investigations of vegetation in Knox (e.g. Reid *et al*. 1997b; Lorimer 1998, 1999a, 1999b, 2000). This method measures the ecological condition of vegetation, but does not directly take into account other aspects of the Habitat Hectares method, mainly related to the abundance of logs, large old trees and forest litter. Account is taken of the vegetation's stage of regeneration or senescence of vegetation as a result of its recent history, whereas the Habitat Hectares method has been criticised for marking down vegetation that is not 'long undisturbed'.

This method relies on the observation that human modification of a natural environment generally causes a reduction in biodiversity (i.e. species and genetic variability) over time and a shift from native to introduced species. Plants are very good indicators of this process; indigenous plants tend to be replaced by weeds, and the total number of plant species declines.

This process goes through several stages. First, a few indigenous plant species that are sensitive to disturbance disappear, while most other species survive and reproduce. With greater disturbance, the number of lost indigenous species increases and some of the remaining ones struggle to reproduce, typically due to reproductive problems or because seedlings are out-competed by weeds. A stage may then arise where half or more of the indigenous species die out, leaving only hardy species that can survive against weed invasion and loss of the native fauna that provide pollination and pest control. If vegetation is removed to make way for urban development, underground services, recreation grounds, gardens or similar uses, only the hardiest plants are likely to survive or regenerate (such as isolated remnant trees in gardens), and these generally gradually decline because they cannot reproduce effectively (e.g. tree seedlings being mowed).

This led the author to devise a scale from A to D based on the position of vegetation in the stages of degradation just described. The ratings are designed to be easily determined in the field, using criteria based on two factors:

- The number of indigenous plant species remaining compared with expectations of a pristine site of the same size and vegetation type; and
- The ability of the indigenous species present to survive and reproduce.

The categories are:

Rating A: Contains almost all of the indigenous plant species that one could expect to occur in that type of vegetation (taking into account the size of the area); at least 80% of plant species able to reproduce

adequately to maintain their numbers. To aid readability, this is generally represented in Volume 2 as 'ecological condition A (excellent)'.

Rating B: Contains at least half of the indigenous plant species that could be expected, but not reaching rating A due to loss of species or reproductive failure. Better management and some revegetation can usually raise the rating to A. This is generally represented in Volume 2 as 'ecological condition B (good)'.

Rating C: Contains less than half of the indigenous plant species that could be expected, but more than about 20% (or at least with the vegetation structure fairly natural). Most of the indigenous plants are likely to be able to reproduce successfully. This is generally represented in Volume 2 as 'ecological condition C (fair)'.

Rating D: Contains less than half of the indigenous plant species that could be expected, frequently less than 20%. Only a handful of species are likely to be reproducing successfully. These areas usually have value only for landscape and hardier wildlife, or as buffers or stepping-stones to areas of better habitat. This is generally represented in Volume 2 as 'ecological condition D (poor)'.

In marginal cases, attention is focused on the plant species that are expected to play the most important ecological role, such as the naturally dominant species in the overstorey and understorey. If the loss of biodiversity is particularly evident among the most ecologically important species, the lower ranking is assigned.

While this method for assessing ecological condition is based on plants, it can be combined with an analysis of the spatial distribution of ecologically connected habitat to obtain a reasonable indication of an area's value to wildlife.

We also believe that the ecological condition scale above is a good workable indicator of the value of a site for conservation of biodiversity. Note that it differs from most indicators of vegetation 'quality' published elsewhere, in that it does not downgrade a site solely for the presence of weeds. For example, many wetlands in Knox have a relatively high density of weeds in a stable coexistence with high numbers of indigenous species (e.g. in the Dandenong Valley Parklands). The ecological condition rating may be 'B' in such a case, despite the weediness, because the indigenous plants are secure. A typical 'vegetation quality' indicator would rate such a site as being of poor quality because of the significant proportion of weeds.

The ecological condition scale above places value on conservation of biodiversity, not on naturalness. A site such as the one quoted above may disappoint people who value naturalness very highly, but that is a secondary consideration for the objectives of this report.

For each of the sites described in detail in Volume 2, there is an estimate of what area of vegetation within each vegetation type falls into each rating of ecological condition; e.g. "Grassy Forest – 0.7 ha in ecological condition 'A' (good), 1·2 ha in ecological condition 'C' (fair) and 2.0 ha in ecological condition 'D' (poor)".

2.5 Incidental Records

Throughout the study, Dr Lorimer and Mr Brown noted any occurrences of flora and fauna that were not recorded in the formal surveys described above, such as birds observed while driving around Knox, or unusual plants seen outside the identified sites of significance.

2.6 Significance Ratings

The biological significance of each site has been classified as 'Local', 'Regional', 'State' or 'National' according to the objective criteria employed by the Department of Sustainability & Environment (Amos 2004).

The significance rating of a site should not be confused with the 'conservation significance' of a particular part of a site, as defined in the Native Vegetation Framework (NRE 2002a, Appendix 3). The latter uses a scale of 'Low', 'Medium', 'High' and 'Very High', and usually varies substantially from one part of a site to another depending on ecological condition, the rarity of the vegetation type and similar factors. As a result, the area

affected by a hypothetical land development may have a conservation significance (according to the Framework) that is 'Low' or even absent, even though the site as a whole may have State significance. One should therefore be careful not to draw too many conclusions from a site's significance level about the appropriateness of land developments there.

The criteria that are used for assessing the significance level of a site fall under the following headings:

1. *Ecological integrity and viability*: the importance of a site as an exceptionally intact example of its type, or in critical habitat requirements (e.g. breeding sites) at the regional scale or wider;
2. *Richness and diversity*: for sites with exceptionally large numbers of species, families, vegetation types etc.;
3. *Rarity*: the importance in conserving species or communities that are listed as rare or threatened;
4. *Representative of a type*: the importance of a particular site or population in demonstrating the principal characteristics or variability of the habitat type or species involved – e.g. showing the features of a habitat type at the limits of its tolerance, or occurring in particularly unusual circumstances); and
5. *Scientific and educational value*: the importance of a site or species in contributing to wider understanding of natural history, by virtue of its use for research, an educational resource, a reference site, a fossil site, etc.

The significance level assigned to a site is the highest level that is determined under any of the individual criteria.

The attribute that most commonly determines the significance of sites in Knox is the presence of a remnant of an Endangered EVC, which confers State significance on a site. Under criterion 3.2.3 of Amos (2004), this only applies to 'remnant patches' as defined under the 'Operational Guidelines' for the Native Vegetation Framework. The 'Operational Guidelines' document was in preparation at the time the criteria were written but were subsequently abandoned, leaving the definition of 'remnant patch' to be published by DSE (2007) as follows:

- *'an area of vegetation, with or without trees, where less than 75% of the total understorey plant cover is weeds or non-native plants (bare ground is not included). That is at least 25% of the understorey cover is native; or*
- *'an area of treed vegetation where the density of the trees is such that canopy tree cover is at least at benchmark canopy cover'.*

For these purposes, the Department of Sustainability & Environment takes understorey to encompass all plants other than mature, long-lived canopy trees. In Knox, even quite weedy native vegetation typically includes enough cover of immature eucalypts and hardy indigenous understorey species such as Black Wattle (*Acacia mearnsii*), Blackwood (*Acacia melanoxylon*), Weeping Grass (*Microlaena stipoides*) and Clustered Wallaby-grass (*Rytidosperma racemosum = Danthonia racemosa = Austrodanthonia racemosa*) to meet the definition of a remnant patch. If, in addition, the EVC is listed as Endangered (as is normal in Knox), the site containing the vegetation meets criterion 3.2.3 of Amos (2004) for a site of State significance.

A consequence is that many sites in Knox are of State significance by the above criteria even though their mediocre ecological condition would have given them only a 'Local' or 'Regional' significance rating by the criteria that most biologists in Victoria used in the twentieth century. As explained by Amos (2004), *'The interpretation used in this document is that that the site makes a substantial contribution to the conservation of the asset* [i.e. the feature that makes the site significant] *at a given scale. The second interpretation (which is not used here) is that the asset or site is outstanding when compared to others within the frame of reference'.* Even though a particular patch of an endangered EVC may not be an outstanding example within the Victorian context, endangered EVCs are so scarce that all surviving examples are deemed by Amos (2004) to make a substantial contribution to the state-wide conservation effort.

3. Scientific Findings

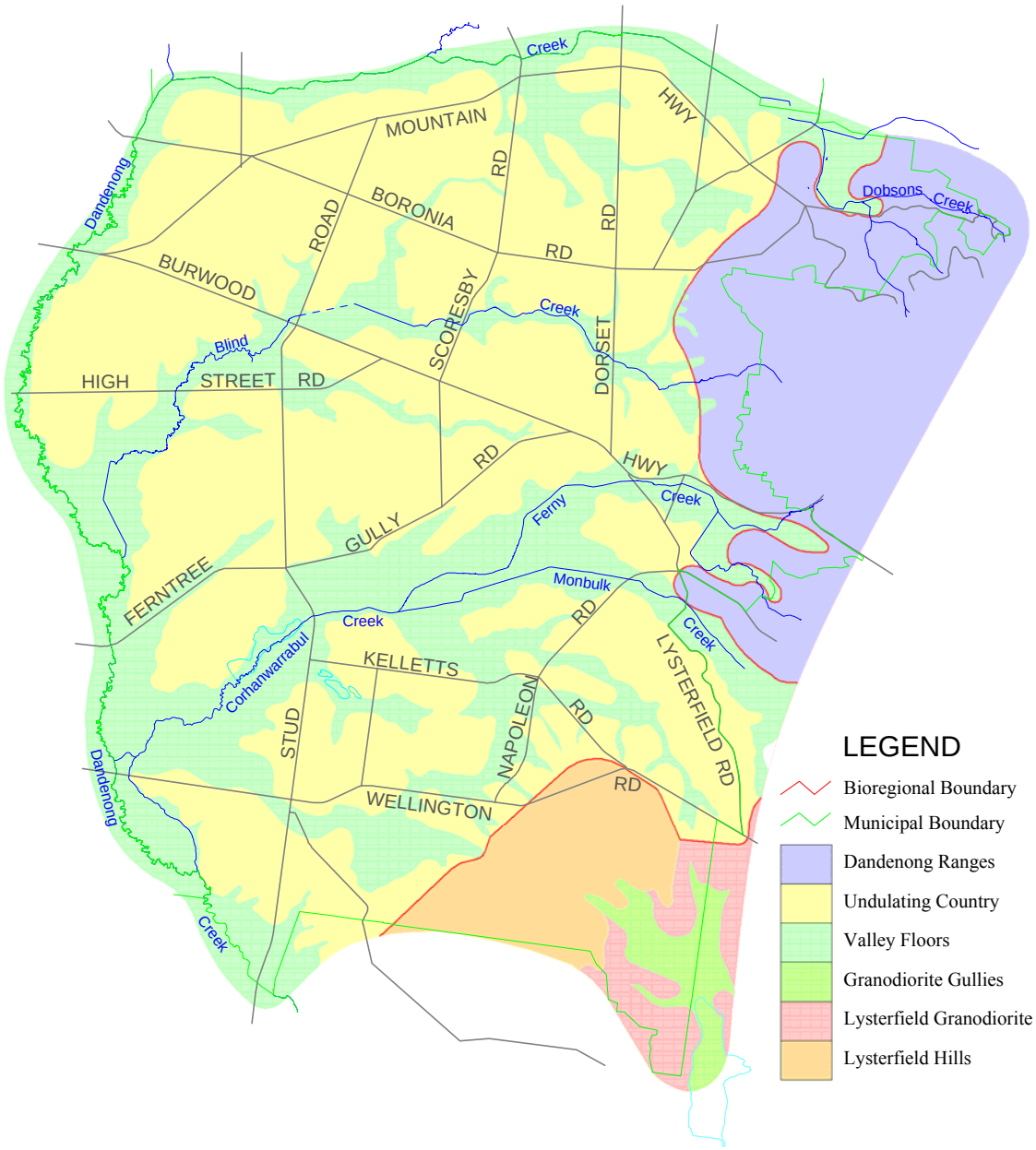


Figure 2. Bioregions and biogeographical zones of Knox. The area generally west of the red curves is the Gippsland Plain bioregion, and the remainder is the Highlands Southern Fall bioregion.

3.1 Bioregions

Knox has been recognised for many years as spanning two biogeographical regions, or 'bioregions', that have more recently come to be called the 'Gippsland Plain' and the 'Highlands Southern Fall' (Willis 1962; Conn 1993; Thackway & Cresswell 1995). In general, the former is characterised by low-lying, near-coastal environments with predominantly woodland vegetation, whereas the latter tends to be characterised by more hilly areas of higher rainfall, dominated by tall forests except on terrain that is particularly exposed to the

elements. In Knox, the transition is determined by geology, with lightly undulating terrain of sedimentary origin in the Gippsland Plain bioregion and hilly terrain of volcanic origin in the Highlands Southern Fall.

The whole of Knox has a cool-temperate, Mediterranean climate. Annual average precipitation in the part that lies within the Gippsland Plain bioregion grades from approximately 800 mm in the west to approximately 1,000 mm in the east. This is very similar to the Highlands Southern Fall part of Knox, whose rainfall ranges from approximately 800 mm at the western end of the Lysterfield Hills to 1,100 mm at Knox's eastern extremity in Sassafras.

The extensive fieldwork of the present study has allowed refinement of the boundary between these bioregions, and further subdivision into finer-scale biogeographical zones according to patterns of geology, soil moisture, soil fertility, topography and the resulting types of vegetation and fauna. The results appear in Figure 2.

The precision with which one can draw a boundary between bioregions varies along the boundary. At its best, in parts of Boronia and Rowville, the transition between bioregions occurs over a band less than 200 m wide. In the vicinity of the intersection of Lysterfield Rd and Wellington Rd, the red bioregional boundary on Figure 2 has been drawn close to that currently recognised by the Department of Sustainability & Environment, but there would be some justification for moving it northward by up to 1·4 km to coincide with the junction between sedimentary and volcanic geology. The department also presently regards the low ridge to the northwest of the intersection of Napoleon Rd and Lysterfield Rd (the Blackwood Park estate) as part of the Highlands Southern Fall, but that seems inconsistent with their treatment of every other ridge and knoll along that geological formation. Figure 2 therefore shows the boundary in that vicinity following a pronounced steepening of terrain that is associated with the edge of the Dandenong Ranges volcanic formation.

The bioregional boundary plays a very important role in determining the legal protection of native vegetation in Knox. Under the Victorian government's 'Native Vegetation Framework' for protection and management of native vegetation (NRE 2002a), there is a strong tendency for native vegetation on the Gippsland Plain to be treated as more valuable than vegetation of the same type and condition in the Highlands Southern Fall. This is because the former bioregion retains far less native vegetation than the latter. Consequently, native vegetation located on the transition between the bioregions might be treated quite differently by government and under the Planning Scheme, depending on whether it is deemed to be on one side or the other of the bioregional boundary. The issues that arise are more of a legal and administrative nature than ecological, and are therefore not considered further here.

3.2 Biogeographical Zones

At a finer scale than the bioregions, Knox can be divided into the six biogeographical zones shown in different colours on Figure 2, according to patterns of geology, soil moisture, soil fertility, topography and the resulting types of vegetation and fauna.

Within each zone, the pre-European flora and fauna at any particular location were primarily determined by topographic factors, such as steepness and the direction that the slope faces. The flora and fauna on a site vary naturally with time due to the cycles of fires, floods, storms and droughts.

The characteristics of each zone are discussed in the following subsections.

3.2.1 Dandenong Ranges

The eastern edge of Knox extends into the lower slopes of the Dandenong Ranges, formed from Devonian volcanic rock eroded to a clay loam. The combination of hilly terrain, volcanic soil origins and the highest rainfall in Knox (approximately 1,000 mm annual average) provides conditions for flora and fauna associated more with the Dandenong Ranges than the rest of Knox, e.g. abundant Mountain Grey-gums and Australian King-parrots.

At the edge of this zone, most of the way between The Basin and Upper Ferntree Gully, there are deposits of soil called colluvium that have slumped downhill over geological time. These areas can have some characteristics intermediate between the Dandenong Ranges and the area of sedimentary geology to the west.

Distinctive vegetation occurs where the colluvium is shallow, such as at Wicks Reserve in The Basin and Koolunga Native Reserve in Ferntree Gully, due to the effects of water seepage and the different sorts of conditions experienced by shallow roots compared with deep tree roots.

Within this zone, the Ecological Vegetation Classes recognised by the Department of Sustainability & Environment show a pattern of:

- Damp Forest in the wettest gullies;
- Herb-rich Foothill Forest in other gullies;
- Grassy Forest on lower, less exposed slopes;
- Grassy Dry Forest on exposed mid-slopes; and
- Shrubby Foothill Forest on the upper slopes (typically >400 m above sea level).

There are also smaller patches of Valley Grassy Forest, Lowland Forest and Shrubby Gully Forest.

3.2.2 Undulating Country

The part of the Gippsland Plain bioregion that occurs in Knox can be divided into valley floors and gently undulating terrain with shallow slopes and moderate drainage. The latter is the 'undulating country' shown in yellow on Figure 2. It has thin duplex soils with light grey loam topsoil over clay subsoil. These are derived from Upper Silurian and Devonian sediments, or from metamorphic rock (principally hornfels) at the interface between these sediments and the volcanic formations of the Dandenong Ranges.

The southeastern corner of this zone, near the intersection of Wellington Rd and Lysterfield Rd, differs in its volcanic soil (a gritty, light grey loam over clay). In this respect, this corner of the zone could be classified as part of the 'Lysterfield Granodiorite' zone of Section 3.2.5, i.e. part of the Highland Southern Fall bioregion. However, the Department of Sustainability & Environment presently regards it as being part of the Gippsland Plain bioregion, presumably because of its topography.

The annual average rainfall in this zone grades from about 800 mm in the west to about 1,000 mm in the east.

Nearly all of the original vegetation of the zone belonged to the nationally endangered Ecological Vegetation Class, Valley Heathy Forest. Exceptions occur in the southeastern corner where Herb-rich Foothill Forest occurs due to the volcanic soil, and at Old Joes Creek in Boronia where Lowland Forest and Damp Forest occur in small patches due to unusual local geography.

3.2.3 Valley Floors

The valley floors within the Gippsland Plain part of Knox are covered with moderately fertile, alluvial soil washed down from the hills. The broadest ones visible on Figure 2 are floodplains with early European descriptions like 'impassable swamp' or 'very swampy and scrubby' (Paget, 1985). For most of the year, soil moisture is abundant and reliable due to drainage and seepage from higher ground. However, the soil often dries out greatly during February to April except within a small distance of the perennial streams. The variation of rainfall across the municipality causes no noticeable gradient in the flora or fauna of this zone because the main factors determining soil moisture are drainage and seepage rather than local rainfall intensity.

Prior to European settlement, the Ecological Vegetation Classes in this zone were:

- A narrow band of Swampy Riparian Woodland dominated by Swamp Gums (*Eucalyptus ovata*), or occasionally Riparian Forest dominated by Manna Gums (*Eucalyptus viminalis*), along perennial streams, where soil moisture was maintained during the driest months by water seeping out of the stream;
- Swampy Woodland over large areas, dominated by Swamp Gums, Mealy (or Silver-leafed) Stringybarks (*Eucalyptus cephalocarpa*) and Swamp Paperbarks (*Melaleuca ericifolia*);
- Floodplain Riparian Woodland, which is confined to the broadest areas of Dandenong Creek's floodplain, south from about High Street Rd (and possibly also along Corhanwarrabul Creek and Monbulk Creek prior to settlement); and

- Wetlands of various sizes, depths and compositions.

These areas have been favoured for agriculture, drainage works and sewers, and they are also susceptible to massive invasion of vine weeds like blackberry (*Rubus anglocandicans*), Japanese Honeysuckle (*Lonicera japonica*), Wandering Jew (*Tradescantia fluminensis*) and Greater Bindweed (*Calystegia silvatica*). Consequently, this biogeographical zone has been very badly degraded almost throughout, despite the comparatively large area that is reserved.

3.2.4 Granodiorite Gullies

Granodiorite is the type of Upper Devonian volcanic rock found in the southeastern corner of Knox. It provides less nutrients and more skeletal soil for plant growth than elsewhere in the municipality. Some of it has eroded and washed into gullies that now flow into Lysterfield Lake.

All of these gullies within Knox are in Lysterfield Park, and were not inspected for this project because the park is outside the scope of detailed investigation for this project (being under the control of Parks Victoria).

The Department of Sustainability & Environment's BioMaps give conflicting accounts of the nature of these gullies. The BioMap of extant Ecological Vegetation Classes (EVCs) shows Shrubby Gully Forest, but the BioMap of pre-European EVCs shows the same EVCs as gullies in the 'Valley Floors' zone of Section 3.2.3 above. Vegetation mapping by Cook (1994) tends to support the latter (for example, he recorded not one *Melaleuca squarrosa*, which is usually a dominant species in Shrubby Gully Forest), but his descriptions of vegetation types are not consistent with current concepts of EVCs.

On balance, it seems more likely that this zone is not sufficiently different from the previous one to warrant separate recognition, but site inspection would resolve this.

3.2.5 Lysterfield Granodiorite

This zone extends east of the Lysterfield Hills Ridge as far as Gembrook and south almost as far as the Princes Hwy. Its characteristics are determined principally by the geology (hence the title), with its moderate undulations, frequent granitic boulders and sandy to gravelly soil of low fertility, providing generally poor growing conditions for plants.

Because of the low fertility, the vegetation in this zone tends to be more heathy and scrubby than surrounding areas, with lower trees – particularly Bundy (or Long-leafed Box) and Mealy (or Silver-leafed) Stringybark.

In Knox, the only native vegetation in this zone is confined to Lysterfield Park, which was not visited in the project. The Department of Sustainability & Environment's BioMaps indicate that the only EVC present is Grassy Forest, and that this was also true prior to European settlement. Cook (1994) indicates that there may also be a trace of Heathy Woodland on the western shore of Lysterfield Lake.

3.2.6 Lysterfield Hills

The Lysterfield Hills form a prominent ridge at the northwestern corner of the Lysterfield Granodiorite geological formation. It is characterised by steep slopes, heavily dissected terrain and gritty soil of rather poor fertility and structure.

This zone could be further subdivided into the steeper northwestern side of the ridge with its naturally sparse and stunted vegetation, and the opposite, sheltered side with its broader valleys and lusher vegetation.

The EVCs that once covered nearly all the northwestern side are Valley Grassy Forest and a rare variant of Grassy Dry Forest (see Appendix A). There are also minor gullies on private land whose vegetation could not be inspected in this project, and there is conflicting evidence about what EVCs may belong there.

The EVCs on the sheltered side were also not inspected in this project because no permission was given to access the private land and the Parks Victoria land is outside the project's scope. Subject to an expert inspection of the area, it seems that the EVCs there are:

- Damp Forest in small areas at the headwaters of several gullies;
- Herb-rich Foothill Forest elsewhere in the gullies; and
- Grassy Forest elsewhere.

3.3 Habitat Types

The Department of Sustainability and Environment has developed a state-wide vegetation classification scheme based on 'Ecological Vegetation Classes', or EVCs, that were introduced for the 'Old Growth Study of East Gippsland' (Woodgate *et al.* 1994). Each EVC is intended to be characterised by a fairly consistent set of major ecological features. An example is the 'Wet Forest' EVC, which represents hilly environments with high rainfall, a very tall, fairly dense canopy of eucalypts, a layer of lower trees, many vines and abundant tree-ferns and other ferns. A single EVC may embrace multiple 'floristic communities' that have different combinations of flora species, provided that the ecological functions are sufficiently similar.

The EVCs that have been identified in Knox during the present project are listed in Table 2 in order of the standard EVC numbering system (with Sedge Swamp aggregated with Swampy Woodland and all other wetland EVCs aggregated within EVC 74). Their identifying features and other characteristics are described in Appendix A.

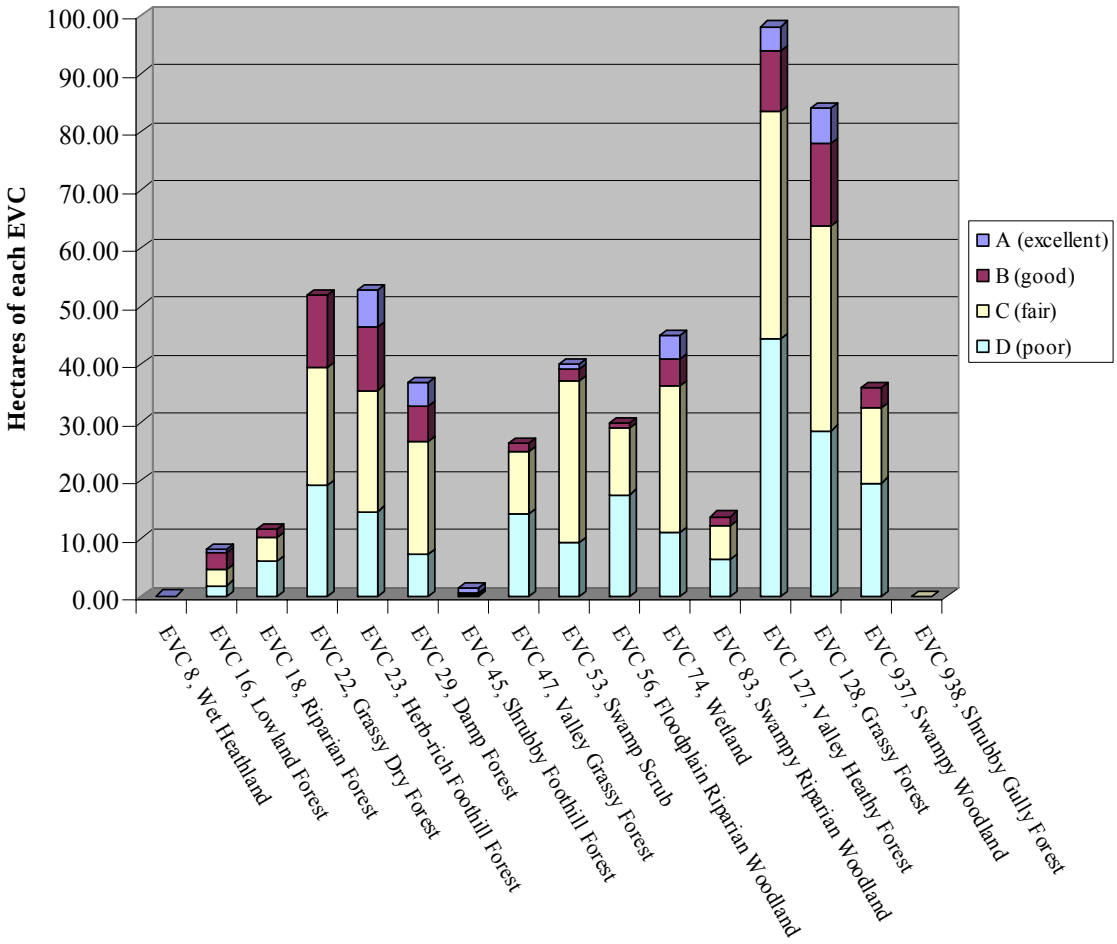
Table 2. EVCs identified in Knox, with numbers of hectares present in different ecological condition.
A dash in the Conservation Status columns means that the EVC does not occur in that bioregion within Knox.

EVC No.	EVC Name	Bioregional Conservation Status		No. of Sites	Ecological Condition (Section 2.4.4)				
		Gippsland Plain	Highlands Southern Fall		A (excellent)	B (good)	C (fair)	D (poor)	Total, A-D
8	Wet Heathland	–	Depleted	1	0.09	0.09	0	0	0.18
16	Lowland Forest	Vulnerable	Least Concern	6	0.44	2.92	2.76	1.92	8.05
18	Riparian Forest	Vulnerable	Least Concern	9	0	1.60	4.05	6.00	11.65
22	Grassy Dry Forest	–	Least Concern	6	0	12.28	20.34	19.21	51.83
23	Herb-rich Foothill Forest	Vulnerable	Least Concern	10	6.30	10.98	20.86	14.65	52.79
29	Damp Forest	Endangered	Least Concern	3	4.03	6.12	19.30	7.31	36.76
45	Shrubby Foothill Forest	–	Least Concern	1	1.00	0.30	0.20	0	1.50
47	Valley Grassy Forest	Vulnerable	Vulnerable	7	0	1.63	10.63	14.20	26.45
53	Swamp Scrub	Endangered	–	6	0.90	2.01	27.90	9.23	40.04
56	Floodplain Riparian Woodland	Endangered	–	5	0	0.8	11.53	17.57	29.87
74	Wetland	Endangered	Endangered	33	3.81	4.75	25.21	11.06	44.82
83	Swampy Riparian Woodland	Endangered	Vulnerable	10	0	1.53	5.74	6.52	13.79
127	Valley Heathy Forest	Endangered	Vulnerable	68	4.18	10.44	39.18	44.27	98.07
128	Grassy Forest	Endangered	Vulnerable	19	6.08	14.30	35.21	28.56	84.15
937	Swampy Woodland	Endangered	Vulnerable	40	0	3.48	12.80	19.60	35.88
938	Shrubby Gully Forest	–	Vulnerable	1	0	0	0.03	0	0.03
				Totals:	26.83	73.23	235.74	200.1	535.86

The areas of each EVC have been estimated or calculated for each of the sites described in Volume 2. These figures have been further broken down into areas at each level of ecological condition (categories A to D,

Section 2.4.4). The figures for each site are given in Volume 2. Aggregate figures appear in Table 2 and are graphed in Figure 3.

Figure 3. Graphical representation of the number of hectares of each EVC in Knox, subdivided according to ecological condition (ratings A to D, see Section 2.4.4).



To translate a number of hectares in the table to a percentage of Knox's total area, divide by 114. For example, the total area with vegetation having excellent or good ecological condition is (26·83+73·23)÷114 = 0·88% of Knox.

The EVCs listed in Table 2 do not exactly match those mapped on the BioMaps described by Oates and Taranto (2001), and the sites at which each EVC appears on the BioMaps differ from those identified here. Oates and Taranto warn on p.24 of their report that the spatial pattern of EVCs was only determined to a precision suitable for displaying at a scale of 1:100,000 or more (i.e. much coarser than for this study), and that the majority of Knox, covered by the Kilsyth and Lysterfield BioMap sheets, was not visited for field assessment. The BioMaps also have straightforward mapping errors, such as the implausible occurrence of Wet Forest and Creekline Herb-rich Woodland on the Dandenong Creek floodplain at Liverpool Rd.

This highlights the need to treat EVC classifications with caution. Even though EVCs offer the best classification system for native vegetation currently available for the purposes of this report, it is important to now consider the system's limitations.

The EVC classification scheme is still under development. In many cases EVC names are being applied inconsistently by different people, with the greatest disparities arising between botanists in different parts of Victoria. One should therefore allow for changes in the classification scheme as botanists and ecologists come to a more common understanding of how it should work.

There are also other reasons why people may classify vegetation differently from each other using the EVC system:

- Some vegetation is intermediate between two or more EVCs;
- Some vegetation is so heavily modified from its natural state that it is only a shadow of its former self, and it can be extremely difficult to relate it to any EVC. (EVCs are not devised for heavily modified environments.);
- Some quite natural vegetation does not fit any recognised EVC, in which case some people may classify it as one of several similar EVCs, some people may struggle with classification and choose an inaccurate EVC, and others may classify it outside the EVC system altogether (as with the Sedge Swamp recognised in Appendix A);
- Some groups of related EVCs are given collective names (often ending in the word, 'complex'), in addition to the names of the various members of the groups. This is particularly so in the case of flood-prone vegetation; and
- Some vegetation has been classified by some investigators based on aerial photography and other indirect means, which can give a different result from classifications determined by an expert making a close inspection in person.

3.3.1 The Importance of Threatened EVCs in Knox

Based on data from this study and that of Oates and Taranto (2001), approximately 100 square kilometres of Knox once supported nine or ten EVCs that are now listed as Endangered, at the national or bioregional scale. This represents 88% of the whole municipality. Vulnerable EVCs account for much of the remaining 12% of Knox. Consequently, most occurrences of native vegetation in Knox represent an endangered or vulnerable EVC.

The main reason for these EVCs being listed as endangered or vulnerable is that they have been subject to extensive clearing and fragmentation, leaving only a tiny proportion of their original extent. They are not adequately reserved in parks to give confidence in their medium- to long-term survival. They can ill afford any further losses, even in the case of rather small or degraded examples that are scattered all around Knox.

The Victorian government's main policy for native vegetation, known as the Native Vegetation Framework (NRE 2002a), adopts the principle that all but the smallest or most degraded remnants of Endangered EVCs are of high or very high conservation significance, and the sites in which they occur are all deemed to be of at least 'State' significance according to the Department of Sustainability & Environment's criteria (Amos 2004).

3.4 Species of Ferns and Flowering Plants

Appendix B contains a table of the 472 indigenous species of ferns and flowering plants that the author accepts as credibly recorded within Knox. Subspecies and varieties bring the total to 476 taxa. Appendix B also includes four species whose ranges have expanded into Knox in recent years and might be seen either as introduced species or as part of a natural response to drought and climate change. Approximately fifty of the listed species have not been seen recently in Knox by the author but he has seen about half of these within a few hundred metres of the Knox boundary.

Comment [GSL1]: 25 species, 1 extinct

Comment [GSL2]: 447

Comment [GSL3]: *Drosera peltata, Eucalyptus viminalis, Isolepis cernua, Lomandra filiformis*

Twenty-seven plant species can be presumed (to scientific standards) to have become extinct from Knox, and a similar number of other species are probably extinct from Knox but have not been adequately investigated to meet the scientific criteria. There are about a dozen unlisted species that the author believes are probably present in Knox but remain undetected (despite his database of over 43,300 records). It is therefore estimated that there are 450 indigenous plant species presently occurring in Knox. There are also more than a dozen hybrids.

Appendix B includes columns to show which species are:

- Listed as threatened (i.e. Critically Endangered, Endangered or Vulnerable) under the *Environment Protection and Biodiversity Conservation Act 1999* for the whole of Australia*;*
- Listed as rare or threatened, nationally or in Victoria, by Walsh and Stajsic (2007)*;*
- Inferred to be rare or threatened in the Melbourne area on the basis of no more than ten locality records (excluding very old records) appearing in *'Flora of Melbourne'* (Gray and Knight, 2001), whose area of coverage extends to Langwarrin, the Dandenong Ranges, Coldstream, Hurstbridge, Craigieburn, Sunbury and the Werribee River; and
- Threatened in Knox according to the international 'Red List' criteria described in Section 3.4.2.

3.4.1 Rare or Threatened Nationally or State-wide

The Victorian and national lists of rare or threatened plants (as summarised by Walsh and Stajsic (2007)) include ten species, two subspecies, one variant and one hybrid that are recorded from Knox, as listed in Table 3. The table includes the conservation status of these plants in Knox (i.e. at the municipal scale), which has been assigned as described in subsection 3.4.2.

Table 3. Plants of Knox that are Rare or Threatened State-wide or Nationally.

In the 'Status' column, 'C' means critically endangered, 'E' means endangered, 'K' means uncertain, 'R' means rare, 'V' means vulnerable, 'X' means presumed extinct and '-' means no rating has been assigned.

Species Name	Status in Aust / Vic / Knox	Comments
Prasophyllum frenchii (Slaty Leek-orchid)	E / E / X	Collected in Boronia by orchid expert, W.H. Nicholls in 1926.
Dianella amoena (Matted Flax-lily)	E / E / C	The author found one in Starlight Reserve in 2000 and a suspected one beside Napoleon Rd in Rowville in 2002, the latter's identity not confirmed because fertile material was absent.
Caladenia oenochila (Wine-lipped Spider-orchid)	V / V / C	Reported in Bayswater and Boronia three times in 1909-29, and may remain near Dandenong Ranges National Park (in which the author has seen it recently).
Eucalyptus yarraensis (Yarra Gum)	R / R / C	The Dandenong Ck valley is a stronghold for the species. Some were removed for the EastLink road
Eucalyptus fulgens (Green Scentbark)	R / R / C	A small population reported by Lynlee Smith in 2002, well outside the previously accepted range of this species.
Acacia leprosa (Cinnamon Wattle) - Dandenong Ranges variant	R / R / V	Abundant between North Ringwood, Boronia, Belgrave South and Woori Yallock; not at all threatened.
Prasophyllum lindleyanum (Green Leek-orchid)	- / R / X	Collected by orchid experts in Bayswater 3 times in 1906-1930. Also seen recently by the author on Mt Dandenong.
Glossostigma cleistanthum (a mud-mat)	- / R / E	Discovered 2004 in abundance at Lakewood Nature Reserve; evidently not previously recorded within 200 km.
Thelymitra luteocilium (Fringed Sun-orchid)	- / R / X	Claimed in *Flora of Melbourne* to have been in Bayswater.
Pterostylis × *ingens* (Sharp Greenhood)	- / R / X	Seen in Boronia by Mr J.A. Jeanes (who believes the colony to have been destroyed in the 1980s). Claimed in *Flora of Melbourne* to have been in Bayswater and Wantirna South.

Species Name	Status in Aust / Vic / Knox	Comments
Senecio campylocarpus (a fireweed)	- / R / E	During this study, an apparently stable population of 100-250 plants of this newly described species was discovered beside Lakewood Lake, followed by over 100 plants at the Henderson Rd wetlands (where vulnerable to development) and approximately fifty plants at Heany Park in Rowville.
Austrostipa rudis ssp. *australis* (a spear-grass)	- / R / V	Discovered at four sites in Knox by Dr Lorimer.
Montia fontana subsp. ?*amporitana* (Water Blinks)	- / K / C	Discovered at Koolunga Native Reserve, Oct 2004. The only prior record from the Melbourne area was Croydon in 1940.
Prasophyllum pyriforme (Silurian Leek-orchid)	- / K / X	Collected in Bayswater by A.B. Braine in 1930.

Note that six of the fourteen entries in the table are orchids and that five of these orchids can be presumed to be extinct in Knox. This reflects the nationwide tendency for orchids to lead the extinctions of plant species.

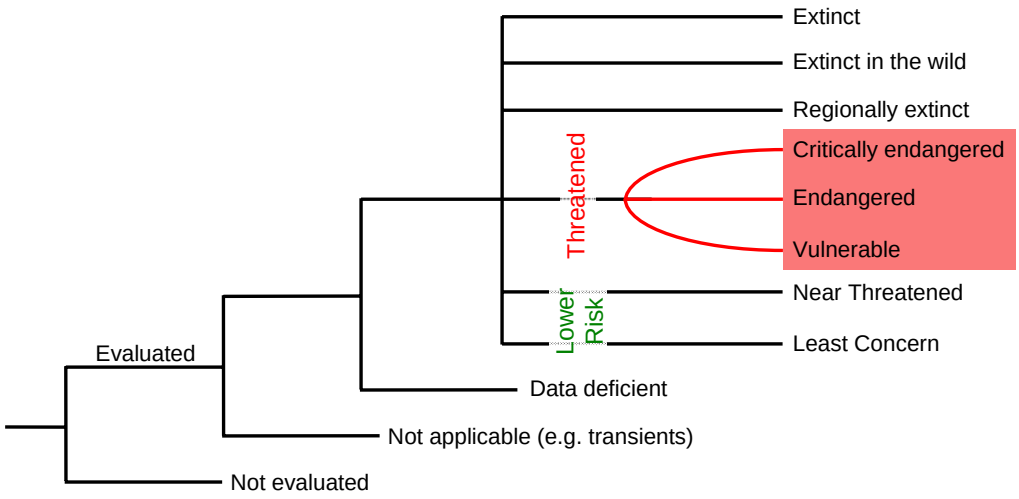
The only plant species in Appendix B that is listed under the *Flora and Fauna Guarantee Act 1988* is *Prasophyllum frenchii*, of which the only record in Knox is from 1926.

3.4.2 Rare or Threatened in Knox

The copious field data gathered during this study allows a reliable determination of the conservation status of each indigenous species of fern and flowering plant within Knox. For this purpose, the author has applied the international standard, which is to apply the IUCN 'Red List' criteria and guidelines (IUCN 2001, 2003, 2008). The same criteria have been applied by the Victorian Department of Sustainability & Environment for fauna (DSE 2007) and flora (in progress). However, criterion B has not been applied in this study because it is applicable to areas much for larger than Knox and cannot be simply scaled to smaller areas.

The 'Red List' categories are depicted in Figure 4. There are three levels of extinction, three levels of 'threatened species' and two levels of 'lower risk'. Five species of indigenous plants in Knox fall into the 'Data Deficient' category because of taxonomic complexities or concerns about possible misidentifications.

Figure 4. Hierarchy of Red List regional conservation status categories (after IUCN 2003).



In simplified terms, any species that has at least a one-in-ten likelihood of becoming extinct from the domain of interest (Knox, in this case) within one hundred years qualifies as Vulnerable under the Red List criteria. The category rises to Endangered if there is at least a one-in-five likelihood of extinction within a period of twenty years or five generations of the species (up to a maximum of one hundred years). The category rises to Critically Endangered if the likelihood of extinction rises to 50% within ten years or three generations (up to a maximum of one hundred years).

It is instructive to reflect upon changes in the native vegetation of Knox since 1910 and the future changes that may arise over coming decades if recent trends in climatic conditions and land development continue as predicted. With this background, one should expect that a high proportion of indigenous plant species would meet the criteria for at least the 'Vulnerable' category.

The likelihood of a species becoming extinct within a fixed period is rarely quantifiable, so the Red List guidelines provide alternative criteria that are intended to be equivalent but are based on more reliably known parameters. For example, a species represented by less than fifty reproductively mature individuals in the domain of interest is deemed Critically Endangered unless immigration is expected to reduce the risk of local extinction.

Red List classifications of species' conservation status in Knox are included in Appendix B. The author retains a tabulation of the rationale and specific criteria applicable to each species, as required under the Red List guidelines.

Figure 5. Summary of the municipal-scale conservation status of Knox's indigenous plant species.

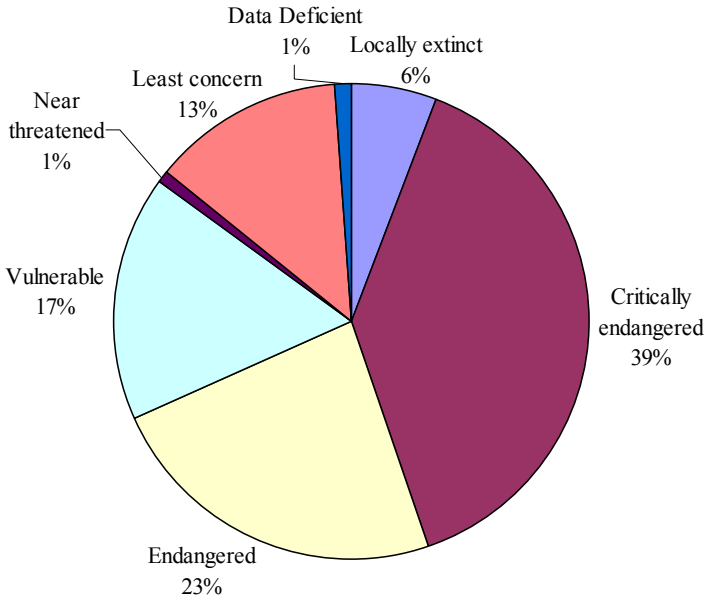


Figure 5 provides a graphical summary of the number of species in each category of extinction risk. One is immediately struck by the large proportion of plant species that are listed as threatened with extinction in Knox – 84% of all the species that are not already extinct. Many of these species are present at very few sites, and many have only critically small populations.

The most common criteria for species to be classified as threatened are that:

- They have less than one thousand reproductively active individuals in the municipality; or
- Their numbers are declining and have already declined by at least 10% over either:
  - The past decade (which has been characterised by extreme drought); or

- Three times the average age of mature individuals in a pristine population.

The prevalence of species that have declined substantially due to dry conditions in recent years is of particular concern because there is now convincing evidence that human-induced climate change has played a major role in the dryness (e.g. Timbal 2009). Plants of swampy ground are suffering worst (Lorimer 2007a). Joint research by the Bureau of Meteorology and the CSIRO indicates that rainfall in Victoria will continue to trend lower, particularly in spring and (to a lesser degree) winter[*].

One hundred and eighty-five species, or 41% of all indigenous species currently growing in Knox, meet the criteria for Critically Endangered. This is an indication that scores of plant species could die out in Knox over the next decade, unless preventative measures are taken. This would be an unprecedented collapse in biodiversity.

Conservation of native flora in Knox is at a critical stage, and this has grave implications for native fauna.

Nevertheless, corrective measures are possible and it is still realistic to aim to maintain the existence of every indigenous plant species presently in the municipality.

Knox City Council has already responded to this finding. *'Knox Vision 2025'* identifies a key initiative of 'Achieving no further extinctions of flora and fauna species or ecological vegetation classes'. The *'Knox Sustainable Environment Strategy 2008-2018'* includes the same goal. Council is also funding the preparation of a management plan for locally threatened species, by the same author as this report and due shortly afterwards.

The main step that is required to prevent extinctions of plant species from Knox is to retain and protect native vegetation that forms their habitat, particularly within the sites of biological significance detailed in Volume 2. This is also critical for conservation of native fauna and for biodiversity generally.

It is recommended that the conservation status of plant species in Knox should be taken into consideration when Council is assessing proposals for works or land development that may adversely affect native vegetation. Whenever possible, any actions that may compromise a species that is listed as Critically Endangered, Endangered or Vulnerable in Knox should be compensated by actions that cause a net increase in the security of that species or a more threatened species, e.g. by propagation, improved protection and removal of threats like environmental weeds. This concept is included in the proposed overlay schedules discussed in Section 5.5.

3.4.3 Environmental Weeds

A table of 234 weed species found in remnant vegetation in Knox appears in Appendix C. There is a column in the table to show the severity of each species in a state-wide context (as per Carr *et al*. 1992) and in a municipal context (using information from the fieldwork described in Section 2.4). A small proportion of the listed species have negligible environmental impact in Knox, and the remainder can be called environmental weeds.

Environmental weeds are a major cause of loss of indigenous flora and fauna species. Some weed species are less serious in Knox than in other parts of the state, and so the severity rating for Knox can be lower than that of Carr *et al*. A few weed species are more serious than realised by Carr *et al*.; for example, it was thought in 1992 that the only infestation in Victoria of Square-stem St John's Wort (or St Peter's Wort, *Hypericum tetrapterum*) was in Yellingbo, but Dr Lorimer has since discovered numerous other outbreaks, including in Knox at eleven sites along Dobsons Creek, Dandenong Creek, Monbulk Creek and Corhanwarrabul Creek and at Lakewood Nature Reserve.

Table 4 summarises the environmental weed species that fall into the category of 'Very Serious' in Knox.

[*] See the predictive maps at http://www.climatechangeinaustralia.gov.au/vicrain1.php.

Table 4. 'Very Serious' environmental weed species in Knox.
Species regulated under the *Catchment and Land Protection Act 1994* are underlined.

Acacia longifolia var. *longifolia* (Sallow Wattle)
Allium triquetrum (Angled Onion)
Anthoxanthum odoratum (Sweet Vernal-grass)
Asparagus scandens (Asparagus Fern)
Briza maxima (Large Quaking-grass)
Calystegia silvatica (Greater Bindweed)
Cestrum elegans (Red Cestrum)
Chrysanthemoides monilifera monilifera (Boneseed)
Coprosma robusta (Karamu)
Crataegus monogyna (Hawthorn)
Crocosmia × *crocosmiiflora* (Montbretia)
Cytisus scoparius (English Broom)
Delairea odorata (Cape Ivy)
Ehrharta erecta (Panic Veldt-grass)
Erica lusitanica (Spanish Heath)
Galium aparine (Cleavers)
Genista monspessulana (Montpellier Broom)
Hedera helix (Ivy)
Hypericum tetrapterum (St Peter's Wort or Square-stem St John's Wort)
Juncus articulatus (Jointed Rush)
Lonicera japonica (Japanese Honeysuckle)
Myriophyllum aquaticum (Parrot's-feather)
Oxalis incarnata (Pale Wood-sorrel)
Oxalis pes-caprae (Soursob)
Paspalum dilatatum (Paspalum)
Paspalum distichum (Water Couch)
Phalaris aquatica (Toowoomba Canary-grass)
Pinus radiata (Monterey Pine)
Pittosporum undulatum (Sweet Pittosporum)
Ranunculus repens (Creeping Buttercup)
Romulea rosea (Common Onion-grass)
Rubus anglocandicans (Blackberry)
Salix species (the Crack Willow group)
Tradescantia fluminensis (Wandering Jew)
Ulex europaeus (Gorse or Furze)
Watsonia meriana var. *bulbillifera* (Bulbil Watsonia)

The severity of weeds varies from year to year according to weather conditions. Monitoring of bushland in Knox by Lorimer (2007a) has demonstrated substantial, protracted changes in the severity of some of the worst environmental weeds over the recent years of drought, notably the declines of Blackberry (*Rubus anglocandicans*), Sweet Vernal-grass (*Anthoxanthum odoratum*) and Cat's Ear (*Hypochoeris radicata*). These changes provide opportunities for more effective weed control while the species are vulnerable, making it harder for the species to recover.

The climate change that is being forecast by scientists should be expected to bring about further changes, with some of the worst weeds declining and other species spreading.

This provides an opportunity for reducing the overall impact of environmental weeds in Knox by inhibiting the spread of weeds that are presently manageable but are capable of becoming more serious if climate changes. One predicted aspect of the climate in future is that there will be less rain overall and it will be more concentrated into fewer events, so that the rainfall in Knox will become more like the historical pattern for Melbourne's inner-eastern to northeastern suburbs. We may therefore expect some of the serious weed species from those areas to become more prominent in Knox. An example would be the White Bladder-flower (*Araujia sericifera*), a very serious weed of valleys in Melbourne's inner and middle-eastern suburbs. This species had not been known in Knox until 2008 when the author discovered one young plant in Rowville and another in Knoxfield. Both plants were removed by Knox City Council within days of their discovery, including seedpods which had not yet opened. This vigilance and prompt action may have thwarted the rapid establishment of an infestation too large to eradicate.

Some emerging weed species in Knox are native to Australia and even to Knox. Since 2000, the indigenous Wonga Vine (*Pandorea pandorana*) and Small-leafed Clematis (*Clematis microphylla/leptophylla*) have spread far beyond their prior range and are smothering and killing indigenous understorey plants around Melbourne's eastern suburbs. The spread has sometimes been aided by misguided revegetation projects. Burgan (*Kunzea ericoides* s.l) has become even more damaging in the northeastern suburbs over a longer period, and threatens to become a problem in Knox as climate changes.

Some degree of change to the composition of native vegetation in response to climate change is inevitable and desirable, but we need to be vigilant against species becoming far out of ecological balance and causing a significant decline in biodiversity.

We should expect more cases of potentially very serious outbreaks of weed species that are currently absent from Knox or not yet highly invasive. An investment in vigilance and rapid response to nip these outbreaks in the bud could avoid a much greater cost in future, financially and environmentally.

3.5 Species of Moss and Liverwort

At the end of Appendix B is a table of twenty-two indigenous species of moss and liverwort that can be confidently concluded to occur in Knox. These groups of plants are poorly studied and there are bound to be other species in Knox. There is inadequate data to assess the species' conservation status in Knox according to IUCN Red List criteria, as done for ferns and flowering plants.

3.6 Fauna

Appendix D provides a list of fauna that have been reliably recorded in Knox, and summary statistics are given in Table 5. As stated in Sections 1.5 and 2.1, there was no concerted effort to detect fauna during this study's fieldwork, so many of the species tabulated in Appendix D were not detected in this study.

Table 5. Summary statistics of Knox's fauna.

Fauna Group	Number of Native Species	Number of Introduced Species	Number of Species Threatened in Vic.
Birds	218	13	29
Mammals	30	9	1
Frogs	11	1	2
Reptiles	20	0	2
Fishes	8	7	1
Butterflies	27	1	1

3.6.1 Birds

The author has noticed some marked changes in the relative abundance of bird species in Knox during the past one or two decades. Some native species have undoubtedly declined in abundance and distribution, while species such as Rainbow Lorikeet, Little Corella and Yellow-tailed Black-cockatoo have increased greatly. In fact, the lorikeet and the corella have changed from being rare visitors twenty years ago to now being abundant, resident birds in urban parts of Knox. These observations mirror the results found in the 'Australian Terrestrial Biodiversity Assessment 2002' (National Land and Water Resources Audit 2002).

A disproportionate number of rare or threatened birds have been reported in a few wetlands in Knox, notably in along the Dandenong Creek and at the lake in Lakewood Nature Reserve. This highlights the importance of both stream corridors and lakes – even artificial lakes – for fauna conservation.

3.6.2 Mammals

The paucity of mammal surveys in Knox makes it hard to discern trends in mammal abundance or distribution. Indeed, several native species are likely to have been overlooked altogether, particularly among the bats.

Nevertheless, it seems very likely that Southern Brown Bandicoots are probably extinct from Knox, and anecdotal evidence of residents in Lysterfield suggests that Eastern Grey Kangaroo numbers have declined in recent years. On the other hand, it is pleasing to note that Sugar Gliders are still present in Rowville and Wantirna.

The Common Brushtail Possum and Common Ringtail Possum are well adapted to an urban existence and in no threat of decline. Some other arboreal mammals in Knox rely on indigenous trees or sometimes large trees that are not indigenous, highlighting the importance of protecting large trees. Eastern Grey Kangaroos should continue to move between Lysterfield Park and nearby large properties as long as such properties remain and retain some eucalypt cover. The other native mammals that are present in Knox rely for their existence on

remnant vegetation with understorey, probably entirely within Sites 1-100 in Volume 2. The protection of these sites is therefore very important for conservation of native mammals in Knox.

Platypuses rely on the quality of their stream habitat, as well as the adjoining native vegetation. This contributes to the importance of protecting the environmental values of streams. Platypus surveys in the Corhanwarrabul Ck – Monbulk Ck system in the last few years indicate a decline, coinciding with major property development along the streams. It is not clear to what degree the decline in Platypus numbers reflects a long-term decline in the overall environmental qualities of this stream system.

Native mammals appear to face a significant threat from harassment and attacks by pets, but this cannot be confirmed without a focused study.

3.6.3 Frogs

Observations of frogs in Knox have been rarely recorded until the last few years, which have been marked by a prolonged drought that has varied from year to year in its intensity. This has made it impossible to discern trends in the abundance and distribution of frog species in Knox. There are also several prime sites for frogs that have not been investigated, such as the lake at Lakewood Nature Reserve.

However, about a dozen sites in Knox have been inspected as part of the Melbourne Water Frog Census on one or more occasions since spring 2001, providing baseline data for the future. Knox City Council has contributed to the program by obtaining a grant to purchase 10 automated frog call boxes, which are to be loaned to the census program. In exchange, Melbourne Water will provide Council with the frog data to enter into the Knox Wildlife Atlas database.

Wetlands that are most likely to be important for conserving frog species are also important for waterbirds, and are principally along Dandenong Creek and at Lakewood Nature Reserve. The section of Blind Creek from near Timmothy Drive in Wantirna to Dandenong Creek may also be important.

3.6.4 Reptiles

Reptiles are inadequately reported to be confident of either the full range of species in Knox or any changes in their abundance or distribution.

Of the two threatened species recorded, the Swamp Skink has been well studied at Liverpool Road Retarding Basin in Boronia and the Tree Goanna is presumably an occasional visitor to Knox from the Dandenong Ranges National Park in the Shire of Yarra Ranges.

Knox's reptile species rely heavily on remnant native vegetation with understorey and logs, practically all of which is in Sites 1-100 in Volume 2. This makes protection of these sites very important for conservation of reptiles in Knox, as in the case of mammals.

3.6.5 Fishes

There has been a substantial degree of expert investigation of fish in Knox's main streams in recent years, providing a fairly sound basis for the inventory in Appendix D. It is probably not important that there has been much less investigation of lakes, such as Caribbean Lake, Cogley Lake, Sutton Lake, Hill Lake and at Lakewood Nature Reserve.

The fish fauna of Knox is largely exotic and the stream habitat is largely heavily modified by straightening and barrel-draining of watercourses and the construction of barriers that impede migration of fish.

Although the studies of fish in Knox are mostly in the past decade, and hence do not span a very long period of time, there is enough evidence for the researchers involved to have concluded that the most significant fish species, the nationally vulnerable Dwarf Galaxias, has suffered a massive population crash and possible extinction from the Dandenong Creek catchment. Changes in other species cannot be discerned from the data gathered in this study.

There is some hope for an improvement in the fish fauna of Knox if changes are made to the weir at Pillars Crossing in Dandenong South. This weir is the main barrier against fish migration between Dandenong Creek and Port Phillip Bay, and Melbourne Water has commissioned a study to investigate the benefits, costs and engineering options for changing this.

3.6.6 Invertebrates

Most of the butterfly records gathered in this study were from Jan Jordan, and most of the remaining records come from Maria Belvedere. Exemplary though their work is, the data do not provide adequate geographical coverage of Knox to represent a very comprehensive inventory for the municipality. There are also very few records from prior to the 1990s, so trends are difficult or impossible to discern except in the case of the Swordgrass Brown, whose numbers and distribution have increased due to a recovery project conducted by the Knox Environment Society in conjunction with Knox City Council.

There is one very notable old record: the endangered Small Ant Blue butterfly recorded in Ferntree Gully, Bayswater and Heathmont. The only date that could be found for any of these records is 1942, and while the species may therefore be extinct from Knox, this should not be concluded without an investigation.

Because most butterfly larvae depend on specific indigenous food plants, conservation of butterflies requires retention of remnant native vegetation with understorey. As in the cases of mammals and reptiles, this adds to the importance of Sites 1-100 in Volume 2.

Invertebrates other than butterflies are studied even less than butterflies, so the only species noted here are two species that that the Department of Sustainability & Environment suspects (but cannot confirm) to be rare or threatened. These are the caddisfly *Plectrotarsus gravenhorstii* and the Dandenong Freshwater Amphipod, *Austrogammarus australis*. The only record of the caddisfly in Knox was in 1943 in Bayswater and no evidence could be found in this study of any subsequent attempt to find it. The amphipod has been found at every attempt to find it on Dobsons Creek in Sassafras (Knox's eastern extremity), including recently. However, entomologist Phil Papas says that its presence there is attributable to the forest in the Dandenong Ranges National Park (Shire of Yarra Ranges) immediately upstream of the detection site, rather than because of suitable habitat in Knox.

3.7 Sites

Volume 2 includes detailed descriptions and maps of 112 sites of biological significance recommended for protection under overlays in the Knox Planning Scheme (Section 5.5), and brief information about an additional four sites (or groups of sites) that are not recommended for protection under an overlay.

Sites 1 to 114 (the ones recommended for overlays) are shown on a key map on page 2 of Volume 2, which shows the distribution and size of Knox's most biologically significant areas. (However, note that size can sometimes be misleading, as in the case of Waverley Golf Course, which is large overall but has proportionally little natural habitat due to fragmentation by fairways, greens and other developed areas). Sites 115 to 118 are not recommended for overlays because they are all either small or have negligible native understorey. They collectively contain much less natural and semi-natural habitat than Sites 1-114.

Only one site – the Dandenong Valley Parklands – is of National significance according to the criteria discussed in Section 2.6. This very high level of significance results from the large population of the nationally rare Yarra Gum (*Eucalyptus yarraensis*), and in other respects the site is of State significance. Seventy-six other sites are of State significance, fifteen are of Regional significance and nineteen are of Local significance. By far the most common reason for a site achieving a rating of State significance is the presence of a regionally endangered EVC, particularly Valley Heathy Forest or Swampy Woodland.

Table 2 in Section 3.3 gives a summary of the distribution and total areas of the various habitat types in Knox. It can be inferred from the table that:

- The total area with vegetation having excellent biodiversity is 0·24% of Knox's total area;
- The total area with vegetation having excellent or good biodiversity represents 0·88%;
- The total area with vegetation having at least fair biodiversity represents 2·7%; and

- The total area of vegetation in any of the conditions A-D (even with just a few indigenous species that are not able to reproduce) represents 4·4% of Knox.

A little more than half of the native vegetation in Knox occurs on public land. The largest areas on private land are the Lysterfield Hills quarries (part of Site 81) and in 'The Basin - Sassafras Forest Precinct' (Site 18) along the Basin-Olinda Rd and Doongalla Rd.

Eighty-one of the 117 sites identified in this study contain at least one plant species that is Critically Endangered with extinction in Knox or more widely. The loss of any one of these eighty-one sites is likely to either render a species extinct from the municipality (or more widely), or significantly increase the risk of this happening.

Every one of the 112 sites recommended to be protected by a planning scheme overlay contains at least one locally threatened species.

Sixty-two plant species that are Critically Endangered with local extinction have never been recorded in a reserve, making private land and properties like the Healesville Freeway Reservation critical for the survival of these species in Knox.

Knox is therefore at the stage where many indigenous plant species are poorly conserved and threatened with local extinction. To avoid local extinctions will require strong avoidance of removal of native vegetation in all sites of biological significance (Section 4.4), coupled with active efforts to increase the security of the threatened species (Section 4.12).

Many sites are also known to support, or be visited by, fauna species that are threatened regionally or more widely. Native fauna generally suffer when native vegetation declines. However, this study does not provide hard statistics about fauna because quantification of the status of fauna species in Knox would require much more fieldwork.

4. Issues Affecting Biodiversity

The main conclusions about the Australian environment appearing in the Executive Summary of *'Australia: State of the Environment 1996'* (Alexander and Taylor, 1996) are:

- 'The loss of biological diversity is perhaps our most serious environmental problem'.
- 'Habitat modification, particularly removal of native vegetation for agriculture, urban development and forestry has been, and still is, the most significant cause of loss of biodiversity'.
- 'Introduced plants are an acute and insufficiently appreciated ecological problem'.
- 'The most significant impediment to the conservation and management of biodiversity is our lack of knowledge about it and the effects of the human population and activities on it'.

The national *'State of the Environment 2006'* investigation updated this assessment with a conclusion, *'It is clear that the major pressures on biodiversity that have been operating for decades are still strong and will continue to drive decline in biodiversity across large areas of the continent, together with new and emerging pressures'* (Cork *et al*. 2006). Record drought and the threat of ongoing climate change are the main new and emerging pressures.

In these respects, Knox is representative of Australia as a whole, except that the issues of agriculture and forestry do not currently apply in Knox, and this study has hopefully made worthwhile progress on the last of the four bullet points above at the municipal scale. The serious decline of many species of indigenous flora and fauna as a result of drought in recent years suggest that drying climatic conditions are presently the most serious threat to biodiversity in Knox. Scientific predictions of climate change in the future suggest that this situation may persist indefinitely.

The other two preeminent threats to biodiversity and ecology in Knox are as identified for Australia as a whole in the bullet points above, i.e. removal of native vegetation and the impacts of environmental weeds. In 2004, the first edition of this report identified environmental weeds as posing a worse threat than vegetation removal. Since then, more clearing has occurred than expected, particularly associated with road construction and quarries in the Lysterfield Hills, while drought has assisted public land managers in controlling weeds. The result has been that vegetation removal has caused more harm than weeds. The drought has had an even more pronounced impact but it is not clear yet whether some of that impact is reversible.

4.1 Protection of Habitat in Reserves

Knox City Council has many bushland reserves, managed well for biodiversity values. Dandenong Valley Parklands and Lysterfield Park are managed well by Parks Victoria. These sites provide an important core for conservation of biodiversity in Knox (although not enough on their own – see Section 4.2).

The main pressures on the biological values of these reserves are:

- Environmental weeds;
- Trampling and cutting of vegetation by people moving off paths;
- Dumping of garden waste;
- Other vandalism;
- Eucalypt dieback; and
- Pressure to construct or maintain firebreaks within the native vegetation.

These issues are each discussed individually in Sections 4.3-4.13.

4.1.1 Management Plans

Knox City Council has several management plans for its bushland reserves. The one by Lorimer (2001a) deals with fire management and related biodiversity issues in seven reserves. Reid *et al*. (1997b) deal with vegetation along Knox's main waterways (excluding Dandenong Valley Parklands), but conditions have changed substantially since it was prepared. Lorimer (1998) deals with native vegetation along some of Knox's roadsides, most of which have not changed greatly. More detailed plans have been prepared for some reserves:

- W.G. Morris Reserve (Lorimer 2007b);
- Blind Creek Billabong, Ferntree Gully (Reid *et al.* 1997a);
- Cathies Lane Bushland, Wantirna South (Lorimer 1997);
- Coppelia Street Bushland, Wantirna South (Lorimer 1999a);
- Koolunga Native Reserve, Ferntree Gully (Lorimer 2006);
- Starlight Reserve, Rowville (Lorimer 2000a);
- Heany Park, Rowville (Lorimer 2009a);
- Lakewood Nature Reserve, Knoxfield (Lorimer 20009b); and
- Roselyn Crescent Reserve, Boronia (Lorimer, in preparation).

Other Council reserves that could benefit from management plans are (in decreasing order of priority):

- Timmothy Drive Bushland, Wantirna South;
- Blamey Reserve, Boronia;
- Stringybark Reserve, Wantirna;
- The Ardnehue Rd Land abutting Dandenong Valley Parklands in Wantirna;
- Millers Reserve, Boronia (north of the oval);
- 'The Ravine' in The Basin (in conjunction with the adjoining National Park land);
- Vaughan Rd Bushland, Ferntree Gully;

Some of the reserves need only rudimentary management plans containing little more than formalisation and refinement of, and small extensions to, actions that are already planned or being undertaken.

4.1.2 Monitoring Change

Council has a formal monitoring program in place for seven bushland reserves (Lorimer 1999b, 2002, 2007a). The results of comparison between data gathered between 1999 and 2002 showed that there had been some marked changes in proliferation of some species of plants, and that the vegetation quality was maintained well. From 2002 to 2007, drought caused major changes in native vegetation, causing decline in tree health and decimation of the populations of some previously abundant indigenous flora species such as Blackwood (*Acacia melanoxylon*), Tree Everlasting (*Ozothamnus ferrugineus*) and Ivy-leaf Violet (*Viola hederacea*). Plants of swampy ground, such as Long Purple-flag (*Patersonia occidentalis*) were worst affected. Surprisingly, the two species that thrived were Wonga Vine (*Pandorea pandorana*) and Elderberry Panax (*Polyscias sambucifolia*), both normally associated with damp conditions. The monitoring also showed that some serious weed species had declined greatly, including Cat's Ear (*Hypochoeris radicata*) and Sweet Vernal-grass (*Anthoxanthum odoratum*), which provided a rare opportunity to bring these species under control while they were vulnerable.

Anecdotally, the trends above have continued unabated since 2007.

The drought of recent years may be symptomatic of long-term climate change. If this is so, the observations above indicate that we should expect substantial shifts in vegetation composition and the seriousness of individual weed species. The monitoring program will be very important to detect and respond to these changes.

Consequently Council has commenced an expansion of its monitoring of bushland reserves by training its bushland management staff to monitor additional sites, more often.

4.1.3 Interpretive Signs

Knox City Council has installed nature interpretation signs in many of its bushland reserves to help visitors develop a better appreciation of the reserves' natural assets and the factors that are sustaining or threatening those assets. Environmental education of this kind can only help to garner support for the natural environment and cooperation from more members of the public in conserving nature.

4.1.4 Interaction with Neighbouring Land

The effectiveness of Knox's bushland reserves for conserving nature is often substantially affected by what occurs on neighbouring land. As explained in the excellent Council booklet, *'Bush Neighbours'*, conservation values are often compromised by:

- Dumping of garden waste from neighbours, leading to spread of weeds and smothering of ground flora and the habitat of small fauna;
- Encroachment of neighbours' mowing, pruning, planting and informal paths into reserves;
- Pet cats that hunt in the reserves;
- Pet dogs that are allowed to chase wildlife, particularly waterbirds at wetlands;
- Pressure for vegetation to be removed from reserves to protect neighbouring buildings that are constructed too close to the bushland for fire safety;
- Removal of firewood or wildflowers;
- Neighbours leaving out unsuitable food to feed birds, resulting in unnaturally high densities of bird species such as Magpies, Red Wattlebirds and Rainbow Lorikeets that displace other species which are important for the health of bushland;
- Neighbours leaving food scraps and uneaten pet food accessible to foxes, whose numbers then increase and kill more wildlife;
- Neighbours leaving out food for possums, leading to high possum densities and consequent serious depletion of tree foliage in the bushland.

On the other hand, a good neighbour to a bushland reserve can be ecologically beneficial by avoiding the above problems and providing complementary habitat such as a locally indigenous eucalypt or wattle in their garden. As explained in Section 4.13 on page 44, Council's 'Gardens for Wildlife' program assists Knox residents to contribute to a community web of habitat that complements bushland on public land.

There are also many neighbours of bushland reserves who play a valuable environmental role in bushland reserves as volunteers in 'Friends' groups, which Council supports with funds, guidance and practical assistance. These neighbours include residents and school communities such as Knox Park Primary School.

4.2 Protection of Habitat Outside Reserves

As the National Strategy for the Conservation of Australia's Biological Diversity (DEST, 1996) says, 'Australia's biological diversity and the threats to it extend across tenure and administrative boundaries. … The conservation of biological diversity is best achieved *in-situ* and requires integrated and consistent approaches across freehold and leasehold and other Crown lands'.

Analysis of the data compiled during this study reveals that ninety-seven plant species listed as threatened (not just rare) in Knox are not found in reserves managed for conservation. This represents 22% of all extant indigenous plant species in Knox, and includes fifty-two species that are critically endangered in Knox.

Another telling figure is that 42% of all plant species that are threatened in Knox are not found in reserves managed for conservation.

Some of the threatened species that are not represented in reserves are highly reliant on sites owned by government, such as schools, roadsides, utility installations or freeway reservations. In many cases, private residential land is critical.

The Silver Banksia, *Banksia marginata*, provides a good example. It is present in two school grounds, two roadsides and on several private residential properties in Boronia. The private properties make a substantial contribution to the total population of the species in Knox.

Council maintains a relationship with some agencies of government regarding the biologically significant land that they own, particularly Melbourne Water and VicRoads. Relationships with schools regarding significant vegetation are less well developed, partly because the significance of their vegetation has not been fully appreciated prior to this study. It is hoped that this report will provide a basis for Council to provide greater encouragement for such public landowners to play a more active role in conserving the municipality's biodiversity.

The large private properties in Knox's eastern extremity, east of Sheffield Rd and Wicks Rd in The Basin, play a particularly important role for conserving the municipality's biodiversity, because they include the only habitat for various ferns and other plants of high-rainfall forests, as well as the fauna of such forests. This importance is tempered to some degree by the fact that these properties are adjacent to much larger areas of the same forest in the Dandenong Ranges National Park, in the Shire of Yarra Ranges.

Similar comments apply to some properties near Lysterfield Park.

Private landowners can make or destroy habitat, depending on their actions. It is desirable for Council to encourage the good examples of habitat creation and restoration that can be seen on some Knox properties.

The National Strategy for the Conservation of Australia's Biological Diversity (DEST, 1996) recommends and lists measures to:

> *'ensure that adequate, efficient and cost effective incentives exist to conserve biological diversity. These would include the use of appropriate market instruments and appropriate economic adjustments for owners and managers, such as fair adjustment measures for those whose property rights are affected when areas of significance to biological diversity are threatened'*.

Knox City Council has considerably expanded its efforts in these regards since the first edition of this report in 2004. Under the title of the 'Biodiversity Buddies' program, Council offers rate rebates for long-term habitat protection and one-off grants for short-term conservation works. A rate rebate of up to 80% is available for the most ecologically valuable commitments to habitat management. Grants provide dollar-for-dollar funding to a maximum of $1,000 for works such as weed removal, cat enclosures and fencing of bushland. Applicants have to participate in the 'Gardens for Wildlife' program, in which Council and the Knox Environment Society provide practical support for planting indigenous species that facilitate wildlife movements through Knox. The 'Gardens for Wildlife' program and the related 'Kindergartens for Wildlife' program are discussed further in Section 4.13 on page 44.

4.3 Weeds

The weeds of concern in this study are 'environmental weeds'; that is, plants which impair the biodiversity or ecological functions of natural or semi-natural habitats. They are widely regarded as one of the most serious nature conservation problems in Victoria and Australia (e.g. Carr *et al*. 1992, Alexander and Taylor 1996, National Land and Water Resources Audit 2002). The author regards environmental weeds as one of the worst threats to nature and biodiversity in Knox.

Fortunately, weed problems are being steadily diminished in many Council reserves in Knox, thanks to active management.

The main threats to Knox by environmental weeds are:

- Out-competing mature indigenous plants;
- Preventing germination and establishment of indigenous plants;

- Making habitat less fit for native fauna and more fit for introduced fauna, including pests which further threaten indigenous species; and
- Altering the cycling of nutrients and organic matter.

These processes are interrelated.

Table 6 provides a list of species that are tractable, fairly recognisable, very serious and widespread on private land in Knox, and not likely to draw strong opposition to eradication. These attributes are ideal for a publicity campaign.

Table 6. Environmental weeds recommended for a publicity campaign.
Species regulated under the *Catchment and Land Protection Act 1994* are underlined.

Asparagus scandens (Asparagus Fern)	*Lonicera japonica* (Japanese Honeysuckle)
Chrysanthemoides monilifera monilifera (Boneseed)	*Pittosporum undulatum* (Sweet Pittosporum)
Crataegus monogyna (Hawthorn)	*Tradescantia fluminensis* (Wandering Jew)
Cytisus scoparius (English Broom)	*Watsonia meriana* var. *bulbillifera* (Bulbil Watsonia)
Genista monspessulana (Montpellier Broom)	

Such a campaign could be conducted jointly between the Department of Primary Industries, Knox City Council and perhaps adjoining Councils. Effort should be concentrated at times of the year when most of the species are in flower, to aid identification and reduce seed production.

Asparagus Fern and Hawthorn are the only species listed above that are not included in a booklet co-produced by Knox City Council in 1999, titled *'Pest Plants – Guide to Identification and Management of environmental weeds in Knox and Maroondah'*.

In the case of Sweet Pittosporum, the emphasis of the campaign should be on female plants because males do not spread seed. This means that only about half of a typical infestation of mature plants needs to be removed. It should also be recognised that none of the listed species is an environmental problem in parts of Knox with no nearby native vegetation. 'Nearby' in this context depends on the species of weed, with berry-forming species having the largest radius of spread (mostly a few hundred metres).

One incentive for residents to participate in the proposed campaign is to offer free plants to replace listed weeds that landowners remove from sensitive areas. The replacement plants could be indigenous or otherwise.

In its management of bushland reserves and roadsides, Council and Parks Victoria should be paying particular attention to the weeds in Table 6 and all the other weeds rated as very serious in Appendix C. The site descriptions in Volume 2 indicate which weeds pose the most serious threats that were detected in each site.

Apart from environmental weeds being naturally spread, the next greatest cause of spread is dumping of garden refuse, clippings and soil. This kind of dumping can be seen in most bushland reserves within Knox. Many cases involve dumping of clippings or prunings that readily take root (e.g. grass, Wandering Jew) or contain fruits or seeds (e.g. grass clippings, Sweet Pittosporum). Garden soil is also often dumped containing bulbs of introduced species such as Bulbil Watsonia and Angled Onion. In most cases, the garden refuse comes from an adjoining residential block.

One way of responding to this problem would be for Council to produce a brochure about being a good neighbour to bushland reserves, and deliver it to relevant properties. The brochure should cover not just weeds but also fire hazard, nutrient seepage and similar issues (see below).

4.4 Vegetation Clearing and Damage

The Executive Summary of *'Australia: State of the Environment 1996'* (Alexander and Taylor, 1996) states:

> *'Habitat modification, particularly removal of native vegetation for agriculture, urban development and forestry has been, and still is, the most significant cause of loss of biodiversity'.*

More recently, the Endangered Species Scientific Sub-committee (ESSS) of the *Environment Protection and Biodiversity Conservation Act 1999* stated that *'ESSS is strongly of the view that land clearance has been the most significant threatening process in Australia since European settlement. ESSS is also strongly of the view that land clearance continues to be a significant threatening process and that if it is not controlled it will lead to additional species becoming endangered, to additional species being listed in Schedule 1* [of the Act]*, and to ecological communities being listed in Schedule 2'* (in advice to the Minister for Environment and Heritage about a nomination for listing land clearing as a key threatening process).

Similarly, the 'Australian Terrestrial Biodiversity Assessment 2002' (National Land and Water Resources Audit 2002) states that *'Vegetation clearing is the most significant threat to species and ecosystems in eastern Australia'*.

These observations are quite relevant to Knox.

As indicated by Table 2 on page 19, remnant native vegetation or areas with natural tree cover (but excluding unvegetated wetlands) occupy only 4.4% of the municipality. This figure drops to 2.7% if one excludes sites with only a small number of hardy native plant species and little chance of natural regeneration (i.e. vegetation with ecological condition rating D). More than a dozen areas of native vegetation that were inspected during this study and deemed worthy of recognition as sites of biological significance were cleared before the report was complete. Permit applications for clearing native vegetation continue to arrive at Council.

As noted in Chapter 3, there are so many EVCs, plants and animals threatened with extinction from Knox or more widely that clearing should be avoided wherever possible, particularly in sites of biological significance. This is reinforced by Victoria's Native Vegetation Framework (NRE 2002a), which is an incorporated document within the Knox Planning Scheme.

There are four main reasons for clearing:

- Residential development;
- Road construction and widening;
- Quarrying in the Lysterfield Hills (which is largely to support road construction); and
- Clearing and tree removal by residents.

These main causes of native vegetation removal are considered in the following subsections.

4.4.1 Housing Development and Construction

Bulldozing for urban housing has been a major cause of native vegetation loss in Knox for decades. Apart from the obvious effects, bulldozing can remove corridor links, alter drainage patterns, increase siltation of drainage lines and waterways, physically damage the roots and limbs of nearby trees, and leave neighbouring vegetation vulnerable to storm damage and weed invasion.

Most residential development in Knox involves allotment sizes of less than 1,500 m². On lots this small, most or all native vegetation originally present is cleared for house construction, driveways, paths, fences and services. Apart from some mature, healthy eucalypts, any vestiges of native vegetation left after a house is constructed are usually replaced by a traditional European style of garden that is environmentally insignificant or even threatens the natural environment, e.g. by introducing environmental weeds.

Larger allotments allow much greater opportunity for retaining native vegetation, provided that multiple dwellings are not put on the allotments.

The locations of houses and associated construction work on a property should be chosen to minimise the effects on native vegetation, as specified under Victoria's Native Vegetation Framework (NRE 2002a). This should include consideration of any native vegetation on adjacent properties. For example, a house next to a bushland reserve should not be located so close to the reserve as to sever roots of trees in the reserve or lead to pressure for a firebreak that damages native vegetation. Note that this applies even on properties that contain no native vegetation.

Where an attempt is made to retain trees on a construction site, the protection of groups of trees rather than isolated individuals is far more likely to be successful. One reason for this is that trees in groups protect each other from climatic extremes. Once isolated by the removal of surrounding vegetation, trees become far more prone to dieback and storm damage, and they lose some of their attractiveness to wildlife.

Prominent, substantial fencing of retained vegetation during land development is very important for highlighting where it is and keeping machinery out. Plastic tape is typically cut and breached.

House construction on sloping sites can cause greater environmental damage than flat sites if the cut-and-fill method is used, mainly because of vegetation buried under the fill. House construction methods such as split level or pier and beam construction are alternatives that can avoid vegetation damage.

Limiting the size of construction machinery to the smallest practicable reduces damage to bark and trunks where large machines cannot readily be manoeuvred between retained trees.

Boring can be used to install underground services with little or no harm to native vegetation above.

Vegetation that cannot be saved from land development despite careful planning may sometimes be removed and relocated within the site or to another suitable site, or else material can be gathered for propagation. This is particularly important for species that are indicated in Appendix B to be rare or threatened in Knox or more widely.

Runoff containing nutrients and weed seeds is a significant cause of ecological degradation of native vegetation in Knox. Cut-off drains provide a means of intercepting and diverting runoff from gardens or domestic areas so that it does not harm native vegetation downhill.

Bonds can be used as a mechanism to promote compliance with permit requirements for protection or restoration of native vegetation associated with all kinds of works, including housing.

Large recreational accessories such as swimming pools and tennis courts can add greatly to the amount of clearing on blocks with native vegetation. So little native vegetation is left in reasonable condition in Knox that any proposals to remove native vegetation for such purposes should be considered very carefully.

4.4.2 Roads

Construction and widening of roads sometimes involves destruction of native vegetation. The EastLink road has been the single greatest adverse influence on Knox's biodiversity since the first edition of this report in 2004, and road works generally has been the greatest contributor to loss of habitat over that period. The greatest road construction threat to Knox's native vegetation in the long term would be if the Healesville Freeway were to be built through the Bateman Street Bush in Wantirna (Site 48 in Volume 2).

Roadside native vegetation may also be damaged by maintenance of roads, footpaths, cables and underground services. To determine what may be at risk from such actions, and to guide protective measures, Knox City Council has conducted a study of most of the more significant roadsides (Lorimer 1998). Most significant roadsides in Knox are signposted as 'significant roadsides' with a warning against potentially damaging actions without consulting Council. Such signs also inform neighbouring residents that the vegetation is valued, and hopefully this stops some residents from doing harmful things to the roadside vegetation.

Machinery operating around roadside native vegetation is apt to compact soil, crush plants, damage trees and leave wheel ruts that hold water and encourage weed growth. Machinery can also spread weed seed and disease organisms in soil carried from other sites.

Parking of vehicles and storage of equipment, materials and supplies for works on roads or roadside services can sometimes do more harm to vegetation than the works themselves. Care should be taken to store these things in places where they will do no harm and not require access through significant vegetation.

Prominent and substantial fencing should be used to protect native vegetation from potentially harmful activities on roadsides.

Trees are often retained during roadside works, only to die later as a result of damage caused by root severance or changes to soil surface levels.

Sometimes it is impossible to avoid some clearing of roadside vegetation. The damage can be ameliorated by relocating some of the plants, as described in Section 4.4.1 for housing development. Replanting can also help, but care must be taken on biologically significant roadsides to use indigenous species, and mulch that does not contain seeds of weedy plants such as Willow-leafed Hakea.

The practice of using herbicide or steam to kill vegetation on road edges is tending to replace the traditional method of edge clipping. The herbicide or steam kills native vegetation very effectively, and leaves few plants other than Couch, Gorse and similar hardy weeds. Between sprays, short-lived weeds such as thistles are encouraged. The sparsely vegetated ground is left vulnerable to erosion if it is sloped. Some road edges with healthy indigenous vegetation, just outside Knox, have been converted to eroded, weedy road edges in one or two years. The practice of spraying indigenous vegetation on road edges should be avoided.

As in the case of housing, bonds can be used as a mechanism to promote compliance with permit requirements for protection or restoration of native vegetation associated with works along roads.

4.4.3 Quarries

Hard rock quarrying in the Lysterfield Hills has been steadily expanding into the habitat of a substantial number of flora and fauna species that are found nowhere else in Knox. The area of native vegetation removed annually has been substantial on the scale of Knox. It seems extremely likely that some species have become extinct in Knox as a result of this quarrying in recent years and that more species will disappear in the coming decade.

4.4.4 Established Residential Land

Remnant indigenous trees are sometimes needlessly destroyed by people who wrongly believe that eucalypts generally, not just particular species, are prone to be dangerous. The decision about whether to remove a tree or not often needs to balance the risk of damage or injury against the harm to the environment and landscape from the tree's removal.

In cases where tree removal is subject to a planning permit, Council uses professional expertise to decide whether the safety risk of a tree outweighs the benefits of its retention. Various areas of Knox are recommended to come under such planning permit control – See Section 5.5.

Although indigenous trees are retained by many property owners, understorey species are often severely damaged or removed to reduce potential fire hazards, to improve visibility and security, for children's play areas and, most frequently, to make the property look more the way the owner wants it to. Most landowners with indigenous understorey plants probably do not recognise which plants are indigenous, much less understand the special values of those species. Council and the Knox Environment Society promote community education about these matters, but it is likely that many indigenous understorey plants are removed unwittingly, regardless of any planning controls that may apply.

4.4.5 Dead Trees

Although recently dead trees are less likely to fall over or drop limbs than live trees, they may become dangerous over a decade or so and are often unsuitable in residential settings. This is unfortunate, because dead trees are essential to some native birds and mammals for nesting. They also provide the main (if not sole) sites for nesting, roosting or vantage points of many other birds and animals. The issues are discussed in *'Land for Wildlife Note No. 38'*, available from the Department of Natural Resources and Environment.

While dead trees are usually unacceptable on smaller residential allotments, it would be highly desirable to retain them on larger allotments and Council land as long as they present no risk to people or property.

4.5 Habitat Fragmentation

The 'Australian Terrestrial Biodiversity Assessment 2002' (National Land and Water Resources Audit 2002, page vii) and the *'State of the Environment 2006'* investigation both concluded that one of the most important threats to biodiversity in Australia is fragmentation of habitat in the highly modified regions of southern and eastern Australia.

This is relevant to Knox. The distribution across the municipality of Knox's biologically significant sites, as shown on the key map on p. 2 of Volume 2, illustrates the highly fragmented nature of most remnant vegetation in Knox, other than in the Lysterfield Hills and the foothills of the Dandenong Ranges. Some sites are linked, often tenuously, by habitat corridors along creeks, roads and railway lines. Others sites are isolated by urban or industrial development.

Comparative studies of birds over time suggest that some species are declining in Knox as links between sites break down. John Reid's observations since 1978 around Dandenong Creek in Wantirna and Heathmont suggest that some migratory and nomadic bird species have become less frequent in the last two decades. A number of species, including Pallid Cuckoo, Fan-tailed Cuckoo, Shining Bronze-Cuckoo, Golden Whistler, Rufous Whistler, and Olive-backed Oriole, appear to be declining in this area. A likely explanation is that sites which were formerly visited by these species on a regular seasonal basis are now too isolated from each other and from major habitat corridors.

This explanation is supported by Baker (1989) who describes a comparative study of bird species of Blackburn Lake (completely isolated from other bushland), and the Mullum Mullum bushland in Mitcham (connected to the Yarra River at Warrandyte by a corridor of vegetation along Mullum Mullum Creek). Baker states that both sites are of similar size and geographic location and considers both to offer similar habitat. Of the 100 or so indigenous bird species residing in or regularly visiting the Mullum Mullum bushland, 28 were absent or in significantly lower numbers at the ecologically isolated site of Blackburn Lake. It is perhaps significant that 23 of this total (82%) are migratory or nomadic birds which tend to move along corridors of native vegetation.

The reduced abundance of native birds that results from fragmentation causes an increase in pest insects that were previously kept in check.

Fragmentation of habitat also means that flora and fauna become especially vulnerable to drastic disturbance such as fire, drought and possible climate change, because there is no adjacent refuge from which to recolonise. This includes plants which colonise bare ground through windborne seed from unaffected areas, particularly the important early colonisers in the daisy family (which store very little seed in the soil).

Inbreeding is another problem of fragmented sites. Fauna need to be able to travel to find mates from other populations, and some plants need to be pollinated or have their seeds dispersed by insects or birds travelling between populations of the plants.

As sites become more fragmented, the ratio of boundary length to area increases. This exposes them to more edge effects such as weed invasion, unsupervised pets, nutrient-rich runoff from gardens, and waste dumping.

The full range of negative environmental impacts of habitat fragmentation is discussed in more detail in the review article by Saunders *et al*. (1991). These CSIRO scientists end their article with the conclusion that the ecological health of remnants of native vegetation is critically dependent on the broader landscape in which they occur, and it is no longer appropriate to treat remnants as independent from their modified surroundings. In the Knox context, this means (in part) that the measures which need to be taken to conserve flora, fauna and significant sites cannot be confined to the significant sites alone; there are measures such as planning control over tree removal that ought to be applied on land between sites of high biological significance. This has been taken into account in the recommendations below for amendments to the Knox Planning Scheme (Section 5).

4.6 Dieback

'Dieback' is a term used to describe the most obvious symptom exhibited by a tree in response to a wide range of stresses related to pests, disease or other environmental factors. In its broadest sense, the term is applied to any native or exotic species exhibiting twig and branch death starting at the branch tips and working down toward the trunk. A good discussion of the problem is given by Jones and Elliot (1986).

One serious cause of dieback is the extremely virulent soil-borne disease, Cinnamon Fungus (*Phytophthora cinnamomi*), which is widespread through southern Australia. It can kill more than 25% of the overstorey species and 50-75% of the understorey species. It spreads through moist soils and favours warm, moist conditions, spreading rapidly after heavy rains in summer. It is almost inactive at temperatures below 15^{o}C.

Cinnamon Fungus is often spread on road making machinery moving from contaminated sites to new projects elsewhere, and also in contaminated fill and gravel used in road construction.

Earthmoving machinery and tractors can readily transmit fungi and diseases, as can introduction of contaminated soil or road gravel. Measures should be taken to minimise the risk to sites of biological significance.

Soil compaction and surface level changes within a tree's root zone are frequently a problem for trees close to newly constructed buildings or those under construction. The parking of vehicles or stockpiling of materials on a tree's root zone will compact the soil, reducing its oxygen exchange capacity and starving the roots of oxygen. Vehicles and heavy equipment should therefore not be placed under trees.

A complex problem contributing to tree dieback in some of Knox's biologically significant sites appears to involve the interaction of Bell Miners, Psyllid insects, loss of shrubby understorey vegetation, and in many cases an increase in soil nutrients. The ecology of the problem is discussed by Buchanan (1989).

Bell Miners are very aggressive birds that form communal territories and feed on Psyllid insects. Psyllids are tiny, sedentary, sap sucking insects which live on eucalypt leaves. They produce a protective cover, or 'lerp' under which they live for most of their lives. Bell Miners eat the lerps and sometimes the nymph of the Psyllid, but usually the insect is left, allowing them to increase in numbers.

The Bell Miner's aggressive behaviour keeps at bay most of the other birds that would normally consume psyllids, and thus the psyllid population is no longer limited by natural means (Low, 1994). As the Psyllid numbers increase, the foliage damage they cause becomes unsustainable and the host trees start to die back. As leaves are shed by afflicted trees, Psyllids start to decline in number, and under natural conditions the Bell Miners would move on. However, Bell Miners cannot move to other areas if the bushland is fragmented (as is normal in Knox), which means that they persist and there is no recovery period for afflicted trees.

Dense shrubs normally provide protection from the Bell Miner for small birds, and these small birds are normally important in controlling the Psyllid population. The loss of shrubby understorey vegetation, generally through lack of periodic burning or from removal as a fire hazard, exacerbates this complex problem by reducing suitable habitat for small birds.

Increased soil nutrient levels from urban stormwater, garden runoff, pet faeces and other sources cause eucalypts to produce increased quantities of soft, sappy growth which provide an ideal food supply for leaf eating or sap sucking insects. This soft growth contains higher than normal amounts of nitrogen, an essential component for the production of amino acids. Insects such as Psyllids that live on this enriched diet grow and reproduce more rapidly, which in turn increases the level of insect damage to trees.

4.7 Fire Management

Fire hazard – real or perceived – puts pressure on some bushland reserves and properties for ecologically undesirable fire prevention works such as construction of firebreaks within bushland. This is a particular problem where buildings are placed too close to bushland. Council should be able to prevent further instances of this in cases where planning permits are required, because of provisions that have been included in the proposed overlay schedules discussed in Section 5.5. However, developments such as buildings that are ancillary to a dwelling often do not require a planning permit, and then Council only has the power of persuasion to prevent undesirable encroachment of buildings on bushland.

As noted in Section 4.3, Council could respond to this problem by producing and distributing a brochure about being a good neighbour to bushland reserves. The brochure would encourage recognition of the values of the reserves and the need to avoid actions that cause incompatibilities between landowners and neighbouring bushland. It would also encourage actions by neighbours on their own properties to keep fire hazard acceptable.

Each year, Council issues roughly fifty fire prevention notices on owners of vacant properties at the foot of the Dandenong Ranges, requiring cutting of vegetation. Some of these properties have biologically significant vegetation. In the case of properties that lie within Sites 1-100 of this report, the measures taken should be decided with the sites' significance in mind, guided by the descriptions of the sites in Volume 2. The relevant sites could be identified with the aid of the key map at the start of Volume 2, or from Council's GIS once the sites are placed on it.

Care should be taken not to cut areas of fairly intact native vegetation too heavily, too often or at inappropriate times of the year, because it can encourage a transition from indigenous plants to faster-growing weeds which produce more flammable material that dries out more thoroughly in the fire danger period.

In the short term, cutting vegetation simply converts green, standing material to dry, fallen material, with little if any real improvement in fire risk. However, manual removal of the hay, leaf litter and sticks (e.g. with a rake) can greatly reduce the density of fine fuel and thereby reduce the fire hazard.

In the absence of manual removal of hay, leaf litter and sticks, the main benefit of slashing, mowing or brushcutting is suppression of growth in the following weeks. This is not very helpful if the cutting occurs too late in the season, when plant growth and rotting of hay are very slow anyway due to the summer drought. On the other hand, acting too early in the season can result in bogged vehicles that can cause weed invasion and ecological damage. Ideally, the timing of slashing or mowing should also take into account any serious weeds that may be stimulated, aiming to cut them shortly before their main annual seed-set. Late November or early December is an appropriate time of year for cutting native vegetation in most of Knox, except that an earlier cut is preferable if the serious weed, Sweet Vernal-grass (*Anthoxanthum odoratum*), is a problem and threatens to drop seed prior to the cut.

Controlled burning appears not to be used on private land in Knox for management of biodiversity or fire hazard. However fire is being increasingly used in Council's bushland reserves and Parks Victoria land in Knox to maintain biodiversity and minimise fire hazard.

Parks Victoria has achieved substantial gains in biodiversity from trial burns in Dandenong Valley Parklands, as demonstrated by Lorimer (2000b, 2001b).

Council's park management staff are progressively acquiring expertise in this area and have developed constructive relationships with local brigades who conduct the burns. Neighbours are notified prior to the burns. Some of the burns are being guided by a report by Lorimer (2001a), and the remainder is the result of discussions and site visits between Council's park managers and the Fire Prevention Officer.

4.8 Feral Animals

The following pests are having a detrimental impact on the native fauna and flora:

Feral cats pose a serious threat to native animals in Knox. Feral cats kill prey up to their own body size, and their diet in Victoria includes over 18 species of native birds, 24 mammal species, and 3 reptile species (Seebeck *et al*., 1991). Frogs and numerous invertebrate animals also contribute to a feral cat's diet (Anon, 1991). Many feral cats carry and transmit infectious diseases such as toxoplasmosis and sarcosporidiosis, that can debilitate and kill native animals, livestock and humans (Anon, 1991).

Foxes are voracious predators that kill native birds and small native mammals, and are major spreaders of seeds of serious weeds such as Blackberry, Hawthorn and Cotoneasters. They also dig extensively at certain times of the year, sometimes causing damage to native ground flora and promoting germination of weeds. They are abundant in Knox, particularly along the creeks.

Rabbits cause moderate to substantial damage to native vegetation in the Lysterfield Hills (including Heany Park) and in the Dobsons Ck valley eastward from Wicks East Nature Reserve in The Basin. Knox City Council has run a rabbit control program since 2001 in four sites in the Lysterfield Hills, using carrots baited with Pindone. The program is in partnership with Parks Victoria and the two neighbouring quarry operators.

Common (or Indian) Mynas, Noisy Miners, Spotted Doves, Starlings exclude native fauna from nest sites. This is often observed in Knox.

Blackbirds disperse berry-bearing weeds such as Blackberries, Cotoneaster, Hawthorn and Sweet Pittosporum in their droppings. They are also aggressive toward some native birds, and their scratching destroys indigenous plant seedlings.

Mallards (a foreign species of duck) are capable of interbreeding with the native Black Duck. Mallards and their hybrid offspring were recorded on several occasions during this study. They are regarded as a mild threat to the native species.

Feral Honeybees inhabit tree hollows, thus reducing the available nest sites for native birds and possums. Honeybees also compete with native bees for nectar (Douglas 1977), and harvest nectar from some species without effecting pollination (Taylor and Whelan 1988).

Slugs and snails often cause considerable damage to orchids, which are the group of indigenous plants that have suffered the greatest level of local extinctions in Knox (Section 3.4).

Rodents (mice and introduced rats) are almost certainly present in most remnant vegetation in Knox. These animals compete with native rodents and small marsupials for ecological resources, and are very difficult to eradicate from indigenous vegetation. Controls on rubbish dumping will remove some of the attractants for these species. Revegetation will encourage native predators such as Kookaburras.

4.9 Pets

It is not clear whether pets such as cats and dogs may be having a severe impact on fauna in Knox through hunting, spreading disease, disturbing nests, harassing wildlife, and frightening wildlife from their habitat. Indigenous plants may be trampled or dug up by pets, and soil disturbance from scratching provides an ideal seed bed for weeds. Also, nutrients in cat and dog faeces contaminate soil and waterways.

Suburban pet cats that are not confined to their properties often move hundreds of metres from home, particularly at night into nearby bushland (e.g. Barratt 1997). This means that a cat at large almost anywhere in Knox is within hunting range of a site of biological significance. There is conflicting observational data about the number and types of animals killed by domestic cats, but it is generally accepted that even well-fed pet cats in Australia kill wildlife – particularly birds and small reptiles. Cats can also spread toxoplasmosis and other diseases that may be innocuous to cats but fatal to wildlife.

Cats are presently regulated under the *Domestic (Feral and Nuisance) Animals Act 1995* and under Knox's *General Provisions Local Law No.2*. The latter requires that all pets must be confined to the owner's property and not be allowed to stray or roam.

4.10 Nutrient Seepage

Most introduced grasses and typical garden plants thrive on elevated levels of phosphorus and nitrogen, so gardeners apply fertiliser to encourage them. By contrast, indigenous plants are adapted to Knox's low natural levels of soil nutrients, and some even exhibit a toxic response to elevated phosphorus levels. When fertiliser is applied to a garden on a slope above native vegetation, the nutrients migrate downhill, poison or debilitate some of the indigenous plants, and provide good conditions for weeds to take over.

The nutrients either build up in the soil and cause increasing damage, or else migrate downhill where they eventually pollute a creek (causing algal blooms, rampant weed growth or other ecological upsets).

These are common problems in Knox's bushland reserves and creeks.

Ideally, the source of the nutrients would be corrected, but it is very hard to achieve this because it would require residents to alter their gardening practices. It would be worth including this issue in a brochure about being a good neighbour to bushland reserves, as discussed above in the context of weeds, garden waste dumping and fire management.

An alternative to control at source that can be effective for a localised problem in bushland is to install a cut-off drain uphill from the affected native vegetation. The drain catches runoff water and seepage and typically diverts them to a stormwater drain or directly to a creek, which does nothing to improve water quality.

Wetlands are sometimes created along creeks specifically to trap nutrients. Plants such as rushes in the wetlands take up nitrogen and phosphorus in their foliage, which is then harvested and removed from the site periodically. A very large example of such a system is under development beside Dandenong Creek immediately downstream from Wellington Rd in Rowville.

4.11 Drainage Works and Waterway Modification

Stormwater and runoff from most of Knox drains to the major creeks via pipes. Heavy machinery has been used to install underground pipes in almost all valleys in Knox, destroying almost all remnant vegetation in their path. The natural course of the creeks has been mostly replaced by straighter, artificial channels, or sometimes roads. This process has continued to occur in 2004, with the conversion of part of Corhanwarrabul Ck and associated wetlands into a road (Sherwood Way, Lysterfield) with a pipe beneath it.

Ditches, dykes and more pipes have been installed on floodplains to drain former wetlands and reduce the incidence of flood.

After such radical alteration, the original vegetation of Knox's valley floors (Figure 2) has been decimated, as is clear from the work of Reid *et al.* (1997b). The aquatic habitat value of the streams has been mostly lost too, partly because of the modified creek beds, flows, surroundings and water quality, and partly because retarding basins, pipes and the Pillars Crossing weir on Dandenong Creek now prevent the migration required by some of the aquatic fauna.

The one consolation is that natural aquatic ecosystems are much easier to re-establish than terrestrial ecosystems, so that wetlands created artificially often develop a rich biodiversity of indigenous organisms with little or no human intervention. One of the best examples in the region is the wetland which arose from the abandonment of the old horse pond a few tens of metres north of Dandenong Creek, just downstream of Dorset Rd in Bayswater North. The pond now teems with aquatic fauna, as well as several regionally rare aquatic plants. Water birds make liberal use of dams and artificial ponds throughout Knox. Artificial creation of wetlands is discussed by Romanowski (1993).

Several municipal councils (e.g. Monash) are reverting heavily modified creeks or drains back to meandering courses lined with vegetation.

4.12 Rare or Threatened Flora and Fauna

This study found that 41% of native flora species are Critically Endangered with extinction from Knox (Section 3.4.2, Appendix B). There is also a high proportion of fauna species in Knox that are threatened or near-threatened state-wide (Section 3.5, Appendix D). However, the threats to these species can be overcome and it is reasonable to aim to retain all presently existing native fauna and flora species until at least the year 2020 (which is a strategic target date for Council).

The first step to conserve these species is to protect their habitat, which is principally within Sites 1-98 of Volume 2 (excluding Site 52, which has been recently degraded). Every site contains at least one species that is threatened in Knox. Protection of habitat in these sites is a major thrust of the recommendations in this report.

The second step is to increase the numbers of the many plant species that are present in such small populations that they are vulnerable to inbreeding and chance events such as vandalism or digging by foxes. Breeding programs for this purpose could be coordinated by Knox City Council, particularly focusing on the more secure reserves and the more threatened species (particularly those that are critically endangered in Knox or threatened state-wide). Sometimes pollen, seed or whole plants will need to be introduced from a nearby site in the same biogeographical zone (Section 3.2) so that outbreeding can occur.

It would also be desirable to monitor the populations of the most significant species. This is a task that could be taken up by members of the community reporting to Council. Prospective volunteers should contact an Environment Officer at Council's Sustainability Department.

With funding from Council, the author is presently working on a management plan for locally threatened plants. This will provide more detail and a broader range of recommended actions than can be given here.

4.13 Revegetation

Previous sections explain how native vegetation in Knox is dwindling and becoming increasingly fragmented and degraded. While it is in no way a substitute for retention of native vegetation, the losses are being ameliorated by replanting of some biologically degraded areas and improving the functioning of habitat corridors.

In the past two decades there has been an increasing trend of using indigenous species for revegetation projects, as supported under the Federal Government's *National Strategy for the Conservation of Australia's Biological Diversity* (DEST, 1996). This should be continued and extended.

It is almost always strongly desirable to determine the native vegetation of a proposed planting site and select species appropriate for that type. (Exceptions occur where the environment is too greatly altered to again support its original type of vegetation). Propagation material should come from the same (or closely related) EVC and biogeographic zone in Knox (Section 3.2) or nearby. Lists of suitable species could be compiled for each EVC to simplify selection.

Various community groups in Knox hold regular working bees to remove weeds and plant indigenous species at selected sites. This is a valuable opportunity for community involvement and ownership of local projects and provides a useful, conscientious and skilled adjunct to Council's own park management staff. The relevant staff at Council support these groups in a number of ways, including staff participation, permission to work on sites and removal of weed waste and rubbish after working bees. Council and the Knox Environment Society cooperate on some projects, such as the Swordgrass Brown Butterfly Project.

A number of schools and kindergartens in Knox have undertaken extensive planting of indigenous species to provide habitat and a resource for environmental education. The impetus for such projects may increase under the proposed national schools curriculum.

As the *National Strategy for the Conservation of Australia's Biological Diversity* (DEST, 1996) says, 'Although all levels of government have clear responsibility, the cooperation of conservation groups, resource users, indigenous peoples, and the community in general is critical to the conservation of biological diversity'.

At the community level, planting of indigenous habitat plants is being fostered through the 'Gardens for Wildlife' program run by Council and the Knox Environment Society. This program helps residents to strengthen habitat corridors or plug gaps in them by planting species that facilitate wildlife movement. Council provides staff and volunteers to visit gardens and offer advice. The Knox Environment Society's indigenous nursery can supply the appropriate species. Residents become part of a network of people working toward the same end.

'Kindergartens for Wildlife' is a similar program aimed at kindergartens, with more of an educational focus.

5. Conservation Measures in the Planning Scheme

5.1 State Planning Policy Framework

The State Planning Policy Framework (SPPF) is part of the Victoria Planning Provisions, and is therefore included within the Knox Planning Scheme. It requires Knox City Council to give effect to various aspects of State level planning policy when planning and administering the municipality. Clause 11.01 states,

> *'Planning, under the Planning and Environment Act 1987, is to encompass and integrate relevant environmental, social and economic factors. It is directed towards the interests of sustainable development for the benefit of present and future generations, on the basis of relevant policy and legislation.'*

New information from this study relates directly to some of the relevant policies, as explained in the following subsections. These policies relate to the part of Clause 11.03-2 of the SPPF that says planning should:

> *'Help to protect the health of ecological systems and the biodiversity they support (including ecosystems, habitats, species and genetic diversity)'.*

In Knox, this applies most importantly to vegetation communities, since much of the municipality's native vegetation belongs to Ecological Vegetation Classes that are listed as Endangered or Vulnerable.

5.1.1 Conservation of Native Flora and Fauna

Clause 15.09-2 is the part of the SPPF that is most directly relevant to this report, and which provides the strongest mandate to Council for implementing the planning measures recommended here.

Perhaps the most important part of that clause is the paragraph about the State government's Native Vegetation Framework (an incorporated document in the Planning Scheme):

> *'Planning and responsible authorities must have regard to Victoria's Native Vegetation Management – A Framework for Action (Department of Natural Resources and Environment 2002). If a permit is required to remove native vegetation, or an amendment to this scheme or an application for subdivision could result in the removal of native vegetation, planning and responsible authorities should follow the three-step approach as defined in the Framework. This is achieved firstly, as a priority, by avoiding the removal of native vegetation; secondly, if the removal of native vegetation cannot be avoided, by minimising the loss of native vegetation through appropriate consideration in planning processes and expert input into project design or management; and thirdly, by identifying appropriate offset actions.'*

The Framework and the technical documents that it cites provide an approach for achieving the objectives stated above. This includes consideration of:

- The rarity of, or threats faced by, each Ecological Vegetation Class;
- The degree to which native vegetation has become ecologically degraded, as measured by a 'habitat score';
- The importance of conserving particularly large, old trees;
- The role that native vegetation plays in protecting against degradation of land and waterways;
- The importance of conserving habitat for species of flora or fauna that are rare or threatened regionally or more widely.

These considerations have all been taken into account in the present study.

The Framework and associated departmental guidance documents are quite prescriptive about how to respond to permit applications that involve removal or consequential loss of native vegetation. As explained in Section 5.6.4, the opportunities for approving permit applications of this kind are limited because of the predominance of threatened vegetation types in Knox. In cases where a permit is issued, the Framework is again quite prescriptive about requirements for 'offsets' that compensate for the loss of native vegetation.

The Framework is supported by regional vegetation plans, the one relevant to Knox being the Port Phillip and Westernport Native Vegetation Plan (PPWCMA 2006). Clause 15.09-2 requires that Council have regard to it when preparing planning scheme amendments or municipal strategic statements affecting native vegetation, flora, fauna, waterways or wetlands.

Clause 15.09-2 of the SPPF also requires that Council, as a planning authority and responsible authority, should:

- *'Consider the potential impacts of land use and development on the spread of plant and animal pests from areas of known infestation into natural ecosystems'*;

and that responsible authorities should:

- *'Ensure that the siting of new buildings and works minimises the removal or fragmentation of native vegetation'.*

However, the SPPF's objectives for Net Gain, weeds and proper siting of buildings and works cannot be implemented in the case of a land use or development that does not need a planning permit, and such a permit is typically not required unless the affected land is specifically recognised in the planning scheme.

This brings us to what we might call 'the three pillars' that are required for protecting biodiversity through the planning scheme:

① Information base: There must be reliable information about the species, sites and biological communities in the municipality, along with the threats to them and positive measures to bring about improvements. The report you are reading provides a fairly high level of such information that is current at the time of writing, and additional information will be required to take into account the specifics of many permit applications.

② Planning provisions: Overlays and possibly Local Policies in the Planning Scheme need to be amended to provide control over various types of development in and around sites of biological significance, and there need to be associated amendments to the Municipal Strategic Statement. These are explained in detail in Sections 5.2 to 5.5.

③ Administrative measures: The controls that are provided by the above planning provisions need to be accompanied by measures for assessing and deciding planning permit applications, making the provisions understood by the affected community, and encouraging compliance. These measures are discussed in Section 5.5.4.

5.1.2 Protection of Waterways and Floodplains

Stream corridors and floodplains feature prominently in the sites of biological significance identified in Volume 2 of this report.

Clause 15.01-2 of the SPPF says that Council, in its roles as planning authority and responsible authority:

'*where possible should encourage:*

- *'The retention of natural drainage corridors with vegetated buffer zones at least 30m wide along waterways to maintain the natural drainage function, stream habitat and wildlife corridors and landscape values, to minimise erosion of stream banks and verges and to reduce polluted surface runoff from adjacent land uses.*
- *'Measures to minimise the quantity and retard the flow of stormwater runoff from developed areas.*
- *'Measures, including the preservation of floodplain or other land for wetlands and retention basins, to filter sediment and wastes from stormwater prior to its discharge into waterways.'*

These objectives overlap to some degree with those in Section 5.1.1 and the same 'three pillars' apply. However, they go further in that they apply to water quality and aquatic environments that may have no significant vegetation. Water quality, flooding and flow regimes are environmentally important for fauna such as Platypus, fish and aquatic invertebrates. Developments and land uses that affect water can also have impacts on flora and fauna well downstream.

The planning provisions recommended in Sections 5.2 to 5.5 below therefore apply in some cases to land that may have little or no native vegetation or other features of biological significance on the site, but which may be subject to development proposals or land use changes with downstream effects on water quality or hydrology.

5.2 Municipal Strategic Statement

A planning scheme amendment to replace the existing Municipal Strategic Statement (or MSS) is currently in the late stages of the amendment process. Proposed changes include recommendations from the first edition of this report, such as recognition of:

- The prevalence of threatened Ecological Vegetation Classes among Knox's surviving native vegetation;
- The importance of waterways and floodplains to Knox's biodiversity;
- The importance of protecting locally threatened plant species through the planning scheme; and
- The many sites of biological significance in Knox and the desirability of protecting them.

On its present trajectory, the new MSS will provide a sound basis for the more specific planning provisions recommended in the following sections of this report.

5.3 Local Planning Policies

5.3.1 Dandenong Foothills Policy

Clause 22.01 of the Local Planning Policies is the Dandenong Foothills Policy, which was amended in 2006 after taking into account the first edition of this Sites of Biological Significance report (among other things). It covers an area that embraces over one dozen sites of biological significance identified in Volume 2 as worthy of inclusion within an Environmental Significance Overlay.

The Dandenong Foothills Policy recognises the presence of areas of environmental significance within the area that it covers, along with landscape values and a residential character that is sympathetic to the natural surrounds.

The policy has specifications for buildings, works and landscaping projects that seek retention of trees and understorey and indicate a priority for new vegetation to be biased toward indigenous species in much of the policy area. These provisions are complementary to the recommendations below for the application of overlays to the more biologically significant parts of the policy area.

5.3.2 Bushland Neighbours

Residential buildings that encroach too close to bushland (including sites of biological significance) sometimes create problems of incompatible land use. The most common and important incompatibility that arises is buildings constructed so close to bushland as to be at risk from bushfire. This typically leads to damage to the bushland from fire prevention works that have to be conducted.

Ideally, such incompatibilities would be avoided by having a protective buffer around bushland areas. New subdivisions that contain or adjoin bushland should always allow for such buffering. However, there are some bushland remnants among Knox's sites of biological significance where no buffer exists and neighbours can presently develop land without regard to either fire risk or the pressures that the development may impose on the bushland.

Theoretically, one way of dealing with such problems would be to impose an overlay on certain properties adjoining sites of biological significance. This could be either the same overlay as the site itself (an Environmental Significance Overlay, or ESO) or a separate Design and Development Overlay (DDO). The overlay could require that developments respond to the issue of fire risk. These overlays have the advantage that they can require a permit for construction of a building, and hence trigger planning controls that would not

otherwise apply. A disadvantage may be that these overlays are not usually used for such purposes, and some people might see it as undesirable to do so. However, such a use of the ESO or DDO would be quite consistent with the overlays' formally stated purposes in the Victoria Planning Provisions, and it would fulfil purposes that have a sound basis in the Planning Scheme.

In principle, another approach would be to impose boundary setbacks for buildings on properties adjoining sites of biological significance. The Planning Scheme can impose setbacks in schedules to zones such as R1Z, and Clause 4.14(1) of the *Building Regulations 1994* provides a mechanism that could effectively insert the Planning Scheme's setbacks into the building permit process. However, these provisions are not intended to be applied selectively on certain properties, which is what is required for properties adjoining sites of biological significance.

The remaining approach is through a new Local Policy. This has the disadvantage that application of a Local Policy is not triggered by many building projects because they do not require a planning permit. Nevertheless, it may be the only way of dealing with the problem.

An example of how such a policy might be worded is given in Appendix E. It includes a list of the sites of biological significance that are subject to this issue.

If an ESO schedule is found to be a preferable alternative, the planning provisions and list of sites in Appendix E can be fairly readily translated into an ESO schedule. However, more effort would be required to determine exactly which properties would be covered by the overlay schedule.

According to page 35 of the Native Vegetation Framework (NRE 2002a), the Victoria Planning Provisions are due to be reviewed with a view toward amendments that would give better effect to the Framework. This may offer an opportunity for a more effective measure to deal with the sorts of incompatibility discussed above. Council should consider this at the time of the review.

5.4 Zones

The Biodiversity Practice Note for the Victoria Planning Provisions (dated March 2002) states that for sites of biological significance that are publicly owned, '*the Public Conservation and Resource Zone is the most appropriate zone for protecting biodiversity values, however, depending on the predominant land-use activity, other public land zones may also be appropriate coupled with an overlay*'. In Knox, the Public Conservation and Resource Zone applies only to a rather narrow strip along parts of Dandenong Creek. The other publicly owned sites of biological significance have various zonings because they are mostly in urban surroundings and have primary uses other than just conservation.

The Biodiversity Practice Note says, *'In predominantly urban environments, zoning is not the best way to achieve biodiversity objectives for isolated locations with biodiversity values, such as waterways, open space areas or recreational uses such as golf courses. It is preferable to use a zone appropriate for the preferred strategic use of the land and to protect biodiversity assets by using an overlay'.* This situation applies to most of the sites of biological significance in Knox, and zoning amendments are not recommended here as a tool for protecting any sites of biological significance in Knox.

5.5 Overlays

Effective protection of most sites of biological significance requires the use of planning overlays and their associated schedules. The appropriate overlay and schedule for a particular site depends on:

- Its level of significance;
- The sensitivity of the significant attributes to different threats (e.g. subdivision or building construction);
- The type of land use and tenure; and
- Whether the significance is associated with native vegetation, other vegetation, lakes, streams etc.

Based on these characteristics, and guided by the Biodiversity Practice Note for the Victoria Planning Provisions, the sites investigated in this study have been divided into four categories with different overlay treatments, as follows:

- Ninety-seven sites are proposed to be covered by an Environmental Significance Overlay with a schedule that provides a fairly high level of planning control. This would affect 2,683 ha, or 23½% of Knox;
- A second, less restrictive schedule to the Environmental Significance Overlay is proposed to cover the treed residential area at the foot of the Dandenong Ranges, between The Basin and Upper Ferntree Gully. This would affect 1,010 ha, or 9% of Knox;
- Fifteen sites (354 ha, or 3% of Knox) are proposed to be covered by a Vegetation Protection Overlay (which is less restrictive again); and
- Five sites (or groups of sites) of lower significance are not recommended to come under any overlay because Clause 52.17 of the Planning Scheme (the baseline 'Native Vegetation Retention' provisions) is believed to provide a basic but appropriate level of planning control.

The overlays proposed here would completely replace the existing Schedules 1 and 3 of the Vegetation Protection Overlay in the planning scheme. This would not significantly change the total area covered by overlays, but there are substantial numbers of properties proposed to be relieved from overlays and others that are proposed to be covered for the first time.

A recommendation (introduced in Section 3.4.2) that applies to each of the overlay schedules is that they be drafted and administered to give recognition to plant species that are threatened within Knox or more widely; i.e. species that are listed in Appendix B as Critically Endangered, Endangered or Vulnerable in Knox. When such a species is affected by works or land uses subject to permit, any loss should be compensated by actions that cause a net increase in the security of that species, e.g. by propagation, improved protection and removal of threats like environmental weeds. Such measures support a key goal in *'Knox Vision 2025'* and the *'Knox Sustainable Environment Strategy 2008-2018'* that no indigenous species become extinct in Knox.

The proposed overlays and schedules are discussed in more detail in the following subsections.

5.5.1 Environmental Significance Overlay – Schedule 2

Sites 1-98 described in Volume 2 are the ones with greatest biological significance (other than Site 52, which has been recently degraded). These sites are therefore recommended for the highest level of recognition in the Knox Planning Scheme, by way of a schedule to the Environmental Significance Overlay (ESO).

There is an existing Schedule 1 to the ESO in the Knox Planning Scheme (since February 2009), so the schedule that is proposed here for Sites 1-51 and 53-98 is referred to as 'ESO2' in what follows. ESO2 is intended to provide an appropriately high level of planning protection for the:

- streams;
- water bodies;
- floodplains; and
- native vegetation

that give rise to the significance of the sites. The native vegetation is often significant in itself, and any of the above features may be significant because of:

- The fauna that rely on them;
- Their role in ecological corridors or networks for movement of fauna, pollen or plant propagules; or
- Their importance in maintaining aquatic systems that are important to humans.

On floodplains, open pastoral landscapes with little native vegetation can form important habitat for certain birds or other wildlife (e.g. birds of prey and the rare fish, Dwarf Galaxias). ESO2 should provide control over subdivision, works or buildings that may be proposed for these sites to protect against adverse changes in water flows, hydrology, silting, weed growth or loss of important vegetation.

Note that no overlay other than the ESO can provide this sort of protection when significant vegetation is not proposed to be removed. The ESO also provides controls over subdivision, unlike the Vegetation Protection Overlay or similar overlays. Even where none of these considerations are important, the ESO is appropriate for riparian sites and any site of known or likely biological significance, according to the Biodiversity Practice Note for the Victoria Planning Provisions (dated March 2002).

The sites recommended for ESO2 vary from Local to State significance for their flora, fauna or habitat values. These levels of significance are determined according to the Department of Sustainability & Environment's 'BioSites' criteria (Amos 2004).

ESO2 should provide exemption for works or vegetation removal to the minimum extent necessary for normal maintenance of existing built assets, including:

- Buildings and other structures;
- Roads, paths and car parks;
- Railway infrastructure (e.g. tracks, sleepers, wiring, signals, platforms);
- Artificial stormwater treatment ponds (except where works and vegetation removal exceed, say, one hectare in area, or where machinery access requires damage to remnant native vegetation);
- The fairways, tees and greens of golf courses; and
- Sports playing fields or courts.

Although some non-indigenous plants can provide habitat for some wildlife, it appears unnecessary for ESO2 to provide protection for plant species that are not indigenous to Knox. Ecological research on birds in eastern Melbourne suburbs (White *et al.* 2005) and insects in Perth (Bhullar and Majer 2000) support other studies and my general observations in Knox that indigenous vegetation provides the best habitat for native fauna. In Knox's most significant habitat areas (which ESO2 represents), non-indigenous plants are much more often an ecological liability than a benefit, particularly in the case of non-Australian species.

A suitable Statement of Environmental Significance for the ESO2 schedule would be:

Statement of environmental significance

The sites covered by this schedule have been identified as sites of biological significance in Volume 2 of the report, *'Sites of Biological Significance in Knox'* by G.S. Lorimer (published by Knox City Council, 2010). Their protection and appropriate management is of particular importance for the maintenance of Victoria's biodiversity. Biodiversity has intrinsic values and it also provides for human needs ('ecosystem services'), including the contribution that it makes to the character and amenity of parts of Knox.

The report just cited should be consulted for details of the attributes that make each site environmentally significant, and the associated level of significance (Local, Regional or State) according to the criteria of the Department of Sustainability & Environment.

A high proportion of sites are of State significance because they contain patches of remnant vegetation belonging to one or more Ecological Vegetation Classes (EVCs) that are regionally Endangered or Vulnerable. Conservation of Victoria's biodiversity requires a high level of protection for remaining examples of regionally Vulnerable or Endangered EVCs, even in the case of rather small patches such as some of the sites that come under this schedule.

Other environmentally significant attributes that are present in various sites are:

- Plant species that are threatened in Knox or more widely;
- Recently recorded native fauna species (including invertebrates) that are uncommon, rare or threatened in the Melbourne area or more widely (according to the Department of Sustainability & Environment's 'Advisory List of Threatened Vertebrate Fauna in Victoria – 2007', the Land Conservation Council's 'Melbourne Area District 2 Review Descriptive Report' (1991) and expert advice about invertebrates);
- Habitat features, such as tree hollows, that are likely to be used by such fauna;
- Streams or wetlands that retain some natural ecological function, including habitat for native fish, Platypus, invertebrates or other fauna;

- A role in dispersal of wildlife, pollen or plant propagules, through acting as an ecological corridor or a 'stepping stone' in a network of sites;
- In a few cases, plants of exceptional size or age for their species.

While most of these attributes relate to remnant native vegetation in whole or in part, other vegetation is also significant at some sites: for example, dead trees or mature planted trees used by fauna, or even the open pasture along Dobsons Creek in The Basin, where migratory birds such as Egrets congregate. In some cases, there are important features unrelated to vegetation, such as stream flow regimes or the frequency and depth of floodwaters that may be needed by certain fauna such as the Dwarf Galaxias (a Vulnerable fish species).

In many cases, a site contains one or more areas that are not environmentally significant when taken in isolation from the rest of the site. These sections are included under this overlay schedule because their use, management and development potential needs to be considered in the context of the site as a whole. This includes any current or potential roles in providing compatible land use adjoining the area(s) of higher environmental significance, such as:

- Providing an ecological buffer;
- Providing a buffer for fire safety;
- Providing management access that does not harm the more significant part of the site; and
- Inhibiting the ingress of nutrients, soil and weed seeds into the significant part of the site.

Precedent

The first application of the ESO in Knox involves just 1·2 hectares in Rowville and it only came into affect in February 2009, but it serves as a precedent for more widespread use of ESO schedules. It introduced ESO Schedule 1 to the Knox Planning Scheme, referred to here as 'ESO1'.

The study behind the report you are now reading was a critical part of Amendment C45 that established ESO1, and a 2008 version of this report is referenced in ESO1. The area covered by ESO1 is part of Site 81 and the ecological information presented in support of the amendment was from this study. ESO1 is similar to the proposed ESO2, although ESO1 is tailored more specifically to the land it affects. The Panel Report for Amendment C45 concluded in Section 4.3.4:

> *'The Panel believes it is important to adequately document the environmental values of the site in order to support transparency and robust decision-making. The current controls are not adequate for protecting the endangered EVC 127 Valley Heathy Forest on the subject site nor its ecological contribution to the surrounds. The proposed Environmental Significance Overlay is the appropriate planning tool for future management of the site whilst still allowing some flexibility of uses'.*

Valley Heathy Forest and other endangered EVCs are ubiquitous in the sites proposed for ESO2 and so are ecological contributions to their surrounds. I believe that the Panel's comments about the inadequacy of current controls and the appropriateness of the ESO could be extended to all sites proposed for ESO2.

5.5.2 Environmental Significance Overlay – Schedule 3

An additional schedule to the Environmental Significance Overlay (called 'ESO3' in this report) is proposed for the leafy, mostly residential areas at the foot of the Dandenong Ranges in The Basin, Boronia, Ferntree Gully and Upper Ferntree Gully. ESO3 is intended to protect vegetation that underpins the existing natural values of the area and provides a buffer to the Dandenong Ranges National Park and other sites of biological significance embedded within the ESO3 area.

The objectives, permit requirements and decision guidelines of ESO3 need not be as broad as ESO2 and the controls can be a little weaker, commensurate with the nature of the land use and the lower significance level of the vegetation proposed for ESO3. All the exemptions that apply to ESO2 should also apply to ESO3.

The Environmental Significance Overlay is proposed because of the need to control subdivision, building and works (other than maintenance of existing built assets) as well as removal of native vegetation, and to a lesser

extent because of the predominance of threatened ecological vegetation classes that are highly fragmented and occur on private land. This is consistent with the Biodiversity Practice Note cited above.

A suitable Statement of Environmental Significance for the ESO3 schedule would be:

> **Statement of environmental significance**
>
> This schedule covers an area whose environmental significance is discussed in detail in Volume 2 of the report, *'Sites of Biological Significance in Knox'* by G.S. Lorimer (published by Knox City Council, 2010), under the heading of Site 99.
>
> The area abuts the Dandenong Ranges National Park and many other identified sites of biological significance, and it has more than a dozen other identified sites of biological significance embedded within it. It also has a higher density of large trees than the rest of Knox, including remnant indigenous trees. These characteristics result in extensive dispersal of native birds, insects, pollen and seeds through the area. This dispersal is important for the landscape-scale maintenance of biodiversity in the area.
>
> The tree canopy and shrubs that occur along the many creeks and drainage lines that flow through the area are important for maintaining the aquatic ecosystems and water quality.
>
> The presence of the vegetation and the associated wildlife (particularly birds) adds greatly to the amenity and character of the area.
>
> In these ways, the area covered by this schedule plays an important role as an ecological buffer zone and for providing ecosystem services, even though it is not of great biological significance when taken in isolation.
>
> Most of the remnant native vegetation in the area belongs to, or is derived from, Ecological Vegetation Classes (EVCs) that are regionally Endangered or Vulnerable. Lorimer (2010) also identifies the presence of significant flora and fauna species.

5.5.3 Vegetation Protection Overlay

The existing Vegetation Protection Overlay (VPO) schedule and maps in the Knox Planning Scheme are proposed to be wholly replaced. A new VPO is proposed here to cover fifteen sites, of which most comprise leafy residential areas or school grounds. The purpose of the VPO would be protection of the tree canopy.

The density and types of trees in the affected sites:

- Fulfil basic habitat needs for some native fauna, such as parrots;
- Display rudiments of pre-European vegetation communities that are now all regionally or nationally threatened; and
- In some cases, are likely to act as ecological corridors or 'stepping stones' for movement of native fauna around Knox.

The presence of the vegetation and the associated wildlife (particularly birds) adds to the amenity and character of the areas.

These sites have some biological significance, but in the sense of the Biodiversity Practice Note they would not be regarded as 'sites of biological significance', but closer to the description 'scattered living food trees with an exotic understorey…'. The Practice Note states that the Vegetation Protection Overlay is the appropriate planning control applicable in such cases.

It is only proposed to protect native trees 5 m or more in height and whose trunk girths exceed 0.5 metre when measured at 0.5m from the ground, and only when a range of exemptions do not apply. Parcels of land larger than 0·4 ha are also subject to Clause 52.17, which protects the full range of native vegetation (excluding Bracken), whether or not the VPO applies.

All VPO schedules require a 'Statement of nature and significance of vegetation to be protected'. A suitable one in this case would be:

Statement of nature and significance of vegetation to be protected

According to the report, *'Sites of Biological Significance in Knox'* by G.S. Lorimer (published by Knox City Council, 2010), the density and types of trees in the areas covered by this schedule:

- Fulfil basic habitat needs for some native fauna, such as parrots;
- Display rudiments of pre-European vegetation communities that are now threatened; and
- In some cases, are likely to act as ecological corridors or 'stepping stones' for movement of native fauna around Knox.

The report just cited should be provides details of the attributes that make vegetation at each site significant.

The presence of the vegetation and the associated wildlife (particularly birds) adds to the amenity and character of the areas.

Trees are generally the most important part of the vegetation, but in some areas, shrubs provide additional habitat for birds, butterflies and other fauna.

5.5.4 Schedule to Clause 52.17

Clause 52.17 of all planning schemes provides a baseline level of planning control over native vegetation removal on lots greater than 4000 m², with many exemptions. It has recently become possible to amend the Knox Planning Scheme to schedule particular species of native vegetation to be exempt from requiring a permit for their removal, destruction or lopping.

It is recommended that such a schedule be introduced to exempt wild, non-indigenous plants which are not otherwise exempt under Clause 52.17. The most important of these species is Sweet Pittosporum, a very serious environmental weed that presently receives some planning protection in Knox.

5.6 Administration of the Planning Scheme

5.6.1 Public Promotion

The first step for achieving effective implementation of planning provisions of the kinds discussed above is to make the Knox community aware of the provisions, understand them and respect them. Council has a good record of doing so with similar existing provisions. For example, there is a clear, informative brochure titled *'Your guide to understanding vegetation controls in Knox'*.

It is recommended that a new brochure replace the existing one, to explain the new provisions that Council adopts and the reasons for them (e.g. the predominance of threatened vegetation types and the Net Gain policy).

A separate brochure could be prepared specifically for owners of private properties covered by ESO2, highlighting the importance of their land and perhaps offering advice or practical assistance for looking after their sites and obtaining financial rewards for doing so. This could be based on Cardinia Shire's eight-page A4 brochure from 1996 titled *'Do You Live in a Site of Significance in Cardinia Shire?'*, or the 1993 brochure from the Upper Yarra Valley & Dandenong Ranges Authority on which the Cardinia brochure was based. Such a brochure could also be given to prospective purchasers of sites of biological significance (or the purchasers' conveyancers) to explain what it means to live in such a site.

In addition to the grants and tax incentives offered by government for conserving biodiversity on private land, Council could consider introducing a scheme like Maroondah City Council's 'Biodiversity Rating Concession Program'. At present, twenty-five qualifying landowners in Maroondah receive financial rewards and practical assistance for managing and protecting their habitat.

Maroondah City Council has also produced A4 colour brochures titled *'Protecting Remnant Roadside Vegetation'* and *'Living Next to Bushland – A Guide to Reducing Edge Effect on Remnant Vegetation'* that would be good models for Knox. Such brochures could be sent to landowners adjoining appropriate sites of

biological significance to explain the effects that neighbours can have on bushland, and encourage good neighbourly behaviour and respect.

5.6.2 Provision of Information to Permit Applicants

The Council already provides prospective permit applicants with printed information about preparing an application that involves vegetation removal. This information will need to be updated to reflect any amendments to the planning scheme that result from the recommendations in this report.

In addition, it would simplify the process of preparing applications if Council made available, through its internet site, a spreadsheet of indigenous plant species in Knox – essentially an electronic form of the table in Appendix B. At the top of the list should be the species listed as Critically Endangered, Endangered or Vulnerable, since these species require special attention under the proposed schedules to the Environmental Significance Overlay. Consultants and others with databases of flora would be able to readily incorporate the conservation status ratings from the spreadsheet into their databases.

5.6.3 Referral and Expert Environmental Opinion

Statutory planners will need specialist support when considering permit applications relating to the planning provisions discussed above.

Council's Environment Officers have considerable familiarity with many of the sites and the associated issues, and they should be consulted regarding applications and decisions involving any of the sites of biological significance identified in this study. They will need some briefing or training about the changed planning provisions and what the provisions should achieve.

The Municipal Fire Prevention Officer may also need to be consulted regarding applications or decisions that could result in unacceptable fire risk or additional pressure on bushland for ecologically harmful fire prevention work. Permit applications should respond to fire risk in cases where this is relevant, as specified in the proposed overlays and local policy in the Appendices. A Municipal Fire Prevention Officer and an Environment Officer can often combine their areas of expertise to find the best ways to meet the dual objectives of fire safety and nature conservation.

Planning permit applications involving the proposed ESO2 will often need to be referred to the Department of Sustainability & Environment, who can provide a high level of assistance with the Native Vegetation Framework, the Net Gain policy, review of reports by environmental consultants, and issues concerning threatened flora and fauna.

The stream management authority (currently Melbourne Water) should be consulted about permit applications or decisions that may affect stream stability, stream flows, water quality or water temperature (e.g. by altering the degree of shade from adjacent vegetation).

Council will probably have to call on ecological consultants sometimes in cases where matters of high biological significance might be at substantial risk from a proposal.

5.6.4 Deciding Planning Permit Applications

The inclusion of a property within one of the sites of biological significance in Volume 2 should be taken as an indication that there are environmental values that may be adversely affected by some types of vegetation removal, works or development proposals. The text and aerial photography of the affected site in Volume 2 should assist assessment of an application, but will often not provide information that is focused narrowly enough for a specific application; For example, Volume 2 does not provide information about every large old tree that may be affected by a permit application. In such cases, Council will have to rely on information provided with the permit application.

Interpreting Significance

It is important that each permit application be assessed on its merits without placing undue weight on the site's significance rating or documented significant attributes that may not be relevant to the application. The site's significance rating – State, Regional or Local – is based on the most significant attribute of the site (Section 2.6), which may not be relevant to a particular development proposal. Similarly, a rare species that occurs in one part of the site may not be affected at all by what happens on another part of the site. To illustrate the important consequences, a particular major development on a site of State significance may have less impact than a much smaller development on a site of Regional or Local significance, depending on the exact siting and other details of the developments.

In most cases, the significance rating of the site as a whole will be less important than the conservation significance of the particular part(s) of the site that are affected by the permit application. As explained in Section 2.6, conservation significance of native vegetation is rated according to the Native Vegetation Framework on a scale of 'Low', 'Medium', 'High' and 'Very High', and usually varies substantially from one part of a site to another depending on ecological condition, the rarity of the vegetation type and similar factors. Thus, the vegetation in an area affected by a hypothetical development may have a conservation significance (according to the Framework) that is 'Low' or even absent, even though the site as a whole may have State significance. In this example, it is the 'Low' conservation significance of the affected vegetation that matters, not so much the State significance of the site as a whole.

Long-term and Off-site Impacts

It is important that proposed vegetation removal, land uses and developments be assessed for their potential impacts off-site (particularly downhill or downstream) and over the long term. For example, a subdivision may not involve clearing of native vegetation prior to any building construction, but the longer-term effects of residential development may result in substantial loss of significant vegetation. The effects might be worsened by off-site impacts if, for example, the lost vegetation has been a wildlife corridor between other sites. The overlay schedules proposed in this report need to take these matters into account.

Applying the Native Vegetation Framework

If native vegetation is proposed to be removed or is reasonably expected to be lost over time as a consequence of a proposed development or land use, the Framework is fairly prescriptive in its guidance to Council as a responsible authority deciding a permit application. Removal or consequential loss of vegetation of 'Very High' conservation significance should not be permitted by Council without ministerial-level approval based on matters of state-wide significance, according to Appendix 4 of the Framework. Removal or consequential loss of vegetation of 'High' or 'Medium' conservation significance should only be permitted in quite restricted circumstances. Most native vegetation in Knox falls into the categories of 'Medium' to 'Very High' because of the predominance of threatened vegetation types. Consequently, the opportunities for issuing permits that involve removal or consequential loss of native vegetation in Knox are quite limited.

Conservation significance cannot be determined without calculating or estimating a 'habitat score' (Section 2.4.4). Determinations of habitat score can theoretically be done by people without much botanical or ecological training, but there can be substantial variation in the habitat scores determined by different people (Tolsma and Newell 2003). It is therefore important that habitat scores and conservation significance ratings presented in support of planning applications should be done by properly qualified and trusted individuals.

The Framework and the Port Phillip and Westernport Native Vegetation Plan should be consulted for minimum 'offset' requirements to compensate for any loss of native vegetation that is permitted, based on the Net Gain policy. In many cases, it will be very difficult or impossible to meet the offset requirements on a residential allotment. The Department of Sustainability & Environment has, for several years, had plans to allow offsets to be traded in a market similar to carbon credits for greenhouse gas accounting, but this still appears far off.

There may therefore be serious problems for some permit applicants to meet the offset standards, at least in the short term.

Location of Offsets

The Native Vegetation Framework imposes restrictions on the location of offsets, but only in relation to the bioregions of Victoria. For example, an offset for clearing of vegetation in the Lysterfield Hills may be required to be located in the same bioregion, which extends as far away as the Buchan River valley in Far East Gippsland. Offsets are usually much cheaper to achieve in remote rural Victoria because of lower land prices, so there is a strong incentive for permit applicants to look far afield for their offsets. However, it would be reasonable for residents of Knox to feel that an offset in a remote part of the state does not adequately compensate them for the loss of habitat and natural assets in their own municipality. Clearly, native flora and fauna displaced by clearing in Knox receive no compensation from an offset hundreds of kilometres away.

Another serious problem with offsets that are remote from the activity that initiated them is that the Council which issues a permit has no capacity to police the creation and maintenance of an offset in a different municipality.

It is therefore recommended that Knox City Council seek offsets within its own municipality wherever possible.

Long-term Security of Offsets

Offsets would be of limited value if their effects only last for a few years, and Council should satisfy itself that any offsets that it accepts will be of lasting benefit. A ten-year time span is suggested as an appropriate horizon for assessing the success of offsets, as specified in the proposed overlay schedules in the Appendices. Such a time span typically includes one or more changes of ownership of a property, so permit conditions involving offsets need to have effect, and be enforceable, over multiple ownerships.

The Department of Sustainability & Environment has been proposing Section 173 agreements as one mechanism for achieving the necessary durability of offset conditions. However, there has been opposition to this from the rural community and an alternative mechanism may be proposed in future. Council will have to consult the department about the favoured mechanism from time to time until this issue is finalised.

Bonds

Damage to significant habitat often happens during the process of developing sites, as discussed in Section 4.4.1. Council should consider the use of bonds in circumstances where a planning permit is issued for works that may adversely affect recognised sites of biological significance. This includes developments on adjacent land that have the potential to affect the significant site.

Permit Tracking

The Department of Sustainability & Environment is establishing a database to keep track of permits and offsets for loss of native vegetation. Council should be contributing to this. It will allow monitoring of progress toward the Net Gain objective and help identify problems in implementation of the Framework. This may be very important for making the Framework successful in the long term or modifying it as required.

5.6.5 Future Review of Significant Sites

Sites of biological significance can either lose or gain significance through changes at individual sites, e.g. through vandalism or habitat restoration. A site can also become more significant even if the site itself does not change, due to widespread loss of similar habitat elsewhere. There may also be sites that will be recognised in future as sites of significance but which have so far been overlooked, although such sites would be rare and probably at the lower end of the significance scale.

It is therefore important to anticipate the need to review the sites covered by overlays in the Planning Scheme. This may occur in response to a case put to Council by someone concerning a specific site, or it may occur as part of normal review of the Planning Scheme to keep it up to date.

Other municipalities with overlays in their planning schemes to protect sites of significance do not seem to have established a protocol for reviewing the status of a site in response to a request by the landowner or a third party. In some cases it may be appropriate for Council to require the person seeking the review to produce

expert scientific evidence and other arguments as to why an amendment is sought and justified. In rare cases, it may be appropriate for Council to take responsibility for investigating the scientific evidence.

Changing the sites covered by an overlay in the Planning Scheme has to be done as a Planning Amendment, which imposes various requirements on the process. After being approached to make an amendment, Council is free to either reject the approach or go ahead and exhibit an Amendment.

The amendment would have to be advertised. Submissions should be accepted over a period of at least two months, and preferably until the following December to allow detection of flora and fauna that are hard to detect except in spring. Council would then consider the amendment in the light of the submissions received. When evidence of important biological considerations has appeared during the exhibition period, Council should receive a biologist's advice on the importance and reliability of the evidence. Council can then approve the amendment, have it referred to a planning panel or abandon it. There is no time limit to make a decision.

6. List of Recommendations

The following are the author's recommendations arising from this study. Recommendations are grouped and individually numbered for reference. Each one is given a suggested level of importance (high, medium, low) and urgency (short, medium and long time frames, corresponding to weeks, months and a year or more).

Administration

1. That Council consider each of the following recommendations with a view to their adoption. (High importance, short time frame)

2. That Council set target dates for the adopted recommendations and arrange allocation of resources for their implementation. (High importance, medium time frame)

3. That Council nominate an officer or committee of Council to oversee implementation and report to Council periodically. (High importance, medium time frame)

Recognition of sites of biological significance in the Town Planning process

4. That Council consider all the recommendations in Chapter 5, including preparation of an amendment to the Knox Planning Scheme that would introduce new overlays to protect sites of biological significance identified as Sites 1-114 in Volume 2. (High importance, short to medium time frame)

5. That when subdivision applications arise within recognised Sites of Biological Significance, Council negotiate to reserve as much as possible of the biologically significant land as Public Open Space, with highest priority on the most significant parts. Exceptions will be where the potentially reserved land would be too small or not ecologically viable. (High importance, short to long time frame)

Other measures to be applied to Sites of Biological Significance

6. That Council develop a schedule for the preparation or updating of management plans for its bushland reserves, taking into account the discussion in Section 4.1.1. (Low importance, medium time frame)

7. That Council keep a file of information on each of its bushland reserves. The file should include, among other things, cross-references to drawings elsewhere in Council, records of all management activities, and the species and provenance of all plantings at the reserve. (Provenance means the ancestral place of origin in the wild.) (Medium importance, medium time frame, cheap to implement).

Financial instruments to support biodiversity

8. That Council investigate financial or other incentive programs to residents or ratepayers whose long-term activities and commitments significantly assist Council's goals of conserving flora and fauna. The scheme in place at Maroondah City Council should be investigated as a possible model. (Low importance, medium to long time frame)

Other native vegetation protection measures

9. That Council works involving damage or clearing of native vegetation should comply with the offset targets set in Victoria's Native Vegetation Framework (NRE 2002a). A procedure for reinstatement and mitigation works should be agreed before the works are approved. (High importance, short time frame)

Effective enforcement for illegal clearing

10. That any removal, destruction or lopping of native vegetation conducted under permit should be inspected by a Council officer during or as soon as possible after the action. This may require permit conditions to notify Council of each instance of removal (etc.) (Medium importance, medium time frame)

Dead trees

11. That Council only remove large, dead trees from public land when they are declared unsafe by someone with appropriate qualifications. Dead trees are important habitat for many birds and mammals (particularly bats). Fallen logs can also be valuable habitat and their removal should be considered in that light. (Low to medium importance, medium time frame)

12. That Council encourage retention of dead trees on private land within, or near, sites of biological significance. This could include the offer of inspection by a properly qualified person to assess safety and habitat value (if approved by Council's insurer). (Low importance, medium to long time frame)

Ecological burning

13. That Council continue to conduct ecological burns on its own Sites of Biological Significance in conformity with management plans (or as practicable where a management plan does not exist). (Medium to high importance, long time frame)

14. That Council issue a permit for an ecological burn on private land where the applicant has the approval of the local fire brigade and the Department of Sustainability & Environment. The Department and brigades would need to be informed that Council is taking this step. (Medium importance, long time frame)

Weeds

15. That Council and the Department of Sustainability & Environment jointly consider a publicity campaign and weed control works targeted at the nine environmental weeds in Table 6, as discussed in Section 4.3. (Medium importance, medium to long time frame)

16. That Council discourage plant nurseries from selling Environmental weeds rated 'Serious' or 'Very Serious' in Appendix C. (Medium importance, long time frame)

17. That Council keep on its staff people who are capable of detecting new and emerging weeds (such as the example of the White Bladder-flower in Section 3.4.3). There should be urgent responses to any such detections. (Medium importance, ongoing)

Tree dieback

18. That revegetation projects should aim to restore a shrubby understorey, especially where the Bell Miner birds and Psyllid insects are dominant. (Medium importance, long time frame)

19. That whenever Council approves a permit application involving machinery operating in a site of biological significance with damp soil, the applicant should be provided with information about controlling the spread of Phytophthora Root Rot (e.g. the brochure *'Phytophthora Root Rot… the plant killer'*, available from the author) and asked to follow its recommendations. (Low to medium importance, short to medium time frame)

Roadsides

20. When Council approves works on roads or roadside services within or adjacent to native vegetation, the approving officer should define the boundaries of roadworks and areas for storage and parking, and specify temporary fences as appropriate. The approving officer should either be competent in recognising biodiversity issues, or take advice from someone who is. Storage areas should not be under trees, to prevent soil compaction and consequent tree death. (High importance, medium time frame)

21. In such cases, machinery should be operated from the road surface whenever possible, not from the nature strip. (Medium importance, medium time frame)

22. The size of the machines used should be determined by the requirements of the work. Excessively large machines lack manoeuvrability and their use increases the likelihood of vegetation damage. (Medium importance, medium to long time frame)

23. Where services or drainage pipes are to be installed in sensitive areas, Council should encourage boring under trees, rather than trenching. If possible, services should be installed under or immediately behind the kerb. (Medium importance, medium time frame)

24. That Council adopt the policy that waste from drainage pits or road grading will not be left on nature strips with native vegetation. (Medium importance, medium time frame)

Drainage works

25. That Council avoid and prevent further barrel draining or filling in of Knox's waterways and drainage lines. (High importance, medium time frame)

26. That damage to native vegetation be minimised during drainage works and excavations along creeks, and that provision be made for revegetation following earthworks. (High importance, medium to long time frame)

Special protection for rare or threatened flora and fauna

27. Council should devise and implement a recovery program of breeding and planting of plant species that are threatened with extinction from Knox. Priority should be given to species on the basis of their threat level in Knox (particularly those that are critically endangered) and whether they are also threatened state-wide. This project could be well assisted by cooperation with the Knox Environment Society, similarly to the Swordgrass Brown recovery project. Involvement should also be sought from the Department of Sustainability & Environment in the case of species that are rare or threatened state-wide. (Medium importance, medium time frame)

28. Transplantation and propagation are sometimes used to rescue plants from land development or works. When these rescues include species that are rare or threatened in Knox, they should be coordinated within the recovery program discussed in recommendation 28. (Medium importance, medium time frame)

29. For security, information about the location of species that are rare in Knox or more widely should be exempted from public access under the Freedom of Information Act. (High importance, short time frame) *This is done in the Department of Sustainability and Environment.*

Harvesting of indigenous plants

30. All plants rescued from sites to be developed should be relocated to a safe area on the same site, or potted up for transplanting into other suitable sites. Species that are rare or threatened in Knox should be relocated in accordance with the program discussed at recommendation . (High importance, medium to long term).

Revegetation

31. In reserves that are recognised sites of biological significance, Council and Friends groups should generally plant species only from the range of species recorded from the EVCs concerned. Rare exceptions will occur where the physical environment is dramatically altered, in which case species should be chosen from habitat types with similar characteristics (particularly drainage and aspect) to the current environment. (High importance, medium time frame)

32. Council should specify that plants provided to it for planting on Council land should be derived from parents in the same biogeographical zone as the planting site (see Section 3.2). (Medium importance, medium time frame)

33. When Council receives a public inquiry about selection of indigenous plants to be grown, the inquirer's attention should be drawn to recommendations 31 and 32. (Medium importance, medium time frame)

34. Council should continue to identify and implement revegetation projects that extend existing sites and rehabilitate gaps between sites. (Medium importance, continuing from present practice).

35. Council should identify sites where fencing and/or reduced mowing can be used to allow natural regeneration. (Medium importance, long time frame)

36. Council should liaise with VicRoads to prepare species selection guidelines for roadside plantings. (Medium importance, long time frame)

Monitoring Change

37. Climate change is adding to the extent and types of environmental change that have occurred in past decades. As explained in Section 3.4.3, early detection of new and emerging weeds, followed by rapid response, can save large financial and environmental costs. Similar benefits arise from early detection of other environmental changes, such as incipient eucalypt dieback or temporary vulnerability of a serious weed species due to drought, fire or flood. Council should continue its program of periodic monitoring of bushland reserves and consider increasing the frequency and number of reserves, as explained in Sections 3.4.3 and 4.1.2. (High importance, continuing current practice)

Supporting 'Friends' groups

38. Council should continue to make available to Friends groups the assistance of a Council officer or agent with expertise in bushland management. The officer or agent should attend occasional working bees of each Friends group. (High importance, continuing current practice)

39. Council should provide Friends Groups with any available information that would assist the group in its activities on their reserve, including access to the file of information about each reserve discussed in recommendation 7. (High importance, continuing current practice)

40. Council should consider providing basic training in appropriate health and safety issues for bushland volunteers, perhaps including herbicide use. This might be done in conjunction with neighbouring municipalities or the Catchment Management Authority. (High importance)

41. Council should offer funding support to Friends Groups for ongoing administrative expenses. (High importance)

Publicity and promotion

42. Council should advertise and increase public awareness of new planning controls that are introduced in response to this report. (High importance, medium time frame)

43. Council should update its brochure titled *'Your guide to understanding vegetation controls in Knox'* to make it conform to any planning scheme amendment that may arise as a result of this report. (High importance, medium time frame)

44. Council should prepare a brochure explaining what a recognised Site of Biological Significance is, what it means to an owner of a site on private land, the importance of protecting significant sites, and basic information about what protection typically involves. Attention should be drawn to the requirement of a permit for removal, lopping and destruction of vegetation, including by burying or other means. Brochures from Cardinia and Yarra Ranges Shires serve as good models. See also Section 5.6.1. (High importance, medium time frame)

45. The brochure above should be sent to owners and neighbours of sites of biological significance, with appropriate cover letters. Personal approaches should also be made where appropriate. Council should also consider organising a seminar on the subject for the same group of people. (High importance, medium time frame)

46. The brochure above should be provided to people who contact Council as prospective purchasers of sites of biological significance (or their conveyancers). (Medium importance, medium time frame)

47. Council could consider introducing a scheme like Maroondah City Council's 'Biodiversity Rating Concession Program' to provide financial rewards and practical assistance for landowners who manage and protect significant habitat (Section 5.6.1). (Medium importance, medium time frame)

48. A brochure and public awareness program should be arranged about being a good neighbour to bushland in Knox. It would cover fire hazard, nutrient seepage, waste dumping (particularly garden waste), encroachment of buildings too close to bushland (particularly reserves), and similar issues. See also Sections 4.3, 4.7 and 4.10. (Medium importance, medium time frame)

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Appendix A – Vegetation Communities in Knox

The characteristics and conservation status of the various habitat types identified in Knox during this study are described below. They are classified according to the Department of Sustainability & Environment's system of Ecological Vegetation Classes, or EVCs, wherever possible. The plant species quoted are typical for the Melbourne region (particularly Knox) and are often not representative of other regions.

EVC 8 – Wet Heathland

Despite the use of the term 'Heathland', the vegetation described by Oates and Taranto (2001) for this EVC is too tall (over 3 m) to be strictly a heathland; It would be more accurately described as a scrub.

Quick recognition: At maturity, Wet Heathland becomes dense, tangled, scrubby vegetation several metres tall (apart from sparse trees above), with numerous characteristic ground flora species such as dense *Empodisma minus* and abundant *Gonocarpus micranthus, Selaginella uliginosa, Patersonia* species and *Lepidosperma filiforme*. Tree ferns are usually present, unlike Damp Heathy Woodland. Leeches are usually abundant.

Position in the landscape: Poorly drained lower hill slopes and swampy tracts, the soil remaining damp or wet except during the driest spells of summer.

Tree canopy: Sparse *Eucalyptus ovata*, typically less than 15 m tall. *Eucalyptus cephalocarpa* and *Acacia mearnsii* replace the *E. ovata* in some locations outside Knox.

Shrubs: There is a multi-layered scrub, the tallest species being any mixture of *Melaleuca squarrosa*, *M. ericifolia*, *Leptospermum scoparium*[*] and *Ozothamnus ferrugineus*. Beneath these are *Allocasuarina paludosa, Hakea nodosa* and *Leptospermum lanigerum*. The main smaller shrubs are *Epacris* species, *Goodenia ovata*, *Pultenaea gunnii* and *Senecio minimus*. *Almaleea subumbellata* is a good indicator species, in some cases abundant and in other cases scarce.

Vines: Scarce or absent.

Ferns: *Lindsaea linearis* can be abundant. *Cyathea australis* is typically present in small numbers, but rarely as large specimens (at least in Knox).

Ground flora: Rich in species and quite distinctive. Dense, particularly with *Empodisma minus*. Sedges are abundant, notably *Lepidosperma filiforme, Baumea tetragona, Baumea rubiginosa, Schoenus lepidosperma, Tetraria capillaris* and *Schoenus apogon*, along with the ubiquitous *Gahnia radula* and sometimes *Gahnia sieberiana*. Either or both of *Patersonia occidentalis* and *P. fragilis* are abundant, as are *Centella cordifolia, Gonocarpus micranthus* and (in season) *Drosera pygmaea* and *Centrolepis* species. Orchids other than *Cryptostylis subulata* are quite scarce.

Conservation Status: Wet Heathland is very rare in Knox and for tens of kilometres around. The only known occurrence in Knox is at Wicks Reserve in The Basin. Its conservation status is regarded by the Department of Sustainability and Environment as 'Depleted' in the 'Highlands – Southern Fall' bioregion, of which the Knox occurrence is part.

EVC 16 – Lowland Forest

The Lowland Forest in Knox is a good match for the floristic community labelled 'SL7c' by Gullan *et al*. (1979).

Quick recognition: Dominated by *Eucalyptus obliqua* typically 20-30 m tall. Mature, intact stands contain dense shrubs and ground flora, the latter containing abundant *Tetrarrhena juncea* and often being so deep and tangled as to impede walking. *Acacia melanoxylon* and frequent patches of bracken are present, unlike EVC 793 (Damp Heathy Woodland). *Banksia marginata*, *B. spinulosa* or both tend to be abundant in intact

[*] Note that Oates and Taranto (2001) mention *L. continentale*, which should be taken to embrace *L. scoparium* according to current taxonomic convention as given in Walsh & Entwisle (1996).

stands, typically along with other members of the Protea family (e.g. *Hakea*, *Lomatia*, *Persoonia*). Herbs with short-lived stems and foliage are much less abundant than tough or wiry ground flora species.

Position in the landscape: Shallow, lower slopes of hills. Lowland Forest grades into Herb-rich Foothill Forest (EVC 23) and eventually Damp Forest (EVC 29) in more sheltered and less drought-prone environments. In less sheltered places, it may adjoin Grassy Forest (EVC 128) further uphill or Valley Heathy Forest (EVC 127) on shallow slopes with lower soil fertility or soil depth.

Tree canopy: Dominated by *Eucalyptus obliqua* typically 22-25 m tall, often with lesser numbers of *E. radiata*. Sometimes also with smaller numbers of *E. cephalocarpa* or other eucalypts that are outliers from adjacent vegetation types.

Lower trees: *Acacia melanoxylon* is present in varying density, as distinct from Damp Heathy Woodland (EVC 793) where that species is rarely present at all. *Exocarpos cupressiformis* may also be present.

Shrubs: Moderately to very dense when allowed to accumulate, dominated by various combinations of *Leptospermum scoparium*, *Cassinia aculeata*, *Spyridium parvifolium*, *Acacia mucronata, A. verticillata, A. leprosa, Olearia lirata*, *Banksias* and *Hakeas*. *Pultenaeas* are common. The proportions of these species depends greatly on the recent history of fire and clearing. *Acacia mucronata* and members of the Protea family, including *Banksias*, *Hakeas* and *Persoonias*, are much more abundant in Lowland Forest than any other EVC in Knox.

Vines: Rather scarce.

Ferns: Patches of dense bracken are scattered liberally, sometimes interspersed with *Calochlaena dubia*.

Ground flora: At maturity, usually dense, tangled and at least knee-deep. Rather heathy and with an abundance of the wiry grass *Tetrarrhena juncea*. Other abundant species are *Gahnia radula, Lomandra* species and often *Xanthorrhoea minor, Empodisma minus* and *Lepidosperma elatius*. The density of the wiry, tangled ground flora can make movement through the vegetation awkward. Tufted grasses, particularly *Rytidosperma pallidum* (=*Joycea pallida*) and *Themeda triandra,* are present but in lower density than Grassy Forest or Damp Heathy Woodland. The dense undergrowth usually suppresses the richness and abundance of small wildflowers such as orchids.

Conservation Status: Lowland Forest is rare in Knox but secure at Wicks Reserve. In the hills to the east it is common and secure and hence the Department of Sustainability & Environment gives it the conservation status rating 'Least Concern' in the 'Highlands – Southern Fall' bioregion. It is much less common in the Gippsland Plain bioregion (which includes most of Knox) and the department rates it as 'Vulnerable' there.

EVC 18 – Riparian Forest

Quick recognition: Identifiable as a gallery or corridor of very tall *Eucalyptus viminalis* along perennial streams, with abundant *Acacia dealbata* and *Pomaderris aspera* in a lower tree layer and abundant *Coprosma quadrifida*, soft-leafed shrubs and *Poa ensiformis* in the understorey. Wetland areas often occur within this EVC. The presence of any *Melicytus dentatus* (=*Hymenanthera dentata*) or *Myrsine howittiana* (=*Rapanea howittiana*) is more likely to indicate Floodplain Riparian Woodland (EVC 56).

Position in the landscape: Along stretches of major streams where deep alluvium has accumulated, the soil kept permanently moist by the associated stream.

Tree canopy: Dominated by very tall *Eucalyptus viminalis* usually over 30 m tall, sometimes with lesser numbers of other eucalypt species from neighbouring vegetation types.

Lower trees: Tall *Acacia melanoxylon*, *A. dealbata* and *Pomaderris aspera* are usually present, but the latter two species may be left absent or scarce after clearing. *Myrsine howittiana* is rarely if ever present, distinguishing Riparian Forest from Floodplain Riparian Woodland (EVC 56).

Shrubs: Very variable in density depending on the history of disturbance (including floods), comprising abundant *Coprosma quadrifida* and a mixture of soft-leafed shrubs that typically include *Prostanthera*

lasianthos, Olearia lirata and *Ozothamnus ferrugineus* in more intact stands, and sometimes *Gynatrix pulchella*. Patches of dense *Melaleuca ericifolia* are common. *Melicytus dentatus* is rarely if ever present, distinguishing Riparian Forest from Floodplain Riparian Woodland (EVC 56).

Vines: *Clematis aristata* and sometimes *Pandorea pandorana* are common.

Ground flora and ferns: At maturity, usually dense and approximately knee-deep, with extensive grassy areas and patches of sedges in wetter spots. The grassy areas are normally dominated by *Poa ensiformis,* with abundant *Lomandra longifolia*, *Acaena novae-zelandiae* and patches of ferns such as *Adiantum aethiopicum* and *Pteridium esculentum*. The wetter spots are dominated by *Lepidosperma elatius*, *Carex* species (particularly *C. appressa*) or both. *Gahnia* species may be abundant throughout. The ferns *Cyathea australis* and *Blechnum* species are typically present, concentrated along the stream bank.

Conservation Status: Riparian Forest occurs sparingly in Knox. Within 150 km of Melbourne, it is generally seriously ecologically degraded by clearing, agriculture and weed invasion. It is significant for its critical roles in maintaining stream ecology, bio-corridors and waterway protection through its particular characteristics of shade, flood response, nutrient cycling, use by fauna and (when intact) resistance to serious riparian weeds. Without taking these factors into account, the Department of Sustainability & Environment gives the conservation status (not significance) of Riparian Forest as 'Vulnerable' in the Gippsland Plain bioregion (which includes most of Knox) and 'Least Concern' in the 'Highlands – Southern Fall' bioregion. The latter bioregion extends as far as Far East Gippsland, and the 'Least Concern' status relies on the existence of large areas of intact Riparian Forest far to the east of Knox. Regardless, Riparian Forest can be deemed vulnerable within 150 km of Melbourne and extremely important for ecology and waterway protection, so any occurrences in Knox that are not seriously degraded should be deemed highly significant. *'Victoria's Native Vegetation Management – A Framework for Action'* (NRE 2002a) explicitly recognises the very high significance of riparian vegetation for waterway protection, but not for the ecology of streams or riparian corridors. It does, however, indicate on p.22 that an assessment of any site's conservation significance should take into account 'the strategic location in the local landscape', which would generally be very important for Riparian Forest.

EVC 22 – Grassy Dry Forest

The occurrences of Grassy Dry Forest in Knox fall into two distinct types: Box-Stringybark Woodland in the Dandenongs and what is introduced here, for the first time, as 'Lysterfield Grassy Dry Forest' associated with the Lysterfield Granodiorite geological formation. The description below covers both types, and this is followed by a formal description of the Lysterfield Grassy Dry Forest (to meet the requirements for recognition of a new community under the Native Vegetation Plan for the Port Phillip and Westernport region).

Quick recognition: A low, rather sparse tree canopy combined with a shrub layer that is sparse except for patches of opportunistic species following soil disturbance, and sparse, grassy ground flora with abundant herbs (particularly monocots such as lilies or orchids), leaving plenty of exposed ground, lichens or moss.

Position in the landscape: Hilltops, ridgetops or dry slopes with shallow, stony soil. Further down the slope or on adjacent eastern or southern aspects, there is typically Grassy Forest (EVC 128) or Valley Grassy Forest (EVC 47). Grassy Dry Forest gives way to Shrubby Foothill Forest (EVC 45) at elevations above about 400 m in the Dandenong Ranges.

Tree canopy: Usually 8-15 m tall, with the crowns mostly separated and rather transparent to sunlight. The Box-Stringybark Woodland community in Knox is dominated by *Eucalyptus macrorhyncha* and (usually) *E. goniocalyx* with fewer *E. melliodora* and *Acacia mearnsii*. The Lysterfield Grassy Dry Forest differs in that *E. macrorhyncha* is absent, replaced by stunted *E. radiata* and/or *E. dives*. (The distinction between the last two species is sometimes unclear.) *Allocasuarina littoralis* and *Acacia implexa* are fairly common in the Lysterfield Hills and decrease in frequency toward the north, becoming absent north of The Basin.

Lower trees: Sparse *Exocarpos cupressiformis*, sometimes with scattered *Acacia melanoxylon*.

Shrubs: Sparse except for patches where soil disturbance has given rise to patches of opportunistic species, particularly *Kunzea ericoides* and *Acacia paradoxa*, that may become quite dense.

Vines: Twiners have very low foliage cover and they rarely climb much higher than 2 m. *Comesperma volubile* is the most common species. *Clematis microphylla* is often present in Grassy Dry Forest but apparently absent from other vegetation types in Knox.

Ferns: Sparse except for localised patches. *Cheilanthes* species occur more in Grassy Dry Forest than elsewhere in Knox, but still not abundantly.

Ground flora: Grassy and with substantial spaces between the tussocks. The dominant species may be *Rytidosperma pallidum, Themeda triandra*, *Poa morrisii* or (particularly in regrowth) *Microlaena stipoides*, depending on the recent history of fire or other disturbance. *Lepidosperma laterale, Lomandra filiformis* subsp. *coriacea* and *Gonocarpus tetragynus* are conspicuous. Herbs are abundant, particularly monocots such as lilies and orchids, to the extent that *Arthropodium strictum* can sometimes become dominant in spring and early summer. The ground flora species are mostly present also in Grassy Forest (EVC 128); However Grassy Forest has less space between the grass tussocks, a correspondingly lower density of herbs between the tussocks, and certain additional ground flora species that are indicative of higher moisture availability (e.g. *Platylobium formosum*).

Conservation Status: Box-Stringybark Woodland occurs on the eastern fringe of Knox, extending into the adjacent Dandenong Ranges National Park where it is much better represented and more secure. Gullan *et al*. (1979, p.160) describe it as 'A rare community which was probably much wider spread'. Lysterfield Grassy Dry Forest is known to occur on the Lysterfield Hills and in a small, isolated patch in Baluk Willam Flora Reserve in Belgrave South.

At the EVC level, the Department of Sustainability & Environment rates the conservation status of Grassy Dry Forest as 'Least Concern' in the Highlands Southern Fall bioregion (which includes all of Knox's occurrences). However, this is on the basis of the relatively high abundance of forms of Grassy Dry Forest that do not occur in Knox, such as forms with *Eucalyptus polyanthemos*. There is support within the botanical community to split up the present concept of Grassy Dry Forest into multiple EVCs, which would lead to better recognition that the forms of Grassy Dry Forest in Knox are not truly of 'Least Concern'.

EVC 22a – Lysterfield Grassy Dry Forest

This is the original description of this community.

Type locality: The uppermost corner of Heany Park, Rowville, is taken here to be the type locality for Lysterfield Grassy Dry Forest, i.e. the vegetation present there is taken to be the standard against which to compare other vegetation for potential recognition as the same community.

Conformity with Grassy Dry Forest: The following characteristics of Lysterfield Grassy Dry Forest in a long-undisturbed state make it fit best within EVC 22 – Grassy Dry Forest:

- It is located on ridges, upper slopes and middle slopes of hilly terrain, mainly with northerly or westerly aspects;
- The soil is shallow, stony, moderately fertile, freely draining, moist in winter and very dry in the early months of the year;
- Tree stature and the foliage density of all vegetation strata are reduced far below what the same species achieve in conducive conditions;
- The canopy trees are eucalypts typically 12m tall, with the crowns mostly rather transparent to sunlight and separated from each other;
- The density of shrubs is sparse except for thickets of opportunistic species (e.g. *Kunzea ericoides* and *Acacia paradoxa*) that establish following soil disturbance;
- Ferns are very scarce or absent;
- In an undisturbed state, the ground layer is rather sparse (the foliage cover of vascular plants being typically 50%) and overwhelmingly dominated by grass (including *Rytidosperma pallidum* = *Joycea pallida*);
- Drought-tolerant graminoids such as Lepidosperma laterale and Lomandra filiformis subsp. coriacea are abundant, and so are geophytes and cryptogams.

Distinctive features: Lysterfield Grassy Dry Forest is distinguished from other Grassy Dry Forest as follows:

- The canopy trees include stunted *Eucalyptus radiata* and/or *E. dives* (only about10-12 m tall), along with the more common members of Grassy Dry Forest, *E. goniocalyx, Acacia mearnsii* and, in proximity to Valley Grassy Forest, *E. melliodora*;
- *E. macrorhyncha* is absent;
- *Allocasuarina littoralis* and *Acacia implexa* are often present as canopy trees (or slightly shorter);
- The ground flora is not particularly rich in species of geophytes, even though the foliage cover of some species (such as *Arthropodium strictum*) can be very high in season. Orchids are apparently not abundant. These features may be at least partly due to past grazing and clearing.

Description:

- The canopy trees are as described above;
- *Exocarpos cupressiformis* are slightly lower and much sparser than the canopy trees;
- Shrubs are sparse except for patches where soil disturbance has given rise to dense patches of opportunistic species, particularly *Acacia paradoxa* or *Kunzea ericoides*;
- Vines are represented by a fairly high density of the light twiner *Comesperma volubile*, and smaller numbers of *Clematis microphylla* and *Billardiera mutabilis*;
- Ferns are very sparse and do not include characteristic species of Grassy Forest such as *Pteridium esculentum* and *Adiantum aethiopicum*;
- The ground layer in its undisturbed state is grassy and has substantial spaces between the tussocks. It is dominated by various mixtures of *Rytidosperma pallidum = Joycea pallida, Microlaena stipoides, Lomandra filiformis* subsp. *coriacea, Themeda triandra* and/or *Poa morrisii*. These are mixed with a range of other grasses and *Lepidosperma laterale*. *Dichondra repens, Gonocarpus tetragynus*, *Bossiaea prostrata, Tricoryne elatior* and *Lagenophora gracilis* are abundant. Geophytes (and particularly *Arthropodium strictum*) are abundant but not represented by many species;
- Ground flora species of more mesic environments (e.g. *Platylobium formosum* and *Adiantum aethiopicum*) are absent, distinguishing this community from Grassy Forest (EVC 128), with which it has been sometimes confused.

Known distribution: Figure 6 below depicts the pre-European and current distribution of Lysterfield Grassy Dry Forest in the Lysterfield Hills, as determined for this report using site inspections. The estimated areas are 145 hectares before settlement and 50 hectares currently. In addition, there is a patch of this community measuring approximately 3,000 m² within Baluk Willam Flora Reserve (120 m southeast of the dead end of Orchid Rd). The Department of Sustainability & Environment's (undated) current BioMap of pre-1750 EVCs shows Grassy Dry Forest with a similar distribution to Figure 1, but expanded to encompass a band of vegetation immediately below the Grassy Dry Forest that is regarded here as Valley Grassy Forest (with deeper soil, *Eucalyptus melliodora* the most abundant eucalypt and with occasional *E. rubida*).

Conservation Status: Taking into account the pre-European and current distributions and the very small proportion that is on public land or in reasonable ecological condition, Lysterfield Grassy Dry Forest is a rare and threatened community, particularly as most of the remaining area is within quarry land. It is recommended that Lysterfield Grassy Dry Forest should be recognised with a conservation status more appropriate than the 'Least Concern' rating that the Department of Sustainability & Environment accords to Grassy Dry Forest generally in the Highlands Southern Fall bioregion.

Figure 6. Map showing the distribution of Lysterfield Grassy Dry Forest in the Lysterfield Hills. The orange-outlined areas depict the pre-European distribution and the hatched areas depict the current distribution, based on topography, geology and inspections of Heany Park, adjoining land and roads bordering the quarries. Some areas that are not hatched, particularly around the Boral quarry, may regrow into Lysterfield Grassy Dry Forest if allowed to do so.

Comments: The floristic diversity, the ground flora density and the stature of trees in Lysterfield Grassy Dry Forest are substantially lower than in nearby Grassy Dry Forest between Ferntree Gully and Montrose and in Croydon North (e.g. Hochkins Ridge Flora Reserve). This is attributable to different geological formations.

Similarly, Grassy Forest that abuts Lysterfield Grassy Dry Forest has substantially lower floristic diversity, ground flora density and tree stature than Grassy Forest in the other locations just mentioned.

Sites inspected: Areas of Heany Park, surrounding properties, Cornish Rd and Baluk Willam Flora Reserve were inspected and found to conform with the above description of Lysterfield Grassy Dry Forest (allowing for human alterations). The Lysterfield Hills quarries could only be inspected from the boundaries, and the modified state of the vegetation made interpretation difficult. Churchill National Park deserves further investigation.

The following nearby sites appear on BioMaps as Grassy Dry Forest and were inspected on 7th August 2003, but no Grassy Dry Forest was found:

- The northeastern slope and hilltop of Sugarloaf Hill, Lysterfield (viewed from 250-300 m away, on Kerrs Lane) where the tree stature and density appear too great for Grassy Dry Forest;
- Near the corner of Wellington Rd and Spring Rd in Belgrave South, where the BioMap of 'Extant EVCs' depicts Grassy Dry Forest but the pre-1750 EVC BioMap depicts Grassy Forest. The ground flora are dense (possibly as an artifice of human modification) and more consistent with Grassy Forest;
- The neighbourhood of Mervyn Rd and The Strand in Belgrave South, where the dominant eucalypts are *E. cephalocarpa* and *E. obliqua*, not at all consistent with Grassy Dry Forest;

- Mt Morton, a basalt hilltop where the tree canopy has been decimated but still supports remnant tall, robust *E. radiata* and *E. ovata*, not at all consistent with Grassy Dry Forest (although a nearby, inaccessible ridge to the west may support Grassy Dry Forest).

EVC 23 – Herb-rich Foothill Forest

Quick recognition: In Knox, Herb-rich Foothill Forest is a densely grassy, tall forest dominated by *Eucalyptus obliqua* and *E. radiata*, with fairly abundant vines (*Clematis aristata, Pandorea pandorana, Glycine clandestina*, *Comesperma volubile*), scattered ferns, and species of shrubs and ground flora that reflect the associated soil moisture availability. Key indicator species in the Dandenongs are *Coprosma quadrifida*, *Ozothamnus ferrugineus*, *Acacia verticillata*, *Pimelea axiflora*, *Olearia lirata*, *Poa ensiformis*, *P. tenera*, *Echinopogon ovatus* and *Desmodium gunnii*. In areas of lower rainfall, *Poa labillardierei* tends to replace *P. ensiformis* and *Pimelea axiflora* does not occur. *Rytidosperma pallidum = Joycea pallida* only occurs as outliers from adjoining, drier forest types.

Position in the landscape: Sheltered hillsides or gullies, typically flanked by Grassy Forest (EVC 128) or Grassy Dry Forest (EVC 22). It gives way to Shrubby Foothill Forest (EVC 45) at elevations above 400 m or so in the Dandenong Ranges, and Damp Forest (EVC 29) is often found below if soil moisture availability is high enough.

Tree canopy: Crowns touch each other, 20-40 m tall. *Eucalyptus obliqua* and *E. radiata* dominate, often with smaller numbers of other eucalypts that are present in adjacent vegetation types (particularly *E. cypellocarpa*).

Lower trees: Usually not much different from whatever is the closest other forest type, typically comprising *Acacia melanoxylon*, *Acacia dealbata* (or *Acacia mearnsii* in drier areas) and sometimes *Exocarpos cupressiformis*.

Shrubs: May be sparse or dense, depending on surrounding vegetation types and the recent history of disturbance by fire or clearing. Key indicator species are *Coprosma quadrifida*, *Ozothamnus ferrugineus*, *Acacia verticillata*, *Olearia lirata* and (in the Dandenong Ranges) *Pimelea axiflora*. *Goodia lotifolia* may also be present, in which case it helps to distinguish from Grassy Forest.

Vines: Typically, a high proportion of the shrubs (excluding thickets) support vines, particularly *Clematis aristata*, *Pandorea pandorana* or *Glycine clandestina*.

Ferns: *Pteridium esculentum*, *Adiantum aethiopicum* and sometimes *Calochlaena dubia* occur in patches.

Ground flora: Densely grassy (except where shrub thickets suppress grasses) and with many species of forbs between the tussocks. The dominant species may be *Themeda triandra*, *Poa* species (typically mixtures of *P. ensiformis, P. morrisii* and *P. tenera*) and *Microlaena stipoides*, depending on the recent history of fire or other disturbance. *Echinopogon ovatus* is usually present, which is not true of related, drier vegetation types such as Grassy Forest. *Rytidosperma pallidum = Joycea pallida* only occurs as outliers from adjoining, drier forest types. *Tetrarrhena juncea* is often absent but may be rather abundant in proximity to Lowland Forest or Damp Forest. The many species of forbs that are likely to be found are very similar to Grassy Forest except that *Desmodium gunnii* and *Gonocarpus humilis* have much greater affinities with Herb-rich Foothill Forest.

Conservation Status: Herb-rich Foothill Forest occurs on the eastern fringe of Knox, extending into the adjacent Dandenong Ranges National Park where it is much better represented and more secure. The Department of Sustainability & Environment rates the conservation status of Herb-rich Foothill Forest as 'Least Concern' in the 'Highlands – Southern Fall' bioregion and 'Vulnerable' in the 'Gippsland Plain' bioregion.

EVC 29 – Damp Forest

Within Knox, this is the same as floristic community 'SL4b' of Gullan *et al*. (1979). It is a broadly circumscribed EVC and the ground flora may be very ferny, grassy or sedgy.

Quick recognition: A very tall canopy comprising any mixture of *Eucalyptus obliqua, E. cypellocarpa* and/or *E. radiata*, with abundant vines and dense ground flora dominated by ferns, large sedges or both.

Position in the Knox landscape: Sheltered gullies or valleys, mainly in the Dandenong Ranges.

Tree canopy: Very tall (25-50 m), dominated by *Eucalyptus cypellocarpa*, *E. obliqua* or both, often with *E. radiata* and sometimes eucalypts from adjacent communities.

Lower trees: *Acacia melanoxylon* is usually present but sometimes quite sparse. *Pomaderris aspera* and *Olearia argophylla* are almost always present close to any creek flowing through intact Damp Forest and they serve as good indicator species. *A. dealbata* is sometimes conspicuous.

Shrubs: The most common shrubs are *Acacia leprosa, A. verticillata, Coprosma quadrifida, Goodenia ovata, Leptospermum scoparium* and *Olearia lirata*. *Prostanthera lasianthos* is occasional. *Bursaria spinosa, Cassinia aculeata* or *Kunzea ericoides* may also be conspicuous. The density of shrubs is typically moderate except for occasional patches that may be denser.

Vines: Abundant, particularly *Clematis aristata*, *Pandorea pandorana* and sometimes *Glycine clandestina*.

Ground flora: Dense and typically waist- or chest-deep, dominated by ferns interspersed with large sedges (*Lepidosperma elatius*), and with abundant grass. *Pteridium esculentum* and *Calochlaena dubia* are the main ferns. *Poa ensiformis*, *Poa tenera* and *Tetrarrhena juncea* are the main grasses. *Lomandra longifolia* and *Acaena novae-zelandiae* are usually abundant. *Stellaria flaccida* is a good indicator species, but often scarce or absent.

Conservation Status: Damp Forest occurs mainly on the eastern fringe of Knox, extending into the adjacent Dandenong Ranges National Park where it is much better represented and more secure. The Department of Sustainability & Environment rates the conservation status of Damp Forest as 'Least Concern' in the 'Highlands – Southern Fall' bioregion, which includes nearly all of Knox's occurrences. The exception is at Old Joes Creek in Boronia, which can be viewed as an outlier of the same bioregion.

EVC 30 – Wet Forest

Wet Forest appears on the Department of Sustainability & Environment's BioMaps at Knox's eastern extremity in Sassafras, but this is questionable. The vegetation that is mapped as Wet Forest does have some elements consistent with that EVC, notable *Australina pusilla*, *Pittosporum bicolor* and *Sambucus gaudichaudiana*, but these are also consistent with a marginal form of Damp Forest (EVC 29). More importantly, none of the following species that are usually associated with Wet Forest could be found there: *Eucalyptus regnans, Bedfordia arborescens, Hedycarya angustifolia, Dicksonia antarctica, Blechnum wattsii*. The vegetation is therefore treated here as being a marginal form of Damp Forest that approaches Wet Forest.

Conservation Status: Wet Forest is well reserved and secure in the Dandenong Ranges National Park immediately east of Knox. The Department of Sustainability & Environment rates the conservation status of Wet Forest as 'Least Concern' in the 'Highlands – Southern Fall' bioregion, which includes the Dandenong Ranges.

EVC 45 – Shrubby Foothill Forest

Quick recognition: Hillside forest with a dense layer of shrubs in the height range 1·5 - 3 metres, largely made up of shrubby wattles (characteristically including *Acacia mucronata*), *Spyridium parvifolium, Pultenaea scabra* and/or *Pultenaea gunnii*. The smaller shrub, *Goodenia ovata,* is usually also abundant. Ferns are usually limited to occasional patches of *Pteridium esculentum*.

Position in the landscape: Hillsides of the Dandenong Ranges at elevations above approximately 400 m.

Tree canopy: Crowns touch each other, 20-40 m tall. Dominated by *Eucalyptus obliqua, E. cypellocarpa* and/or *E. radiata*. *E. goniocalyx* or *E. macrorhyncha* are sometimes present in proximity to other EVCs where those species dominate.

Lower trees: *Acacia melanoxylon* and *Exocarpos cupressiformis* are common. *Acacia dealbata* can be fairly dense, but mostly in shrub form rather than as trees.

Shrubs: Key indicator species are *Acacia mucronata*, *Spyridium parvifolium* and *Pultenaea scabra*, which are abundant within a dense layer that also includes other shrubby wattle species (e.g. *A. stricta, A. myrtifolia, A. verticillata*), *Goodenia ovata*, *Polyscias sambucifolia* and often *Olearia lirata*. *Lomatia ilicifolia* may be fairly abundant.

Vines: Fairly abundant, particularly *Clematis aristata*, *Pandorea pandorana, Glycine clandestina, Billardiera mutabilis* and *Comesperma volubile*.

Ferns: Usually limited to occasional patches of *Pteridium esculentum*.

Ground flora: Fairly dense and not particularly rich in species, comprising a mixture of grasses, sedges and forbs. The grasses include *Rytidosperma pallidum = Joycea pallida*, *Poa ensiformis, P. morrisii*, *Tetrarrhena juncea* and *Microlaena stipoides*. *Gonocarpus humilis* and/or *Gonocarpus tetragynus* are abundant. *Dianella tasmanica*, *Tetratheca* species and *Gahnia radula* are common.

Conservation Status: Shrubby Foothill Forest occurs in Knox only on the slopes above the upper reaches of Dobsons Ck in The Basin. It is common higher in the Dandenong Ranges, particularly the western slopes and the former Olinda State Forest. It is also scattered across the ranges to the east and has not been favoured for agriculture, so the Department of Sustainability & Environment rates its conservation status as 'Least Concern' in the 'Highlands – Southern Fall' bioregion, which includes Knox's occurrence.

EVC 47 – Valley Grassy Forest

Quick recognition: A tree canopy dominated by *Eucalyptus melliodora*, often mixed with *E. radiata*, not on swampy or poorly drained soil (which would suggest Swampy Riparian Woodland). *E. rubida* is not always present, but when it is, it is a very good indicator of this EVC. The ground layer is very grassy and herbaceous, whereas the related Valley Heathy Forest has more woody and tough ground flora species such as *Hibbertia riparia* and *Platylobium obtusangulum*.

Position in the landscape: Downhill from Grassy Dry Forest (EVC 22), or on low ridges and hills of hilly terrain where soil conditions are too mesic (conducive to plant growth) for Grassy Dry Forest to establish. Grassy Forest (EVC 128) occupies equivalent positions in areas of higher winter rainfall.

Tree canopy: Crowns separated slightly or just touching each other, 20-30 m tall in Knox and surrounding areas. *Eucalyptus melliodora* is always present, often mixed with *Eucalyptus radiata*. *Eucalyptus rubida* is rare in Knox and only occurs in Valley Grassy Forest. *Eucalyptus goniocalyx* may be present near a transition toward Valley Heathy Forest.

Lower trees: Not dense, but fairly rich in species: *Exocarpos cupressiformis, Acacia mearnsii, Acacia melanoxylon* and *Acacia implexa* are common.

Shrubs: Probably once fairly sparse in Knox, but *Acacia paradoxa*, *Kunzea ericoides* and *Cassinia* species are now often dense due to soil disturbance.

Vines: Light twiners such as *Billardiera mutabilis* and *Comesperma volubile* may be fairly common. More substantial climbers are usually absent or limited to occasional plants of *Clematis* species.

Ferns: *Pteridium esculentum* or *Adiantum aethiopicum* can become abundant where the vegetation approaches Herb-rich Foothill Forest (EVC 23) or riparian EVCs.

Ground flora: Dense and grassy, often with many lilies. *Themeda triandra* is usually one of the most dominant grasses, along with *Microlaena stipoides, Austrostipa rudis* and species of *Poa* and *Rytidosperma* (=*Danthonia*). *Lomandra longifolia* is also often abundant. The most abundant lilies are *Arthropodium strictum, Burchardia umbellata, Caesia parviflora* and *Dianella admixta*. Other species that are more common in Valley Grassy Forest than similar EVCs are *Galium* species, *Ranunculus lappaceus* and *Veronica* species (although *V. gracilis* is also common in Valley Heathy Forest). In addition to the

Veronicas, other creepers such as *Dichondra repens* and *Acaena novae-zelandiae* can be quite abundant. Daisies such as *Brachyscome decipiens* were apparently fairly common once, but now rare.

Conservation Status: Valley Grassy Forest occurs in Knox on a ridge in Upper Ferntree Gully and in narrow bands or small sites in Rowville and Lysterfield. These sites are predominantly on the interface between the Gippsland Plain and Highlands Southern Fall bioregions recognised by the Department of Sustainability & Environment. Valley Grassy Forest is much more common north of the Maroondah Hwy. Its grassy, productive understorey has led to widespread degradation and clearing associated with grazing by stock. The conservation status is 'Vulnerable' in both bioregions, according to the department.

EVC 53 – Swamp Scrub

Swamp Scrub can occur either naturally or as regrowth following clearing of floodplain forests. It is possible that all of the occurrences in Knox are in the latter category.

Quick recognition: A dense, tall scrub of *Melaleuca ericifolia*, sometimes punctuated with scattered *Eucalyptus ovata, E. cephalocarpa* or *Acacia melanoxylon*. The understorey is quite sparse because of the dense shade. The ground is boggy for most of the year.

Position in the landscape: Poorly drained floodplains.

Canopy: As described above.

Shrubs: Usually quite sparse. *Coprosma quadrifida* is fairly common, but other shrubs of similar size are uncommon. The main smaller shrubs are *Goodenia ovata* and *Senecio minimus*.

Vines: Indigenous vines are very sparse or absent, but Japanese Honeysuckle and Blackberry often invade and become abundant.

Ferns: Often absent, but *Blechnum minus* can be fairly abundant and *Cyathea australis* is sometimes present in small numbers.

Ground flora: Moderately to very sparse, depending on the canopy density. The species present usually include many of the following: *Phragmites australis, Lomandra longifolia, Isolepis inundata, Lobelia anceps, Centella cordifolia* and various species of *Juncus*. Nonvascular plants may have greater cover than vascular ground flora.

Conservation Status: Swamp Scrub occurs on various floodplains in Knox. The vast majority of native vegetation on floodplains throughout the Melbourne region has been cleared, grazed or excavated for drainage or sewerage. The pockets of Swamp Scrub are consequently only tiny compared with what would once have existed, and much of what now exists in Knox may be artificial as a result of clearing of Swampy Woodland. The Department of Sustainability & Environment rates the conservation status of Swamp Scrub as 'Endangered' in the Gippsland Plain bioregion, which includes all occurrences in Knox.

EVC 56 – Floodplain Riparian Woodland

Quick recognition: Identifiable as a woodland of *Eucalyptus viminalis* (or in some of Victoria, *Eucalyptus camaldulensis*) that extends many tens, or even hundreds, of metres from a perennial streams. Unlike Riparian Forest (EVC 18), *Melicytus dentatus* (=*Hymenanthera dentata*) is abundant and *Pomaderris aspera* is much less common. *Myrsine howittiana* (=*Rapanea howittiana*) is not always present, but it is rarely found outside this EVC. Wetlands within this EVC are usually classified as EVC 172 – Floodplain Wetland Complex.

Position in the Knox landscape: Apparently confined to the broadest areas of Dandenong Creek's floodplain. Riparian Forest occurs in narrower valleys whose floodwaters drain more rapidly.

Tree canopy: Rather open, dominated by *Eucalyptus viminalis*, sometimes with *Eucalyptus ovata*.

Lower trees: *Acacia melanoxylon*, *A. dealbata* and *A. mearnsii* are usually present, apparently not reaching as tall as in Riparian Forest. *Myrsine howittiana* is present south of Wellington Rd, the only locality for this species for a radius of tens of kilometres. *Pomaderris aspera* is scarce or absent.

Shrubs: *Melicytus dentatus* (=*Hymenanthera dentata*) and *Melaleuca ericifolia* are abundant. *Ozothamnus ferrugineus, Bursaria spinosa* and *Gynatrix pulchella* may also be rather abundant. *Senecio minimus* is usually abundant. Only two plants of *Callistemon* ?*sieberi* occur in this EVC in Knox, but they are regarded as a characteristic species of this EVC elsewhere in the Port Phillip and Westernport region (Oates and Taranto 2001).

Vines: Indigenous vines are sparse or absent, the most common of which is the parasite *Cassytha pubescens*. Japanese Honeysuckle and Blackberry often invade and may become abundant.

Ferns: Often absent, but *Blechnum minus* can be fairly abundant and *Cyathea australis* is sometimes present in small numbers.

Ground flora: Highly degraded in Knox by past agriculture, overrun by pasture grasses (e.g. *Phalaris aquatica* and *Pennisetum clandestinum*) and pastoral weeds. *Carex appressa* is abundant, and *Phragmites australis* is often so. *Lycopus australis* can be abundant, and is rare or absent from other EVCs in and around Knox.

Conservation Status: Floodplain Riparian Woodland is regarded by the Department of Sustainability & Environment as 'Endangered' in the Gippsland Plain and Highlands Southern Fall bioregions. Perhaps the most intact example in Knox is in the Police Road Retarding Basin, where it is threatened by the proposed Mitcham to Frankston Freeway. All riparian native vegetation is very important for stream ecology and waterway protection.

EVC 74 – Wetland Formation

This EVC is best regarded as a collection of EVCs, and it applies to any freshwater water body or seasonally inundated area that has native vegetation. It includes within it Floodplain Wetland Complex (EVC 172) and Aquatic Herbland (EVC 653), each of which has been separately identified in this study where possible. Wetlands often occur within swampy or riparian EVCs (e.g. Riparian Forest or Swampy Riparian Woodland) and they can be either classified as EVC 74 or deemed part of the surrounding EVC.

Water bodies with negligible or no known vegetation are classified as EVC 998 (Water Body – natural or man-made) rather than EVC 74. Only the most barren water body fits this description, taking into account that underwater plants are usually difficult to detect. Vegetation that is submerged and invisible may be important habitat for invertebrates, fish and birds that dabble or dive. The cluster of Sutton, Cogley and Hill Lakes in Rowville provide an excellent example of this. Nevertheless, the Department of Sustainability & Environment's BioMaps of EVCs appear to ignore submerged vegetation.

Position in the landscape: Natural and manmade occurrences are scattered fairly liberally along Knox's stream corridors, but usually modified by past grazing, drainage, changed hydrology and removal of the surrounding forest. There are also dams scattered on more elevated ground, which often become vegetated once wind and waterbirds introduce seeds and plant fragments.

Conservation Status: The vegetation of all wetland communities (including EVCs 74, 172 and 653) is regarded by the Department of Sustainability & Environment as 'Endangered' in the Gippsland Plain and Highlands Southern Fall bioregions.

EVC 83 – Swampy Riparian Woodland

Quick recognition: Identifiable as a gallery or corridor of *Eucalyptus ovata* or sometimes *E. viminalis* within a few metres to a few tens of metres of the current or former course of a perennial stream, growing in friable alluvium which is often inundated but drains freely. Unlike Riparian Forest (EVC 18), Swampy Riparian Woodland does not have abundant *Pomaderris aspera*, and unlike Shrubby Gully Forest (EVC 938), *Melaleuca squarrosa* is scarce or absent and there are at most only patches of dense scrub dominated by species of *Leptospermum, Melaleuca* and/or *Acacia* (except for a period following clearing). Treeless patches of wetland are often taken to be included within Swampy Riparian Woodland.

Position in the landscape: In narrow bands along creeks, in the zone where inundation occurs on most of the occasions when the associated stream breaks its banks. It is the most common vegetation type on the banks of Knox's creeks, punctuated by stretches of Riparian Forest (EVC 18) or Floodplain Riparian Woodland (EVC 56). It is often flanked by Swampy Woodland (EVC 937), which (by contrast) tends to be flooded only by slow-moving water flowing downhill rather than by a stream breaking its banks. Swampy Riparian Woodland occurs in both bioregions that the Department of Sustainability & Environment recognises in Knox.

Tree canopy: Dominated by *E. ovata* typically 15-20 m tall or (less often) *E. viminalis* > 20 m tall, sometimes mixed with *E. cephalocarpa* that are rather shorter. Mature stands are rare in Knox, and can reach over 25 m tall.

Lower trees: *Acacia melanoxylon* and *A. dealbata* tend to dominate, sometimes with veteran *Melaleuca ericifolia*. *Pomaderris aspera* is absent or sparse.

Tall shrubs: Typically 4-8 m tall, dominated by any combination of *Melaleuca ericifolia*, *Leptospermum scoparium* and *Ozothamnus ferrugineus*, with variable density depending on how recently clearing or floods have occurred. Visibility typically 10 m. If *Melaleuca squarrosa* occurs, Shrubby Gully Forest (EVC 938) is more likely.

Lower shrubs: Similarly variable density. Dominants are *Coprosma quadrifida, Goodenia ovata* and sometimes *L. lanigerum* or *Acacia verticillata*. *Senecio minimus* is often abundant, as in the related community, Swampy Woodland (EVC 937).

Vines: Very sparse.

Ferns: *Pteridium esculentum* is dense in patches; *Blechnum* species are often scattered.

Ground flora: Typically patchy and variously dominated by *Phragmites australis, Lomandra longifolia*, *Poa ensiformis* (or *P. labillardierei*), *Pteridium esculentum*, rushes or *Carex* species.

Conservation Status: Many kilometres of creeks in Knox are lined with Swampy Riparian Woodland, but overwhelmingly the vegetation is in poor ecological condition due to insensitive land use and the vegetation's vulnerability to environmental weeds such as Japanese Honeysuckle and Wandering Jew. All riparian native vegetation is significant for its critical roles in maintaining stream ecology, bio-corridors and waterway protection through its particular characteristics of shade, flood response, nutrient cycling and use by fauna. Without taking these factors into account, the Department of Sustainability & Environment gives the conservation status of Swampy Riparian Woodland as 'Endangered' in the Gippsland Plain bioregion (which includes the majority or whole of every stream in Knox) and 'Depleted' in the 'Highlands – Southern Fall' bioregion. An unthinking application of these designations would lead to a discontinuity in the inferred conservation significance of Swampy Riparian Woodland along a stream at the point where it crosses the (somewhat arbitrary) boundary that the department has drawn between the two bioregions. This would not be sound because of the ways that a stream corridor functions ecologically. It is more ecologically defensible to treat all of the Swampy Riparian Woodland in Knox as having the 'Endangered' conservation status, even several kilometres upstream of the mapped boundary of the 'Gippsland Plain'. In addition, the conservation significance of any patch of Swampy Riparian Woodland has to take into account the environmental significance of riparian corridors, consistent with *'Victoria's Native Vegetation Management – A Framework for Action'* (NRE 2002a).

EVC 127 – Valley Heathy Forest

The Department of Sustainability & Environment's BioMaps of pre-1750 EVCs indicate that Valley Heathy Forest's distribution in the Port Phillip and Westernport region was confined within an area roughly between Templestowe, Kilsyth, Ferntree Gully, Rowville and Burwood, plus minor intrusions into the sand belt to the southwest. The remnants that remain show a strong gradient of characteristics across this range, both north-south and east-west. From Templestowe to North Ringwood, it approaches Valley Grassy Forest; from Kilsyth South to Boronia it approaches Lowland Forest; in Ferntree Gully it approaches the Dandenong Ranges form of Grassy Forest; and there is a noticeably different form between Scoresby and Lysterfield. There are also marked variations at the local scale. For example, the vegetation of Stringybark Reserve in Wantirna can be regarded as falling wholly within the range

of variability of Valley Heathy Forest even though the northern half is scarcely distinguishable from Valley Grassy Forest and the southern half is quite similar to Grassy Forest.

Quick recognition: Difficult, for the reasons above. Check the tree species and heights for conformity with the description below. *Eucalyptus cephalocarpa* and *E. goniocalyx* should be present. *Eucalyptus melliodora* and *Allocasuarina littoralis* are often present, unlike Grassy Forest and Lowland Forest. The shrub layer is usually rather dense and prickly. *Bursaria spinosa* and *Microlaena stipoides* are often abundant (typically dominant in their respective strata after grazing or clearing), and *Acacia paradoxa* has a similar tendency. *Hibbertia riparia* is common in Valley Heathy Forest, unlike similar EVCs. *Gahnia radula*, *Austrostipa rudis, Poa morrisii* and/or wallaby-grasses (particularly *Rytidosperma tenuius*) are typically abundant. Intact examples should have abundant lilies, particularly *Dianella admixta, D. longifolia, Tricoryne elatior* and *Arthropodium strictum*. *Platylobium obtusangulum* and *Leptospermum continentale* are very common (whereas *P. formosum* and *L. scoparium* are more associated with Grassy Forest and other foothill forests). *Daviesia latifolia* and *Pterostylis nutans* are much more common than in other EVCs in the metropolitan area or the hills to the east. Members of the Protea family are usually absent and never abundant. Lowland Forest is distinguishable by its generally taller canopy (>20 m), abundant members of the Protea family and a dense, tangled ground layer that includes *Tetrarrhena juncea*.

Position in the Knox landscape: Widespread on undulating terrain between the perennial stream valleys, but not extending up the slopes of the Dandenong Ranges.

Tree canopy: Height varies from below 15 m in the west and south to 20 m in the east. Foliage density is typically 25% cover, with the tree crowns overlapping slightly. *Eucalyptus cephalocarpa* and *E. goniocalyx* are nearly always present. *E. melliodora* and *E. radiata* are often present. *E. obliqua* is abundant in more mesic areas. *E. macrorhyncha* can be found where Valley Heathy Forest approaches Grassy Forest or in proximity to Grassy Dry Forest. *E. rubida* is associated more with Valley Grassy Forest than Valley Heathy Forest.

Lower trees: *Exocarpos cupressiformis* and *Acacia melanoxylon* are usually present, and often also *Acacia mearnsii, A. implexa* or *Allocasuarina littoralis*. Patches of *Acacia pycnantha* are common. *A. dealbata* is rarely present.

Shrubs: There is usually a shrub layer approximately 2-3 m deep, often becoming dense in patches depending on the history of fire and other disturbance. Visibility is typically 20 m. This layer is pricklier and denser than the similar Grassy Forest and is typically dominated by *Bursaria spinosa* and sometimes *Acacia paradoxa* (particularly in areas that have been grazed or cleared). *Acacia* species tend to be more numerous than other EVCs. *Leptospermum continentale* is common, but *L. scoparium* is much less common (being more associated with foothill forests such as Grassy Forest). *Cassinia* species are common. *Cassinia arcuata* and sometimes *Daviesia latifolia* can be prolific following disturbance (unlike Grassy Forest). *Epacris impressa* and *Dillwynia cinerascens* are typically present in more intact areas.

Vines: Moderately common but representing a very low foliage cover compared with the rest of the understorey. *Billardiera mutabilis* and *Comesperma volubile* are the most common climbers, and *Hardenbergia violacea* is the most common creeper (although *Kennedia prostrata* becomes abundant after fire). The vine component of Valley Heathy Forest is very similar to Grassy Forest.

Ferns: *Pteridium esculentum* is often dense in patches, particularly after disturbance. Other ferns are much less common.

Ground flora: Mostly less than knee deep and with a foliage cover usually above 80% in mature vegetation; Densely grassy, rich in species and with a minor but important component of heathy elements (e.g. *Hibbertia riparia*) that distinguish this community from Valley Grassy Forest and Grassy Forest. *Microlaena stipoides* is consistently abundant and often a dominant species, becoming very dense in areas with a history of grazing. *Gahnia radula*, *Austrostipa rudis, Poa morrisii* and/or wallaby-grasses (particularly *Rytidosperma tenuius*) are typically abundant and any of these can dominate the ground flora. *Themeda triandra* and/or *Rytidosperma pallidum* = *Joycea pallida* are often conspicuous but not as much as the other grasses just mentioned. *Tetrarrhena juncea* only occurs where the vegetation approaches Lowland Forest. As in EVCs related to Valley Heathy Forest, the following species are very common but with much less foliage cover than the grasses: *Lomandra filiformis, Gonocarpus tetragynus, Acrotriche serrulata, Hypericum gramineum*,

Oxalis perennans / exilis, *Stylidium* sp.2 and *Hovea heterophylla*. *Xanthorrhoea minor* is common in more intact areas. A high frequency of *Hibbertia riparia* is a distinctive feature of this EVC. *Platylobium obtusangulum* is usually present, whereas *P. formosum* is more associated with Grassy Forest and some other foothill forests. *Veronica gracilis* is common and tends to be replaced by *V. calycina* in Grassy Forest. Valley Heathy Forest has abundant *Pterostylis nutans* and lilies, particularly *Dianella admixta, D. longifolia, Tricoryne elatior, Burchardia umbellata* and *Arthropodium strictum* (the last of which can sometimes dominate the ground flora in spring). *Caesia parviflora* is often present in more intact areas. *Opercularia ovata* tends to be more abundant than *O. varia*, whereas the reverse is true in Grassy Forest. *Drosera whittakeri* is also much more common in Valley Heathy Forest than Grassy Forest. Until the 1960s, Valley Heathy Forest was very rich in orchids (with suburbs like Bayswater and Boronia renowned for them), but broad scale environmental changes have caused a massive decline.

Conservation Status: The Department of Sustainability & Environment rates the conservation status of Valley Heathy Forest as 'Endangered' in the Gippsland Plain bioregion, which applies to all occurrences in Knox. Despite this, Valley Heathy Forest accounts for a large fraction of the small amount of remnant vegetation left in Knox.

EVC 128 – Grassy Forest

The Department of Sustainability & Environment's BioMaps of extant and pre-1750 EVCs have applied the title 'Grassy Forest' to two distinct kinds of vegetation that occur in Knox. One kind is the type of forest for which the title was originally coined (Commonwealth and Victorian Regional Forest Agreement Steering Committee 1997). The other is a low, open woodland that does not conform to the original description, nor to the description in the report about the BioMap project (Oates and Taranto 2001).

In this report, the term 'Grassy Forest' is used only for vegetation that is consistent with the published descriptions. The title 'EVC 128a – Bundy Woodland' is coined here for the other type of vegetation mapped as Grassy Forest on the BioMaps. The following description is for typical Grassy Forest. Bundy Woodland is described beneath that, under a separate heading.

Quick recognition: Recognisable by a diverse eucalypt overstorey (see below), a sparse shrub layer and a rich array of ground flora in a grassy layer with plenty of space between tussocks (though less than in Grassy Dry Forest). The following are good indicator species: *Acacia stricta, Rytidosperma pallidum = Joycea pallida*, *Lepidosperma laterale*, *Pimelea humilis, Cynoglossum suaveolens, Platylobium formosum* (far more than *P. obtusangulum*) and *Plantago varia*. *Hibbertia riparia* and *Eucalyptus melliodora* are usually absent, unlike the related Valley Heathy Forest (EVC 127).

Position in the Knox landscape: Gentle slopes (particularly with northerly to westerly aspect) in the lower Dandenong Ranges and the ridge of metamorphic geology that runs parallel to, and just east of, Dorset Rd.

Tree canopy: Tall (typically 20 m) and rich with the tree crowns typically overlapping slightly. *Eucalyptus obliqua* is nearly always present, in any mixture with several (usually three) of the following: *E. radiata, E. macrorhyncha, E. goniocalyx. E. cypellocarpa* is sometimes also present in the Dandenong Ranges.

Lower trees: *Exocarpos cupressiformis* is moderately dense and *Acacia melanoxylon* is usually present at lower density. *Acacia dealbata* may also be present. *Acacia mearnsii* and *Allocasuarina littoralis* are more associated with Valley Heathy Forest, but may appear in Grassy Forest.

Shrubs: Mostly up to 2-3 m tall and of variable density, depending on the recent history of fire and other disturbance. A sparse cover is the most common natural state. The most common species are *Cassinia aculeata, Leptospermum scoparium, L. continentale*, *Bursaria spinosa, Acacia* species, *Correa reflexa, Pultenaea gunnii, Olearia lirata* and *Epacris impressa*. Visibility is typically 30 m, but variable.

Vines: Moderately common but representing a very low foliage cover compared with the rest of the understorey. Frequent species are *Comesperma volubile*, *Clematis aristata*, *Pandorea pandorana*, *Glycine clandestina* and *Billardiera mutabilis*.

Ferns: *Pteridium esculentum* and sometimes *Adiantum aethiopicum* are dense in patches, but the patches are sparse enough that the ferns do not normally have high foliage cover overall.

Ground flora: Mostly less than knee deep and with a foliage cover of typically 80% in mature vegetation. Dominated in patchwise fashion by *Themeda triandra, Poa morrisii, Rytidosperma pallidum = Joycea pallida* and *Gahnia radula*, always with abundant *Lomandra filiformis* subsp. *coriacea* and often with fairly abundant *Microlaena stipoides, Austrostipa rudis* and *Austrostipa pubinodis*. There are numerous ground flora species, the most frequent being *Platylobium formosum* (creeping form), *Acrotriche* species, *Gonocarpus tetragynus, Goodenia lanata, Helichrysum scorpioides, Arthropodium strictum, Lepidosperma gunnii*, *L. laterale*, *Pimelea humilis* and *Dipodium roseum*. Orchids and lilies are usually rather abundant in healthy areas of Grassy Forest, particularly after fire or with light grazing or slashing. *Thysanotus tuberosus* and *Wahlenbergia stricta* are often present (sometimes in abundance), unlike the similar Valley Heathy Forest (EVC 127).

Conservation Status: The Department of Sustainability & Environment rates the conservation status of Grassy Forest as 'Vulnerable' in the Highlands Southern Fall bioregion and 'Endangered' in the Gippsland Plain bioregion. Most of the Grassy Forest in Knox is in the former bioregion, adjoining larger, more intact areas on the lower slopes of the Dandenong Ranges National Park. Vegetation that is intermediate between Grassy Forest and Valley Heathy Forest occurs between Army Rd and Dorset Rd in Boronia, which is in the Gippsland Plain bioregion.

EVC 128a – Bundy Woodland

As explained above, Bundy Woodland is the name coined here for a vegetation community that has been mapped on the Department of Sustainability & Environment's BioMaps as Grassy Forest (EVC 128), but does not conform to published descriptions of this EVC. It conforms to the department's interim 'benchmark' for Grassy Forest in the Gippsland Plain bioregion, but not for the Highlands Southern Fall bioregion.

Typical Grassy Forest has a canopy comprising slightly overlapping crowns of eucalypts of several species reaching approximately 20 m tall. By contrast, Bundy Woodland supports a near-pure stand of stunted *Eucalyptus goniocalyx* to 15 m tall, which are mostly well separated. The understorey of typical Grassy Forest is also richer in species than Bundy Woodland.

Quick recognition: Recognisable as a sparse, near-pure stand of Bundy with crowns well separated. The shrub layer is rather sparse except for disturbed patches, and there is a densely grassy layer with low or modest richness of species. Similar EVCs are Grassy Forest (EVC 128), Grassy Dry Forest (EVC 22) and Valley Heathy Forest (EVC 127).

Position in the Knox landscape: Knolls and hillsides in rather steep, often rocky terrain of foothills to the Dandenong Ranges, at Sugarloaf Hill in Boronia and Lysterfield Park.

Tree canopy: A practically pure stand of well-spaced *E. goniocalyx* to 15 m tall.

Lower trees: *Exocarpos cupressiformis* may be moderately dense. *Acacia mearnsii* and/or *A. implexa* may be present in smaller numbers and may reach as tall as the eucalypt canopy.

Shrubs: Mostly up to 2-3 m tall and sparse except where stimulated by soil disturbance. The most common species are *Bursaria spinosa, Cassinia aculeata, Leptospermum scoparium, L. continentale*, *Acacia* species and *Epacris impressa*. Visibility is typically 30-50 m, but variable according to disturbance history.

Vines: Moderately common but representing a very low foliage cover compared with the rest of the understorey. Frequent species are *Billardiera mutabilis, Glycine clandestina* and *Pandorea pandorana*.

Ferns: Usually scarce and rarely including any *Pteridium esculentum* (unlike typical Grassy Forest). *Adiantum aethiopicum* can be dense in patches around rocks, but with low overall foliage cover.

Ground flora: Mostly less than knee deep and with a foliage cover usually above 90%. Less disturbed ground flora are dominated in patchwise fashion by *Themeda triandra, Austrostipa rudis, Lomandra filiformis* subsp. *coriacea* and sometimes *Goodenia lanata*, but *Microlaena* can dominate following grazing. *Rytidosperma pallidum = Joycea pallida* and *Gahnia radula* are scarce or absent, unlike typical Grassy Forest. Other ground flora species are similar to Grassy Forest (EVC 128), Grassy Dry Forest (EVC 22) and Valley Heathy Forest (EVC 127), but with fewer species.

Conservation Status: For the purpose of applying *"Victoria's Native Vegetation Management – A Framework for Action"* (NRE 2002a), Bundy Woodland should be treated as part of EVC 128 to avoid inconsistency with the research and classifications that underpin the Framework. The Department of Sustainability & Environment rates the conservation status of Grassy Forest as 'Vulnerable' in the Highlands Southern Fall bioregion and 'Endangered' in the Gippsland Plain bioregion. The 'benchmark' for Grassy Forest on the Gippsland Plain is a satisfactory match, but the one for Highlands Southern Fall is not a reasonable match and it should not be used for Bundy Woodland.

EVC 164 – Creekline Herb-rich Woodland

This EVC may or may not be present in Knox, and if so, only at the Lysterfield Hills Quarries. The Department of Sustainability & Environment's BioMap of pre-1750 EVCs show it as having occurred on the Dobson Creek floodplain in The Basin and on the headwaters of two creeks in the Lysterfield Hills. This is not consistent with the corresponding BioMap of extant EVCs, and the purported pre-1750 occurrence at The Basin is also inconsistent with the geographical context of this EVC (as presently interpreted by the Department of Sustainability & Environment).

An occurrence on the southern slopes of the Lysterfield Hills has been reported by Mr S. Mueck in a 1998 report, *'Ecological Assessment of Native Vegetation Adjacent to a Proposed Extension of the Lysterfield Quarry'*. This conflicts with all other EVC maps of the area. It would also be geographically out of character and the species list that Mueck provides seems more consistent with Herb-rich Foothill Forest (EVC 23).

The purported occurrences on the Lysterfield Hills could not be checked during this study because access to the quarry land could not be arranged.

The following description is based on typical occurrences north of Knox.

Quick recognition: Always found in narrow strips of alluvium along minor drainage lines. There is a well-developed stratum of *Acacia mearnsii* and *A. melanoxylon* beneath the eucalypts. Look for the ground flora species *Poa labillardierei, P. tenera, Gahnia radula, Juncus* species, *Lomandra longifolia, Lobelia anceps, Centella cordifolia, Acaena novae-zelandiae, Adiantum aethiopicum. Veronica plebeia* and *Gratiola peruviana* are good indicators, but not always present. Distinguish from Herb-rich Foothill Forest (EVC 23) by the presence of alluvium and ground flora species that indicate poor drainage (e.g. *Centella* or *Goodenia elongata*).

Position in the landscape: Always found in narrow strips of alluvium along minor drainage lines (usually with a non-perennial creek flowing through them), usually flanked by Valley Grassy Forest (EVC 47) or Herb-rich Foothill Forest (EVC 23) on more protected slopes (sometimes by Grassy Dry Forest (EVC 22) on exposed, north-facing slopes).

Tree canopy: Similar in composition to the flanking vegetation, but typically taller and with the addition of *Eucalyptus ovata* and/or *E. rubida*. Variable in height but typically about 20 m.

Lower trees: There is a well-developed stratum of *Acacia mearnsii* and *A. melanoxylon* (or occasionally *Acacia dealbata*).

Shrubs: Often patchy, typically about 3 m tall. *Kunzea eriocoides* may be abundant, depending on the site's history. *Leptospermum scoparium* and *Bursaria spinosa* are very common. Visibility is typically 20 m, but variable.

Vines: Fairly scarce. *Glycine* species are most common.

Ferns: *Adiantum aethiopicum* is usually present and patches of *Pteridium esculentum* can be present.

Ground flora: Grassy and with many herb species. Dominant species comprise a selection from *Poa labillardierei, P. tenera, Gahnia radula, Juncus* species and *Lomandra longifolia*. Characteristic forb species are *Lobelia anceps, Centella cordifolia, Acaena novae-zelandiae, Veronica plebeia, Goodenia elongata* and *Gratiola peruviana*.

Conservation Status: The Department of Sustainability & Environment rates the conservation status of Creekline Herb-rich Woodland as 'Endangered' in the Highlands Southern Fall and Gippsland Plain bioregions. If present at all in Knox, it is extremely rare, highly endangered and probably badly degraded.

EVC 172 – Floodplain Wetland Complex

Quick recognition: Seasonal or perennial wetlands on floodplains of the more major streams, with floating aquatic plants and fringed by the genera *Alisma*, *Juncus, Carex, Typha* and *Persicaria*. Aquatic Herbland (EVC 653) appears to be a narrower type of vegetation that lies within EVC 172, except that the former is not (arbitrarily?) confined to broad floodplains of larger streams.

Position in the Knox landscape: Billabongs, cut-off meanders and depressions on the floodplains of Dandenong Ck, Blind Ck and Corhanwarrabul Ck, particularly in association with Floodplain Riparian Woodland.

Trees, vines, terrestrial ferns: None, although *Eucalyptus viminalis* is normally close by or overhanging.

Shrubs: *Melaleuca ericifolia* may occur at the water's edge.

Fringing plants: Members of the genera *Alisma*, *Juncus, Carex, Eleocharis, Typha* and *Persicaria* are abundant. *Crassula helmsii* and *Alternanthera denticulata* are often present

Aquatic plants: *Potamogeton* species, *Triglochin procerum* and *Lemna disperma* are generally present. *Ottelia ovalifolia* and *Azolla filiculoides* are fairly common. *Landoltia* (=*Spirodela*) *punctata* and *Wolffia australiana* are sometimes present.

Conservation Status: The vegetation of all wetland communities (including EVCs 74, 172 and 653) is regarded by the Department of Sustainability & Environment as 'Endangered' in the Gippsland Plain and Highlands Southern Fall bioregions.

EVC 653 – Aquatic Herbland

Based on currently available descriptions and mapping by the Department of Sustainability & Environment, the only things that make Aquatic Herbland different from Floodplain Wetland Complex (EVC 172) are that water in the wetland must be permanent or semi-permanent and the location need not necessarily be on the floodplain of a larger stream. These distinctions make no material difference in ecological terms in the urban environment where stream flows and flooding are regulated and quite different from natural.

Position in the Knox landscape: This EVC appears on the Department of Sustainability & Environment's BioMaps at one location only in Knox – the lake at Lakewood Nature Reserve. It is on a minor creek, but it otherwise fits the description of Floodplain Wetland Complex.

Conservation Status: The vegetation of all wetland communities (including EVCs 74, 172 and 653) is regarded by the Department of Sustainability & Environment as 'Endangered' in the Gippsland Plain and Highlands Southern Fall bioregions.

EVC 937 – Swampy Woodland

Quick recognition: Identifiable as a poorly drained slope or floodplain dominated by *Eucalyptus ovata*, with abundant soil moisture most of the year due to percolation of water from uphill (rather than due to proximity to a stream).

Position in the landscape: As above, in major and minor valleys right across Knox and occasionally on hillsides where soil is kept damp by water seepage or surface runoff. See also the comments about the closely related Swampy Riparian Woodland (EVC 83).

Tree canopy: Similar to Swampy Riparian Woodland: Dominated by *E. ovata* typically 15-20 m tall, often mixed with *E. cephalocarpa* that are rather shorter. Mature stands are rare in Knox, and can reach over 25 m tall.

Lower trees: *Acacia melanoxylon* is practically always present, often with *Exocarpos cupressiformis* and/or *Melaleuca ericifolia*. The *Melaleuca* may form dense patches, either as a tree layer when mature or as scrub when young.

Shrubs: There is usually a shrub stratum 3-5 m tall that can become fairly dense at the 'adolescence' stage of the vegetation's development. Visibility is typically 10 m but variable. Dominants are *Leptospermum scoparium, Ozothamnus ferrugineus, Acacia verticillata* and sometimes *Hakea nodosa* or *Cassinia aculeata*. *Epacris impressa* is usually present, depending on the history of disturbance.

Vines: Sometimes fairly common but representing a very low foliage cover compared with the rest of the understorey. Frequent species are *Glycine clandestina* and *Billardiera mutabilis*.

Ferns: *Pteridium esculentum* may be dense in patches.

Ground flora: Dense and up to about one metre deep, sometimes becoming difficult to walk through, but with enough openings between the larger tussocks to support a fairly rich range of damp-loving small herbs. Dominant species can include various mixtures of *Lomandra longifolia*, *Juncus* species, *Gahnia* species, *Poa labillardierei, P. ensiformis* and *Microlaena stipoides*. Smaller herbs that are typically present in more intact areas include *Centella cordifolia, Goodenia humilis, Lepidosperma filiforme* and *Patersonia* species. *Austrofestuca hookeriana* is often present in the most intact sites but not often in large numbers.

Conservation Status: The Department of Sustainability & Environment rates the conservation status of Swampy Woodland as 'Vulnerable' in the Highlands Southern Fall bioregion and 'Endangered' in the Gippsland Plain bioregion. Remnants of Swampy Woodland are fairly common along the valleys of Knox in both these bioregions, but overwhelmingly in poor ecological condition.

EVC 938 – Shrubby Gully Forest

Shrubby Gully Forest corresponds to the floristic communities 'SL11' of Gullan *et al.* (1979) and 'Sub-community 3.3' of Opie *et al.* (1984).

Quick recognition: Found in swampy places. *Eucalyptus ovata* dominates, sometimes with *E. cephalocarpa* or outlying eucalypts from adjacent communities. There is a tall, usually dense, shrub layer. *Melaleuca squarrosa* is practically always present, usually in some mixture with *Leptospermum scoparium, Ozothamnus ferrugineus* and/or *M. ericifolia*. The ground layer is often over a metre deep and hard to walk through, with abundant sedges, rushes, ferns and *Lobelia anceps*.

Position in the landscape: Found around the fringe of the Dandenong Ranges where the slope becomes shallow, along slowly flowing creeks and drainage lines or lower slopes with plenty of groundwater seepage. Soil is sandy or silty alluvium derived from granodiorite, rhyodacite or related rock. Particularly swampy patches within this vegetation class lose their tree cover and become a wetland or swamp dominated by sedges. Shrubby Gully Forest is in less fertile catchments than the related Swampy Riparian Forest (EVC 83) and, by contrast, is often flanked by Lowland Forest (EVC 16) or Damp Heathy Woodland (EVC 793) rather than Swampy Woodland (EVC 937).

Tree canopy: Dominated by *Eucalyptus ovata*, sometimes with some *E. cephalocarpa* or other eucalypts intruding from adjacent vegetation.

Lower trees: *Acacia melanoxylon*, sometimes very sparse.

Shrubs: A variable (but typically high) density of *Melaleuca squarrosa, Leptospermum scoparium*[*] and *Ozothamnus ferrugineus* in any proportions are the dominant taller shrubs, often with *Leptospermum lanigerum* and sometimes *Melaleuca ericifolia*. *Melaleuca squarrosa* is a particularly good indicator species. *Acacia verticillata, Coprosma quadrifida, Hakea nodosa* and *Olearia lirata* are usually present and can become abundant where taller plants admit more sunlight. *Goodenia ovata* and *Senecio minimus* are usually present, becoming abundant after disturbance.

[*] Note that Oates and Taranto (2001) mention *L. continentale*, which should be taken to embrace *L. scoparium* according to current taxonomic convention as given in Walsh & Entwisle (1996).

Ground flora: Typically dense and over one metre deep. Where enough light penetrates, the ground flora is dense with sedges, particularly *Lepidosperma elatius, Carex appressa, C. gaudichaudiana*, *Baumea* species and sometimes *Gahnia* species. Rushes (*Juncus* and *Typha* species) or *Phragmites australis* may also be dominant in more open patches. *Lobelia anceps, Poa tenera, Gonocarpus* species and *Isolepis* are common but not dominant in projected foliage cover. *Blechnum* species are common, as is *Cyathea australis*.

Conservation Status: The Department of Sustainability & Environment rates the conservation status of Shrubby Gully Forest as 'Vulnerable' in the Highlands Southern Fall bioregion, which covers all known and purported occurrences of this EVC in Knox.

998 – Water Body, natural or man-made

'998' is a 'map unit number' (rather than EVC number) assigned to water bodies with no or negligible vegetation in them. Most water bodies have some vegetation, even though it may be hidden underwater (see EVC 74).

Conservation Status: The Department of Sustainability & Environment Native Vegetation Framework does not assign any conservation status rating to water bodies that are essentially unvegetated. The biological significance of any such water body depends on the support that it provides to wildlife or the indirect benefits that it may provide to indigenous flora or fauna, e.g. by discharge or percolation of water to habitat next to it or downhill.

Sedge Swamp (related to EVC 136 – Sedge Wetland) **{ TC "Sedge Swamp" \l 2}**

EVC 136 – 'Sedge Wetland' – as described by Oates and Taranto (2001) is a community of the coastal sand-belt, dominated by the large sedge *Lepidosperma longitudinale* (Pithy Sword-sedge). By comparison, the Sedge Swamp described here has a different (but very similar) dominant species, *Lepidosperma elatius*, while the structure, ecology and many of the plant genera are common to both communities. One could conceivably apply the label EVC 136 to sedge swamp in Knox on the basis that EVCs were intended to group vegetation according to ecology and functional groups of plants rather than the particular species present. However, EVCs have tended to become subdivided more finely than that, and EVC expert, Mr Doug Frood, advises that it is best to treat the sedge swamp described here as a community for which the EVC system is presently deficient.

In Volume 2, areas of Sedge Swamp have been included either under EVC 74 (Wetland Formation) or as part of the surrounding EVC (e.g. Swampy Woodland).

Quick recognition: A swamp with few or no trees, overwhelmingly dominated by sedges at least 1½ m tall.

Position in the landscape: Found in shallow billabongs, cut-off meanders or on creeks where the riparian zone broadens and drainage is slow, including around the Dandenong Ranges and along Dandenong Ck and the Yarra River. Soil is silty or sandy alluvium and incorporates swamp deposits.

Trees: Usually treeless but often with some overhanging branches, particularly of *Eucalyptus ovata*, *E. viminalis* subsp. *viminalis* or (less commonly) *E. cephalocarpa*.

Shrubs: There are usually some shrubs at the edges of the swamp: *Leptospermum lanigerum* and *Melaleuca* species are frequent and sometimes there is *Ozothamnus ferrugineus, Leptospermum scoparium* or *Gynatrix pulchella* (Hemp Bush).

Ground flora: Dense with tall sedge species, overwhelmingly dominated by *Lepidosperma elatius*, *Cyperus lucidus* and/or *Carex fascicularis*. *Carex appressa* and *Baumea* species are also typically present. *Persicaria* species are common. The dominance of the large sedges keeps flora diversity low.

Conservation Status: There is too little bioregional data about this EVC to classify its status.

Appendix B – Indigenous Plant Species of Knox

The table below is an inventory of indigenous plant species in Knox. Several unlisted species are suspected to exist in Knox but have not been confirmed.

In this report, scientific names of plants generally follow Walsh and Stajsic (2007) except that *Austrodanthonia* and *Notodanthonia* are referred to *Rytidosperma* in accordance with recent genetic work on a global scale (Linder *et al*., in press). Common synonyms are given where appropriate.

Common names follow *'Flora of Victoria'* (Walsh and Entwisle 1994, 1996, 1999). Where *'Flora of* Victoria' has not published a common name, we default to Beauglehole (1983) and then to the names used by the Arthur Rylah Institute.

The first column contains each species' code number in the *'Flora Information System'* database maintained by the Department of Sustainability & Environment.

The column headed '# Sites' indicates the number of sites in which the species have been credibly recorded. For this purpose, Wicks Reserve and Wicks East Nature Reserve are treated as separate sites even though Volume 2 unites them as Site 15. The next column shows how many of these sites were observed to support the species during the present study. The 'Most Recent' column gives the year in which each species was most recently recorded.

The entries in the 'Threat Level' columns refer to the species' status as rare or threatened at various spatial scales. The subheading 'Melb' is for the region covered by the standard text, *'Flora of Melbourne'*. The letters in the columns beneath the subheadings have the following meanings, with more detailed definitions given in Section 3.4.1:

- X Presumed extinct within the corresponding domain
- C Critically Endangered
- E Endangered
- V Vulnerable
- NT Near threatened, i.e likely to move into the Vulnerable category
- R Rare but not in any of the categories above
- DD Data deficient: Suspected to be rare or threatened, but with too little information to tell
- L Least Concern
- NA Not applicable, as in the case of hybrids and species that have only recently expanded into Knox via gardens
- M Recorded by *Flora of Melbourne* at no more than ten sites, excluding very old records

Specimens of nearly all unusual plant species found in this study have been collected and lodged at the National Herbarium of Victoria as permanent records. Species that are poorly understood by science are discussed below the table.

FIS Code	Scientific Name	Common Name	# Sites		Most recent record	Threat Level				Comments or source of record
			Total	This study		Knox	Melb	State	National	
	Ferns and their Allies									
129	*Adiantum aethiopicum*	Common Maidenhair	22	19	2009	V				
288	*Asplenium flabellifolium*	Necklace Fern	1	0	1998	C				1903 FNCV report; Hanson Quarry report
347	*Azolla filiculoides*	Pacific Azolla	3	2	2008	V				
348	*Azolla pinnata*	Ferny Azolla	3	1	2005	E	M			
404	*Blechnum cartilagineum*	Gristle Fern	7	6	2007	E	M			
407	*Blechnum minus*	Soft Water-fern	6	6	2004	C	M			
408	*Blechnum nudum*	Fishbone Water-fern	2	2	2008	E	M			
887	*Calochlaena dubia*	Common Ground-fern	10	9	2007	V				
730	*Cheilanthes austrotenuifolia*	Green Rock Fern	3	2	2004	C				
733	*Cheilanthes sieberi*	Narrow Rock Fern	1	1	2002	C	M			
895	*Cyathea australis*	Rough Tree-fern	21	18	2009	E				
1039	*Dicksonia antarctica*	Soft Tree-fern	2	2	2002	E	M			
1098	*Doodia australis*	Common Rasp-fern	1	1	1999	C	M			Possibly planted
1691	*Histiopteris incisa*	Bat's Wing Fern	5	4	2008	C	M			

FIS Code	Scientific Name	Common Name	# Sites		Most recent record	Threat Level				Comments or source of record
			Total	This study		Knox	Melb	State	National	
1752	*Hypolepis glandulifera*	Downy Ground-fern	3	3	2009	C	M			
1751	*Hypolepis muelleri*	Harsh Ground-fern	2	2	2002	C	M			
1753	*Hypolepis rugosula*	Ruddy Ground-fern	4	4	2007	C	M			
1876	*Lastreopsis acuminata*	Shiny Shield-fern	1	0	2002	C	M			
2014	*Lindsaea linearis*	Screw Fern	18	16	2009	V				
2503	*Phylloglossum drummondii*	Pigmy Clubmoss	1	0	1909	X	M			1906 specimen; 1909 FNCV report
2576	*Pleurosorus rutifolius*	Blanket Fern	1	1	2002	C	M			
2645	*Polystichum proliferum*	Mother Shield-fern	9	7	2009	E	M			
2777	*Pteridium esculentum*	Austral Bracken	58	54	2009	L				
2779	*Pteris tremula*	Tender Brake	3	3	2009	E	M			
3098	*Selaginella uliginosa*	Swamp Selaginella	1	1	2007	C	M			
	Flowering Plants									
7	*Acacia acinacea* s.l.	Gold-dust Wattle	2	1	2007	C				
8	*Acacia aculeatissima*	Thin-leaf Wattle	9	9	2008	E				
25	*Acacia dealbata*	Silver Wattle	36	32	2009	L				
38	*Acacia genistifolia*	Spreading Wattle	3	2	2006	C				
45	*Acacia implexa*	Lightwood	19	18	2009	V				
5140	*Acacia leprosa* (Dandenong Range variant)	Dandenong Range Cinnamon Wattle	15	12	2009	V		R	R	Locally common – see note at end of table
5369	*Acacia leprosa* × *paradoxa*	Cinnamon Wattle × Hedge Wattle hybrid	1	0	1989	NA	M			
56	*Acacia mearnsii*	Black Wattle	72	69	2009	V				
57	*Acacia melanoxylon*	Blackwood	105	106	2009	V				Depleted over 3 generations
62	*Acacia mucronata*	Narrow-leaf Wattle	4	4	2007	E				
63	*Acacia myrtifolia*	Myrtle Wattle	22	20	2008	E				
72	*Acacia paradoxa*	Hedge Wattle	47	45	2009	L				
78	*Acacia pycnantha*	Golden Wattle	25	25	2009	E				
91	*Acacia stricta*	Hop Wattle	35	29	2009	E				
98	*Acacia ulicifolia*	Juniper Wattle	1	0	1985	C	M			Paget 1985; FNCV 1907
99	*Acacia verniciflua*	Varnish Wattle	2	0	2004	C				
100	*Acacia verticillata*	Prickly Moses	38	31	2009	V				
106	*Acaena echinata* group	Sheep's Burr	20	21	2008	V				See the note at end of table
105	*Acaena novae-zelandiae*	Bidgee-widgee	57	53	2009	L				
110	*Acianthus caudatus*	Mayfly Orchid	0	0	1928	X	M			1928 FNCV report
4439	*Acianthus pusillus*	Small Mosquito Orchid	0	0	2004	C				Ferntree Gully
122	*Acrotriche prostrata*	Trailing Ground-berry	23	22	2009	V				
123	*Acrotriche serrulata*	Honey-pots	40	39	2009	L				
174	*Alisma plantago-aquatica*	Water Plantain	21	18	2008	NT				
451	*Allittia cardiocarpa*	Swamp Daisy	5	4	2001	C	M			
677	*Allocasuarina littoralis*	Black Sheoak	36	36	2009	V				
683	*Allocasuarina paludosa*	Scrub Sheoak	3	2	2007	C	M			
2875	*Almaleea subumbellata*	Wiry Bush-pea	0	0	1928	X	M			1928 FNCV report
5097	*Alternanthera denticulata*	Lesser Joyweed	16	12	2007	V				
208	*Amphibromus archeri*	Pointed Swamp Wallaby-grass	2	2	2004	C	M			
3628	*Amphibromus nervosus*	Veined Swamp Wallaby-grass	1	1	1997	C	M			
220	*Amyema pendula*	Drooping Mistletoe	44	40	2009	C				
222	*Amyema quandang*	Grey Mistletoe	19	17	2009	V				
243	*Aphelia pumilio*	Dwarf Aphelia	1	1	2001	C	M			

FIS Code	Scientific Name	Common Name	# Sites		Most recent record	Threat Level				Comments or source of record
			Total	This study		Knox	Melb	State	National	
269	*Arthropodium milleflorum*	Pale Vanilla-lily	6	4	2004	C				
5126	*Arthropodium strictum*	Chocolate Lily	46	45	2009	L				
278	*Asperula conferta*	Common Woodruff	9	6	2007	C				
304	*Astroloma humifusum*	Cranberry Heath	2	0	2000	C				
4260	*Australina pusilla*	Shade Nettle	1	1	2002	C	M			
909	*Austrocynoglossum latifolium*	Forest Hound's-tongue	5	5	2007	E	M			
	Austrodanthonia – see *Rytidosperma*									
1360	*Austrofestuca hookeriana*	Hooker Fescue	3	3	2001	C	M			
3279	*Austrostipa mollis*	a Spear-grass	2	2	2009	V				
3288	*Austrostipa pubinodis*	Tall Spear-grass	39	39	2009	L				
4940	*Austrostipa rudis* ssp. *australis*	Veined Spear-grass	8	8	2009	V	M	R		
4942	*Austrostipa rudis* ssp. *rudis*	Veined Spear-grass	66	66	2009	L				
363	*Banksia marginata*	Silver Banksia	7	6	2004	E				
373	*Baumea acuta*	Pale Twig-rush	3	2	2002	C	M			
374	*Baumea arthrophylla*	Fine Twig-rush	1	1	2002	C	M			
4229	*Baumea rubiginosa*	Soft Twig-rush	2	2	2007	C	M			
381	*Baumea tetragona*	Square Twig-rush	1	1	1997	C	M			
382	*Bedfordia arborescens*	Blanket-leaf	3	3	2002	C	M			
4291	*Billardiera mutabilis*	Common Apple-berry	67	63	2009	L				
417	*Bolboschoenus medianus*	Marsh Club-rush	1	1	1997	V	M			Figures exclude known plantings
440	*Bossiaea prostrata*	Creeping Bossiæa	38	34	2009	NT				
455	*Brachyscome decipiens*	Field Daisy	0	0	1970	X	M			
508	*Brunonia australis*	Blue Pincushion	15	14	2007	V				
510	*Bulbine bulbosa*	Yellow Bulbine-lily	5	4	2008	E				
512	*Burchardia umbellata*	Milkmaids	36	33	2009	L				
5690	*Bursaria spinosa*	Sweet Bursaria	91	91	2009	L				
519	*Caesia calliantha*	Blue Grass-lily	1	0	1989	C				Adams & Simmons (1989); 1936 FNCV report
518	*Caesia parviflora*	Pale Grass-lily	25	21	2008	V				
526	*Caladenia cardiochila*	Heart-lip Spider-orchid	0	0	1909	X	M			1909 FNCV report; regionally extinct
955	*Caladenia carnea*	Pink Fingers	2	2	2002	C				
4900	*Caladenia catenata*	White Caladenia	1	1	1998	C	M			
528	*Caladenia clavigera*	Plain-lip Spider-orchid	1	0	1985	X	M			
529	*Caladenia congesta*	Black-tongue Caladenia	0	0	1929	C	M			1929 FNCV report
	Caladenia deformis – see *Pheladenia deformis*									
	Caladenia iridescens - see *C. transitoria*									
3694	*Caladenia oenochila*	Wine-lipped Spider-orchid	0	0	1929	C	M	V	V	3 FNCV reports, 1909-29
4344	*Caladenia ?phaeoclavia*	Brown-clubbed Spider-orchid	1	0	1990	C				1929 FNCV report; Nortons
543	*Caladenia praecox*	Early Caladenia	0	0	1928	C	M			1928 FNCV report
5422	*Caladenia transitoria*	Eastern Bronze Caladenia	0	0		C	M			*Flora of Melbourne*
565	*Callistemon sieberi*	River Bottlebrush	1	1	2002	C				Possibly planted beside Dand. Ck
571	*Callitriche muelleri*	Round Water Starwort	1	0	1998	C	M			Hanson Quarry report
585	*Calochilus campestris*	Copper Beard-orchid	0	0		X	M			*Flora of Melbourne*
587	*Calochilus paludosus*	Red Beard-orchid	1	0	1985	C	M			recorded by Paget in 1985
589	*Calochilus robertsonii*	Purplish Beard-orchid	1	1	1998	C				
603	*Calystegia marginata*	Forest Bindweed	7	5	2008	E	M			
604	*Calystegia sepium*	Large Bindweed	2	1	2003	C	M			See note at end of table

FIS Code	Scientific Name	Common Name	# Sites		Most recent record	Threat Level				Comments or source of record
			Total	This study		Knox	Melb	State	National	
623	*Carex appressa*	Tall Sedge	28	23	2009	L				
627	*Carex breviculmis*	Short-stem Sedge	51	45	2009	L				
638	*Carex fascicularis*	Tassel Sedge	9	6	2008	E	M			
639	*Carex gaudichaudiana*	Fen Sedge	9	7	2008	E	M			
642	*Carex inversa*	Knob Sedge	11	5	2003	DD				
666	*Cassinia aculeata*	Common Cassinia	46	45	2009	L				
667	*Cassinia arcuata*	Drooping Cassinia	53	52	2009	L				
668	*Cassinia longifolia*	Shiny Cassinia	23	21	2009	V				
669	*Cassinia trinerva*	Three-nerved Cassinia	5	4	2008	C	M			
672	*Cassytha melantha*	Coarse Dodder-laurel	16	12	2008	E				
674	*Cassytha pubescens*	Downy Dodder-laurel	17	16	2009	E				
706	*Centella cordifolia*	Centella	40	34	2009	E				
5614	*Centipeda elatinoides*	Elatine Sneezeweed	2	0	1997	C	M			
711	*Centrolepis aristata*	Pointed Centrolepis	0	0	1986	C				
716	*Centrolepis strigosa*	Hairy Centrolepis	3	2	2003	C				
726	*Chamaescilla corymbosa*	Blue Stars	5	2	2009	C				
744	*Chenopodium glaucum*	Glaucous Goosefoot	1	0	1989	NA				Not present pre-settlement
748	*Chenopodium pumilio*	Clammy Goosefoot	1	1	2009	NA				Not present pre-settlement
753	*Chiloglottis reflexa*	Autumn Bird-orchid	1	1	2007	C	M			
4888	*Chiloglottis valida*	Common Bird-orchid	8	5	2004	V				
756	*Chloris truncata*	Windmill Grass	0	0	1999	NA				Not present pre-settlement
1628	*Chrysocephalum semipapposum*	Clustered Everlasting	2	2	2007	C	M			
788	*Clematis aristata*	Mountain Clematis	29	25	2009	V				
7387	*Clematis decipiens*	a small-leafed clematis	12	11	2009	NA				Doubtfully indigenous
797	*Comesperma ericinum*	Heath Milkwort	1	0	2000	C	M			
801	*Comesperma volubile*	Love Creeper	20	19	2009	V				
817	*Coprosma hirtella*	Rough Coprosma	5	3	2007	C	M			
822	*Coprosma quadrifida*	Prickly Currant-bush	54	45	2009	V				
832	*Correa reflexa*	Common Correa	12	11	2007	E				
2698	*Corunastylis archeri*	Variable Midge-orchid	0	0		X	M			*Flora of Melbourne*
2705	*Corunastylis despectans*	Sharp Midge-orchid	2	0	1995	C	M			Braine 1946; Paget 1985; J&J Jeanes c.1995
837	*Corybas incurvus*	Slaty Helmet-orchid	0	0		X				*Flora of Melbourne*
846	*Cotula australis*	Common Cotula	8	8	2009	V				Not uncommon in lawns
4650	*Craspedia variabilis*	Variable Billy-buttons	1	1	2009	C				
860	*Crassula decumbens*	Spreading Crassula	12	13	2009	V				Not uncommon in lawns
862	*Crassula helmsii*	Swamp Crassula	10	7	2009	E				
866	*Crassula sieberiana* s.l.	Sieber Crassula	3	2	2003	V				
883	*Cryptostylis leptochila*	Small Tongue-orchid	6	5	2007	E	M			
884	*Cryptostylis subulata*	Large Tongue-orchid	4	2	2007	C				
903	*Cymbonotus preissianus*	Austral Bear's-ears	2	1	2004	C				
	Cynoglossum latifolium – see *Austrocynoglossum*									
910	*Cynoglossum suaveolens*	Sweet Hound's-tongue	12	12	2009	E				
926	*Cyperus lucidus*	Leafy Flat-sedge	2	1	2002	C	M			
	Danthonia – see *Rytidosperma*									
996	*Daviesia latifolia*	Hop Bitter-pea	25	23	2009	E				
1000	*Daviesia leptophylla*	Narrow-leaf Bitter-pea	13	11	2008	E				
2415	*Derwentia derwentiana*	Derwent Speedwell	1	1	2004	C	M			
1008	*Desmodium gunnii*	Southern Tick-trefoil	6	4	2004	E				
1016	*Deyeuxia densa*	Heath Bent-grass	1	1	2004	C	M			
1023	*Deyeuxia quadriseta*	Reed Bent-grass	53	48	2009	L				

FIS Code	Scientific Name	Common Name	# Sites		Most recent record	Threat Level				Comments or source of record
			Total	This study		Knox	Melb	State	National	
1024	*Deyeuxia rodwayi*	Tasman Bent-grass	1	1	2002	C	M			
5555	*Dianella admixta*	Black-anther Flax-lily	78	78	2009	L				
5084	*Dianella amoena*	Matted Flax-lily	2	2	2000	C	M	E	E	
1028	*Dianella longifolia* s.l.	Pale Flax-lily	51	46	2009	V				
1030	*Dianella tasmanica*	Tasman Flax-lily	24	20	2009	V				
1033	*Dichelachne crinita*	Long-hair Plume-grass	2	2	1997	C				
3792	*Dichelachne rara*	Common Plume-grass	26	22	2009	L				See note at end of table
3791	*Dichelachne sieberiana*	Plume-grass	3	2	2002	C	M			See note at end of table
1036	*Dichondra repens*	Kidney-weed	56	51	2009	L				
1050	*Dillwynia cinerascens*	Grey Parrot-pea	39	37	2008	V				
4501	*Dipodium roseum*	Hyacinth Orchid	18	15	2008	E				
5423	*Diuris chryseopsis*	Golden Moths	3	1	2001	C	M			
1079	*Diuris orientis*	Wallflower Orchid	4	2	2001	C				
1080	*Diuris pardina*	Leopard Orchid	1	0	2008	C				
1085	*Diuris sulphurea*	Tiger Orchid	1	0	2004	C				
1102	*Drosera peltata* subsp. *auriculata*	Tall Sundew	33	30	2009	V				
1107	*Drosera peltata* subsp. *peltata*	Pale Sundew	15	9	2006	E				
1108	*Drosera pygmaea*	Tiny Sundew	2	1	2002	C	M			
1110	*Drosera whittakeri*	Scented Sundew	22	15	2009	V				
1114	*Dysphania glomulifera*	Pigweed	1	1	2007	E	M			
1122	*Echinopogon ovatus*	Common Hedgehog-grass	4	1	2004	E				
1133	*Einadia nutans*	Nodding Saltbush	2	2	2009	NA				Arrived in Knox c. 2005
1138	*Elatine gratioloides*	Waterwort	2	2	2009	E	M			
1139	*Eleocharis acuta*	Common Spike-rush	16	15	2009	V				
1141	*Eleocharis gracilis*	Slender Spike-rush	4	3	2005	C	M			
1146	*Eleocharis sphacelata*	Tall Spike-rush	14	9	2009	L				
146	*Elymus scaber*	Common Wheat-grass	25	24	2009	L				
1155	*Empodisma minus*	Spreading Rope-rush	4	3	2007	V	M			
1681	*Epacris gunnii*	Ace of Spades	0	0	1928	X	M			FNCV reports, 1907 & 1928
4478	*Epacris impressa*	Common Heath	49	42	2008	V				
4445	*Epilobium billardierianum* subsp. *cinereum*	Variable Willow-herb	13	10	2009	V				
1179	*Epilobium hirtigerum*	Hairy Willow-herb	36	32	2009	L				
1185	*Eragrostis brownii*	Common Love-grass	38	31	2009	L				
1219	*Eriochilus cucullatus*	Parson's Bands	1	0	1985	C				Paget, 1985
1240	*Eryngium vesiculosum*	Prickfoot	1	1	1999	C	M			
1250	*Eucalyptus baxteri*	Brown Stringybark	1	0		C	M			
1258	*Eucalyptus camaldulensis*	River Red Gum	1	1	2008	C				
3733	*Eucalyptus cephalocarpa*	Mealy Stringybark	91	95	2009	V				Depleted over 3 generations
1267	*Eucalyptus cypellocarpa*	Mountain Grey Gum	12	8	2009	V				Depleted over 3 generations
5175	*Eucalyptus fulgens*	Green Scentbark	1	0	2002	C	M	R	R	L. Smith, unconfirmed
3732	*Eucalyptus goniocalyx*	Bundy, Long-leaf Box	78	79	2009	L				
1294	*Eucalyptus macrorhyncha*	Red Stringybark	44	45	2009	E				
1297	*Eucalyptus melliodora*	Yellow Box	49	48	2009	V				Depleted over 3 generations
1304	*Eucalyptus obliqua*	Messmate Stringybark	61	61	2009	V				Depleted over 3 generations
1307	*Eucalyptus ovata*	Swamp Gum	69	65	2009	V				Depleted over 3 generations
4335	*Eucalyptus polyanthemos*	Red Box	2	1	2001	E				
3828	*Eucalyptus radiata*	Narrow-leaf Peppermint	98	98	2009	E				Depleted over 3 generations
1315	*Eucalyptus rubida*	Candlebark	6	4	2003	C				
4487	*Eucalyptus viminalis* subsp. *pryoriana*	Coast Manna Gum	2	1	2007	C	M			
4463	*Eucalyptus viminalis* subsp. *viminalis*	Manna Gum	28	18	2008	E				Depleted over 3 generations

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1326	*Eucalyptus yarraensis*	Yarra Gum	4	5	2004	C	M	R	R	
1466	*Euchiton collinus*	Creeping Cudweed	28	23	2009	V				
1465	*Euchiton involucratus*	Common Cudweed	22	15	2009	E				
1471	*Euchiton sphaericus*	Star Cudweed	2	1	2007	E	M			
1338	*Euphrasia collina*	Purple Eyebright	0	0	1936	X	M			3 FNCV reports, 1918-36
1350	*Exocarpos cupressiformis*	Cherry Ballart	93	93	2009	V				
1353	*Exocarpos strictus*	Pale-fruit Ballart	13	13	2009	D1				
1394	*Gahnia radula*	Thatch Saw-sedge	81	78	2009	L				
1395	*Gahnia sieberiana*	Red-fruit Saw-sedge	16	12	2009	E				
1403	*Galium australe*	Tangled Bedstraw	2	0	2004	DD	M			
1409	*Galium gaudichaudii*	Rough Bedstraw	7	6	2007	E				
1413	*Galium propinquum*	Maori Bedstraw	3	1	2002	E				
4459	*Gastrodia sesamoides*	Cinnamon Bells	4	4	2002	C				
	Genoplesium – see *Corunastylis*									
5345	*Geranium gardneri*	Rough Cranesbill	4	3	2003	E	M			
1427	*Geranium homeanum*	Northern Cranesbill	4	3	2004	C	M			
1431	*Geranium potentilloides*	Cinquefoil Cranesbill	10	8	2004	V				
5343	*Geranium* sp. 2	Variable Cranesbill	9	6	2007	V				
5346	*Geranium* sp. 5 (‘*inundatum*’)	Naked Cranesbill	3	3	2008	C				
1445	*Glossodia major*	Wax-lip Orchid	1	1	1998	C				
1450	*Glossostigma cleistanthum*	Spoon Mud-mat	1	1	2009	E	M	R		Until 2004, not recorded within 200 km
1451	*Glyceria australis*	Australian Sweet-grass	7	6	2004	V				
1455	*Glycine clandestina*	Twining Glycine	20	16	2009	V				
3741	*Glycine microphylla*	Small-leaf Glycine	2	1	2004	E	M			
1484	*Gonocarpus humilis*	Shade Raspwort	5	4	2002	E				
3851	*Gonocarpus micranthus*	Creeping Raspwort	3	3	2002	C				
1489	*Gonocarpus tetragynus*	Common Raspwort	73	70	2009	L				
1496	*Goodenia elongata*	Lanky Goodenia	5	4	2007	C	M			
1503	*Goodenia humilis*	Swamp Goodenia	7	4	2007	E				
1504	*Goodenia lanata*	Trailing Goodenia	23	20	2009	NT				
1507	*Goodenia ovata*	Hop Goodenia	56	53	2009	L				
1517	*Goodia lotifolia*	Golden-tip	3	2	2004	C	M			
1524	*Gratiola peruviana*	Austral Brooklime	4	0	2004	C				
3747	*Gratiola pubescens*	Glandular Brooklime	4	2	2002	C	M			Died during drought at all known locations in Knox
3853	*Gynatrix pulchella*	Hemp Bush	15	10	2008	E				
5070	*Hakea decurrens*	Bushy Needlewood	0	0	1936	X				
1568	*Hakea nodosa*	Yellow Hakea	6	6	2009	C				
1574	*Hakea ulicina*	Furze Hakea	3	3	2004	C				
1584	*Haloragis heterophylla*	Varied Raspwort	2	1	2003	C				
1596	*Hardenbergia violacea*	Purple Coral-pea	32	31	2009	V				
1600	*Hedycarya angustifolia*	Austral Mulberry	1	0	1986	C	M			
2762	*Helichrysum luteoalbum*	Jersey cudweed	8	5	2009	V				
1626	*Helichrysum scorpioides*	Button Everlasting	26	19	2008	V				
1654	*Hemarthria uncinata*	Mat Grass	22	21	2009	V				
1675	*Hibbertia riparia*	Erect Guinea-flower	25	23	2009	E				
1705	*Hovea heterophylla*	Common Hovea	17	16	2008	V				
1718	*Hydrocotyle callicarpa*	Small Pennywort	1	0	2004	C				
1720	*Hydrocotyle foveolata*	Yellow Pennywort	7	7	2009	E				
1721	*Hydrocotyle geraniifolia*	Forest Pennywort	3	3	2008	E	M			
1722	*Hydrocotyle hirta*	Hairy Pennywort	17	15	2007	V				

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1723	*Hydrocotyle laxiflora*	Stinking Pennywort	3	1	1999	E				
1728	*Hydrocotyle sibthorpioides*	Shining Pennywort	0	1	2003	NA				In lawns, probably not natural
1729	*Hydrocotyle tripartita*	Slender Pennywort	5	0	1998	C	M			Lysterfield Hills, perhaps misidentified
	Hymenanthera - see *Melicytus*		1	0						
1741	*Hypericum gramineum*	Small St John's Wort	52	45	2009	E				
1743	*Hypericum japonicum*	Matted St John's Wort	1	1	2002	C	M			
4589	*Hypoxis hygrometrica*	Golden Weather-glass	7	4	2007	C				
3778	*Hypoxis vaginata*	Sheath Star	6	5	2005	E				
1760	*Imperata cylindrica*	Blady Grass	14	12	2009	E				
1761	*Indigofera australis*	Austral Indigo	16	16	2009	E				
1772	*Isolepis cernua* var. *cernua*	Nodding Club-rush	4	0	2003	E				
1783	*Isolepis cernua* var. *platycarpa*	a Club-rush	8	6	2002	E				
1775	*Isolepis fluitans*	Floating Club-rush	1	1	2002	C				
1777	*Isolepis hookeriana*	Grassy Club-rush	4	2	2003	E				
1779	*Isolepis inundata*	Swamp Club-rush	25	23	2009	V				
1780	*Isolepis marginata*	Little Club-rush	4	2	2003	E				
1793	*Isotoma fluviatilis*	Swamp Isotome	1	1	2002	C	M			
	Joycea pallida – see *Rytidosperma pallidum*									
1803	*Juncus amabilis*	Hollow Rush	39	38	2009	L				
1808	*Juncus australis*	Austral Rush	4	4	2009	C	M			
1810	*Juncus bufonius*	Toad Rush	29	23	2009	L				
1820	*Juncus gregiflorus*	Green Rush	37	29	2009	L				
1821	*Juncus holoschoenus*	Joint-leaf Rush	15	12	2009	C				See note at end of table
1830	*Juncus pallidus*	Pale Rush	47	45	2009	L				
1831	*Juncus pauciflorus*	Loose-flower Rush	7	6	2009	E				Scattered along stream channels
1833	*Juncus planifolius*	Broad-leaf Rush	16	12	2009	E				
1835	*Juncus procerus*	Tall Rush	25	20	2009	E				
1841	*Juncus sarophorus*	Broom Rush	39	38	2009	L				
1843	*Juncus subsecundus*	Finger Rush	29	30	2009	E				
1846	*Juncus vaginatus*	Clustered Rush	4	3	2008	C	M			
1847	*Kennedia prostrata*	Running Postman	10	10	2006	C				
1856	*Kunzea ericoides* spp. agg.	Burgan	59	53	2009	L				
149	*Lachnagrostis aemula*	Purplish Blown Grass	6	5	2002	C				
151	*Lachnagrostis filiformis*	Common Blown Grass	44	37	2009	L				
1861	*Lagenophora gracilis*	Slender Lagenophora	19	19	2009	V				
1863	*Lagenophora stipitata*	Common Lagenophora	14	10	2009	E				
3224	*Landoltia punctata*	Thin Duckweed	2	1	2004	C	M			
1893	*Lemna disperma*	Common Duckweed	11	9	2009	E				
1908	*Lepidium pseudohyssopifolium*	Pepper-cress	1	1	2009	C	M	K		
1919	*Lepidosperma elatius*	Tall Sword-sedge	25	21	2008	L				See note at end of table
1920	*Lepidosperma filiforme*	Common Rapier-sedge	5	4	2007	E	M			
4699	*Lepidosperma gunnii*	Slender Sword-sedge	36	36	2009	L				
1923	*Lepidosperma laterale*	Variable Sword-sedge	28	25	2009	V				See note at end of table
1927	*Lepidosperma neesii*	Stiff Rapier-sedge	1	1	2002	C	M			
1929	*Lepidosperma tortuosum*	Tortuous Rapier-sedge	1	0	1985	C	M			A. Paget, Bateman St bush
1947	*Leptorhynchos tenuifolius*	Wiry Buttons	17	15	2008	V				
1956	*Leptospermum continentale*	Prickly Tea-tree	58	56	2009	L				
1958	*Leptospermum lanigerum*	Woolly Tea-tree	6	6	2004	E				
1965	*Leptospermum scoparium*	Manuka	38	37	2009	E				

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1995	*Leucopogon virgatus*	Common Beard-heath	3	1	1998	C				
2017	*Linum marginale*	Native Flax	7	5	2008	E				
2024	*Lobelia anceps*	Angled Lobelia	17	13	2007	E				
4432	*Lobelia gibbosa*	Tall Lobelia	1	1	2002	C	M			
4709	*Lomandra filiformis* ssp. *coriacea*	Wattle Mat-rush	92	93	2009	L				
4710	*Lomandra filiformis* ssp. *filiformis*	Wattle Mat-rush	58	58	2009	L				
2046	*Lomandra longifolia*	Spiny-headed Mat-rush	77	75	2009	L				
2048	*Lomandra multiflora*	Many-flowered Mat-rush	2	1	2002	C				
2051	*Lomatia ilicifolia*	Holly Lomatia	2	2	2002	C	M			
3841	*Luzula meridionalis*	Common Woodrush	17	10	2007	V				
2085	*Lycopus australis*	Australian Gipsywort	4	3	2008	C	M			
2087	*Lyperanthus suaveolens*	Brown-beaks	2	0	2004	C				Probably destroyed, Phillippa Rd
2092	*Lythrum hyssopifolia*	Small Loosestrife	32	29	2009	V				
2133	*Mazus pumilio*	Swamp Mazus	1	0	1989	C	M			
2147	*Melaleuca ericifolia*	Swamp Paperbark	53	49	2009	E				
2154	*Melaleuca parvistaminea*	Rough-barked Honey-myrtle	2	1	2008	C	M			
2153	*Melaleuca squarrosa*	Scented Paperbark	3	3	2002	C				
4933	*Melicytus dentatus*	Tree Violet	8	8	2009	E				
2179	*Microlaena stipoides*	Weeping Grass	103	105	2009	L				
2182	*Microseris scapigera* spp. agg.	Yam-daisy	1	1	2008	C				
2187	*Microtis parviflora*	Slender Onion-orchid	24	16	2009	NT				
2188	*Microtis rara*	Sweet Onion-orchid	0	0		X	M			*Flora of Melbourne*
2189	*Microtis unifolia*	Common Onion-orchid	6	1	2009	C				
2222	*Montia fontana*	Water Blinks	1	1	2005	C	M			
2233	*Muellerina eucalyptoides*	Creeping Mistletoe	23	19	2007	C				Serious decline in drought
3867	*Myriophyllum crispatum*	Upright Milfoil	3	3	2004	C	M			
3873	*Myriophyllum* ?*simulans*	Amphibious Milfoil	2	0	1997	C	M			Probably already extinct
2916	*Myrsine howittiana*	Muttonwood	2	2	2008	C	M			
2221	*Neopaxia australasica*	White Purslane	1	0	1998	C	M			
	Notodanthonia – see *Rytidosperma*									
2299	*Olearia argophylla*	Musk Daisy-bush	7	5	2007	E	M			
2312	*Olearia lirata*	Snowy Daisy-bush	24	21	2008	V				
2316	*Olearia myrsinoides*	Silky Daisy-bush	13	10	2007	E				
4785	*Olearia ramulosa*	Twiggy Daisy-bush	2	2	2007	C				Possibly planted
2341	*Opercularia ovata*	Broad-leaf Stinkweed	28	22	2009	V				
2344	*Opercularia varia*	Variable Stinkweed	51	45	2009	V				
2370	*Orthoceras strictum*	Horned Orchid	1	1	2004	C	M			
2375	*Ottelia ovalifolia*	Swamp Lily	2	1	2005	C	M			
7311	*Oxalis exilis/perennans*	Wood-sorrel	66	63	2009	L				See note at end of table
1616	*Ozothamnus ferrugineus*	Tree Everlasting	62	58	2009	E				
1620	*Ozothamnus obcordatus*	Grey Everlasting	2	1	2002	C	M			One plant left in 2002, in Boronia
1624	*Ozothamnus rosmarinifolius*	Rosemary Everlasting	1	1	1997	C	M			
2399	*Pandorea pandorana*	Wonga Vine	33	29	2009	L				
2437	*Patersonia occidentalis*	Long Purple-flag	6	3	2007	C				
2442	*Pelargonium australe*	Austral Stork's-bill	1	0	1998	C				
2446	*Pelargonium inodorum*	Kopata	3	2	2004	C				
2456	*Pentapogon quadrifidus*	Five-awned Spear-grass	5	3	2007	E				
3919	*Persicaria decipiens*	Slender Knotweed	37	33	2009	L				

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2628	*Persicaria hydropiper*	Water-pepper	13	8	2008	E				
2630	*Persicaria lapathifolia*	Pale Knotweed	7	5	2004	E				
3938	*Persicaria praetermissa*	Spotted Knotweed	10	6	2008	E	M			
2635	*Persicaria prostrata*	Creeping Knotweed	1	1	2009	C	M			
2637	*Persicaria subsessilis*	Hairy Knotweed	9	6	2009	C	M			
2463	*Persoonia juniperina*	Prickly Geebung	2	2	2002	C				
531	*Pheladenia deformis*	Bluebeard Caladenia	0	0		X	M			*Flora of Melbourne*
2497	*Phragmites australis*	Common Reed	22	20	2009	E				
2515	*Pimelea axiflora*	Bootlace Bush	5	5	2002	C	M			
4832	*Pimelea curviflora*	Curved Rice-flower	8	7	2008	E				
2523	*Pimelea humilis*	Common Rice-flower	34	30	2009	V				
2540	*Pittosporum bicolor*	Banyalla	1	1	1997	C	M			
2555	*Plantago debilis*	Shade Plantain	3	3	2006	C	M			
2566	*Plantago varia*	Variable Plantain	19	18	2007	V				
2568	*Platylobium formosum*	Handsome Flat-pea	37	33	2008	V				
2569	*Platylobium obtusangulum*	Common Flat-pea	26	26	2008	V				
2584	*Poa clelandii*	Matted Tussock-grass	2	1	2004	C	M			
2590	*Poa ensiformis*	Purple-sheathed Tussock-grass	27	23	2009	L				
4694	*Poa labillardierei* var. *labillardierei*	Common Tussock-grass	13	8	2009	E				
2602	*Poa morrisii*	Soft Tussock-grass	80	75	2009	L				
2608	*Poa ?sieberiana*	Grey Tussock-grass	8	0	2004	DD				Probably all *P. morrisii*
2610	*Poa tenera*	Slender Tussock-grass	33	30	2007	E				
2643	*Polyscias sambucifolia*	Elderberry Panax	18	17	2009	E				
2650	*Pomaderris aspera*	Hazel Pomaderris	17	13	2008	E				
2660	*Pomaderris lanigera*	Woolly Pomaderris	1	1	1998	C	M			
2671	*Pomaderris racemosa*	Cluster Pomaderris	8	6	2004	C	M			
7704	*Poranthera microphylla*	Small Poranthera	64	57	2009	L				
2688	*Potamogeton crispus*	Curly Pondweed	7	4	2004	V	M			
2690	*Potamogeton ochreatus*	Blunt Pondweed	9	8	2009	V				
2691	*Potamogeton pectinatus*	Fennel Pondweed	1	1	2002	C	M			In a single settlement pond
2693	*Potamogeton tricarinatus* s.l.	Floating Pondweed	2	1	2005	C	M			
2699	*Prasophyllum australe*	Austral Leek-orchid	3	0	1970	X	M			Herbarium specimens from Boronia & Scoresby to 1970
2703	*Prasophyllum brevilabre*	Short-lip Leek-orchid	1	0		C	M			*Flora of Melbourne*
2709	*Prasophyllum frenchii*	Slaty Leek-orchid	1	0	1926	X	M	E	E	1926 herbarium specimen
2702	*Prasophyllum lindleyanum*	Green Leek-orchid	1	0	1930	X	M	R		3 specimens, 1906-30
2717	*Prasophyllum odoratum* s.l.	Sweet Leek-orchid	1	0	1926	C	M			1926 specimen
4871	*Prasophyllum pyriforme* s.s.	Silurian Leek-orchid	1	0	1930	X	M	K		1930 specimen; See the notes at the end of the table
4845	*Prostanthera lasianthos*	Victorian Christmas-bush	23	19	2008	E				
	Pseudognaphalium – see *Helichrysum luteoalbum*									
2818	*Pterostylis alpina*	Mountain Greenhood	2	2	2005	C				
2807	*Pterostylis atrans*	Dark-tip Greenhood	1	0	1924	X	M			1924 specimen, perhaps outside Knox
2791	*Pterostylis curta*	Blunt Greenhood	1	0	2001	C				Seen by John Jeanes in Boronia
2793	*Pterostylis decurva*	Summer Greenhood	1	0	1925	X	M			1925 specimen, perhaps outside Knox
2797	*Pterostylis falcata*	Sickle Greenhood	4	0		X	M			*Flora of Melbourne*
2800	*Pterostylis* × *ingens*	Sharp Greenhood	4	0	1985	X	M	R		Flora of Melbourne; seen by John Jeanes in Boronia
4131	*Pterostylis melagramma*	Tall Greenhood	10	7	2007	E				

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2806	*Pterostylis nutans*	Nodding Greenhood	21	17	2009	L				
4033	*Pterostylis parviflora*	Tiny Greenhood	1	0	1985	C				Gary Cheers, c.1980; Paget 1985
2810	*Pterostylis pedunculata*	Maroon-hood	6	3	2006	C				
2850	*Pultenaea gunnii*	Golden Bush-pea	27	24	2009	V				
2852	*Pultenaea hispidula*	Rusty Bush-pea	2	1	2003	C	M			Private land in Boronia
2864	*Pultenaea pedunculata*	Matted Bush-pea	2	2	2002	C	M			
2871	*Pultenaea scabra*	Rough Bush-pea	5	5	2009	C				
2907	*Ranunculus amphitrichus*	Small River Buttercup	1	0	1998	C	M			Hanson Quarry report, 1998
2893	*Ranunculus inundatus*	River Buttercup	2	1	2005	C	M			R. Brown, 2002
2894	*Ranunculus lappaceus*	Australian Buttercup	8	5	2007	E				
4910	*Ranunculus pumilio*	Fan-leaf Buttercup	1	0	1998	C	M			Hanson Quarry report, 1998
2956	*Rubus parvifolius*	Small-leaf Bramble	20	17	2008	E				
2968	*Rumex brownii*	Slender Dock	2	2	2005	C				
961	*Rytidosperma caespitosum*	Common Wallaby-grass	6	4	2009	E				
963	*Rytidosperma duttonianum*	Brown-back Wallaby-grass	1	1	1997	C	M			
964	*Rytidosperma erianthum*	Hill Wallaby-grass	2	2	2002	V				
965	*Rytidosperma geniculatum*	Kneed Wallaby-grass	14	11	2009	L				
967	*Rytidosperma laeve*	Smooth Wallaby-grass	30	29	2009	L				
4409	*Rytidosperma linkii* var. *fulvum*	Leafy Wallaby-grass	33	31	2009	L				
973	*Rytidosperma pallidum*	Silvertop Wallaby-grass	52	49	2009	L				
974	*Rytidosperma penicillatum*	Slender Wallaby-grass	65	62	2009	L				
975	*Rytidosperma pilosum*	Velvet Wallaby-grass	20	19	2008	V				
977	*Rytidosperma racemosum*	Clustered Wallaby-grass	63	65	2009	L				
979	*Rytidosperma semiannulare*	Tasmanian Wallaby-grass	24	19	2009	E				
4379	*Rytidosperma setaceum*	Bristly Wallaby-grass	53	52	2009	L				
981	*Rytidosperma tenuius*	Purplish Wallaby-grass	42	43	2009	L				
2999	*Sambucus gaudichaudiana*	White Elderberry	1	1	2002	C	M			
3039	*Schoenus apogon*	Common Bog-rush	57	49	2009	L				
3055	*Schoenus lepidosperma*	Slender Bog-rush	2	0	2001	C	M			Paget, 1985
3048	*Schoenus maschalinus*	Leafy Bog-rush	2	1	2002	C	M			
3056	*Schoenus tesquorum*	Soft Bog-rush	3	2	2002	C	M			
4958	*Senecio bathurstianus*	a fireweed	1	1	1997	C	M			
7136	*Senecio campylocarpus*	Floodplain Groundsel	4	4	2009	E	–	R		Recently described species
3107	*Senecio glomeratus*	Annual Fireweed	27	23	2009	L				
4959	*Senecio hispidulus*	Rough Fireweed	41	38	2009	L				
3115	*Senecio linearifolius*	Fireweed Groundsel	3	1	2004	C	M			
3119	*Senecio minimus*	Shrubby Fireweed	33	27	2009	E				
3120	*Senecio odoratus*	Scented Groundsel	1	0	1994	C	M			
3126	*Senecio prenanthoides*	Beaked Fireweed	19	18	2009	E				
3124	*Senecio quadridentatus*	Cotton Fireweed	52	48	2009	L				
3149	*Sigesbeckia orientalis*	Indian Weed	4	3	2008	C	M			
3169	*Solanum aviculare*	Kangaroo Apple	7	1	2007	C				
3179	*Solanum laciniatum*	Large Kangaroo Apple	26	22	2009	V				
3186	*Solanum prinophyllum*	Forest Nightshade	2	1	2004	C	M			
3195	*Solenogyne dominii*	Solenogyne	11	8	2009	V				
3196	*Solenogyne gunnii*	Solenogyne	1	2	2006	V				
4725	*Sphaerolobium minus*	Globe-pea	3	1	2008	C	M			

FIS Code	Scientific Name	Common Name	# Sites		Most recent record	Threat Level				Comments or source of record
			Total	This study		Knox	Melb	State	National	
3223	*Spiranthes australis*	Ladies' Tresses	1	0	2005	C	M			Winton Wetlands
	Spirodela - see Landoltia									
3235	*Spyridium parvifolium*	Australian Dusty Miller	13	11	2009	E				
3244	*Stackhousia monogyna*	Candles	20	19	2007	E				
3250	*Stellaria flaccida*	Forest Starwort	2	2	2002	C	M			
3255	*Stellaria pungens*	Prickly Starwort	3	1	2004	C				
	Stipa – see *Austrostipa*									
3303	*Stylidium armeria/graminifolium*	Grass Trigger-plant	27	21	2009	E				See notes at end of table
3304	*Stylidium inundatum*	Hundreds and Thousands	1	0	2003	C	M			
3345	*Tetraria capillaris*	Hair-sedge	2	1	2007	C	M			
3348	*Tetrarrhena juncea*	Forest Wire-grass	27	25	2009	L				
3351	*Tetratheca ciliata*	Pink-bells	8	7	2003	E				
3308	*Thelionema caespitosum*	Tufted Blue-lily	2	0	1997	C	M			
3361	*Thelymitra antennifera*	Rabbit-ears	0	0	1929	X	M			1929 FNCV report
5355	*Thelymitra arenaria*	Forest Sun-orchid	1	1	2004	C	–			
3362	*Thelymitra aristata*	Great Sun-orchid	0	0	1930	X	M			1929 FNCV report
3364	*Thelymitra carnea*	Salmon Sun-orchid	0	0	1929	X	M			
3372	*Thelymitra ixioides* group	Dotted Sun-orchid	4	2	2004	C				
3375	*Thelymitra luteocilium*	Fringed Sun-orchid	0	0		X	M	R		*Flora of Melbourne*
3379	*Thelymitra media*	Tall Sun-orchid	2	1	1999	C	M			
5914	*Thelymitra peniculata*	Trim Sun-orchid	17	11	2009	V				
3384	*Thelymitra rubra*	Salmon Sun-orchid	2	1	2003	C	M			
3387	*Themeda triandra*	Kangaroo Grass	81	81	2009	L				
3399	*Thysanotus patersonii*	Twining Fringe-lily	10	5	2009	V				
3400	*Thysanotus tuberosus*	Common Fringe-lily	6	5	2007	E				
3421	*Tricoryne elatior*	Yellow Rush-lily	35	30	2009	L				
4073	*Triglochin procera*	Water-ribbons	6	4	2005	C				
5513	*Triglochin striata* (flat leaf variant)	Streaked Arrowgrass	11	6	2009	E				
3468	*Typha domingensis*	Cumbungi	14	13	2008	E				
3470	*Typha orientalis*	Cumbungi	13	9	2009	E				
3476	*Urtica incisa*	Scrub Nettle	1	1	2002	C	M			
5364	*Utricularia dichotoma*	Fairies' Aprons	0	0	1906	X	M			1906 FNCV report
4040	*Vallisneria americana*	Lake Eel-grass	1	1	2009	C	M			
3503	*Veronica calycina*	Hairy Speedwell	7	6	2007	E				
3506	*Veronica gracilis*	Slender Speedwell	31	29	2009	V				
3512	*Veronica plebeia*	Trailing Speedwell	10	7	2009	E				
3521	*Villarsia reniformis*	Running Marsh-flower	3	2	2005	C	M			
3523	*Viminaria juncea*	Golden Spray	5	4	2004	C	M			
5058	*Viola hederacea*	Ivy-leaf Violet	51	42	2009	E				
3529	*Viola ?sieberiana*	Tiny Violet	1	0	1985	C	M			A. Paget at Bateman St Bush
3555	*Wahlenbergia gracilenta*	Annual Bluebell	1	0	2004	C				Hanson Quarry report, 1998
4069	*Wahlenbergia gracilis*	Sprawling Bluebell	18	18	2009	E				
3557	*Wahlenbergia gymnoclada*	Naked Bluebell	1	1	1998	C	M			
3560	*Wahlenbergia multicaulis*	Tadgell's Bluebell	3	2	2002	C	M			
3559	*Wahlenbergia stricta*	Tall Bluebell	7	6	2004	E				
3578	*Wolffia australiana*	Tiny Duckweed	4	3	2009	V	M			
4082	*Wurmbea dioica*	Common Early Nancy	14	11	2009	E				
3588	*Xanthorrhoea minor*	Small Grass-tree	34	32	2009	V				
4561	*Xanthosia dissecta*	Cut-leaf Xanthosia	21	16	2007	E				

Mosses and Liverworts

FIS Code	Scientific Name	Common Name	# Sites		Most recent
			Total	This study	
6009	*Achrophyllum dentatum*	Moss	1	0	2004
6042	*Atrichum androgynum*	Moss	1	0	2004
6079	*Breutelia affinis*	Common Breutelia	1	0	2004
6137	*Campylopus clavatus*	Broody Swan-neck Moss	7	7	2009
6140	*Campylopus introflexus*	Heath Star Moss	10	8	2009
9341	*Campylopus* sp.	Moss	3	2	2007
6262	*Fissidens asplenioides*	Moss	1	0	2004
6329	*Funaria hygrometrica*	Common Fire-moss	3	1	2009
6384	*Hypnodendron vitiense* subsp. *australe*	Umbrella Moss	1	0	2004
6387	*Hypnum cupressiforme*	Common Hypnum	6	6	2009
6557	*Polytrichum juniperinum*	Common Juniper-moss	2	1	2007
6588	*Ptychomnion aciculare*	Paper Moss	6	5	2007
6609	*Racopilum cuspidigerum* var. *convolutaceum*	Moss	1	0	2004
6099	*Rosulabryum billarderi*	Common Thread-moss	3	2	2009
6692	*Thuidiopsis furfurosa*	Golden Weft-moss	11	11	2009
6731	*Triquetrella papillata*	Moss	1	0	2004
6745	*Wijkia extenuata*	Spear Moss	1	0	2004
6447	*Chiloscyphus semiteres*	Green Worms	6	5	2009
6164	*Heteroscyphus fissistipus*	Crestwort	1	0	2004
6450	*Lunularia cruciata*	Moonwort	1	1	2009
6459	*Marchantia berteroana*	Liverwort	1	0	2004
6639	*Riccia crystallina*	Liverwort	1	1	2009

Poorly understood species

Acacia leprosa (Dandenong Range variant): According to Dr. N.G. Walsh at the National Herbarium of Victoria, this wattle may well be eventually described as a distinct species. It is abundant between the Dandenongs and North Ringwood.

Acaena agnipila, A. echinata and *A. ovina* (Sheep's Burrs) form a group of species whose distinctions are not well defined, in this author's view (after inspecting all specimens at the National Herbarium of Victoria and discussing them with Mr Jeff Jeanes, who provided the treatment of this group in *Flora of Victoria*). Specimens from Melbourne's eastern suburbs mostly do not fit the descriptions in standard references such as *Flora of Victoria*. The entry in the table above for *Acaena echinata* includes specimens that show characteristics of *A. agnipila* and *A. ovina*.

Calystegia sepium: Most records of this species in Knox investigated by the author appear to be misidentifications of the introduced *C. silvatica* or hybrids between the two species. The formation of hybrid swarms is discussed by J. Ogden in *NZ J. Botany* **16**:123-140 (1978) but has been little recognised by Victorian field botanists. Note that typical *C. sepium* has capsules ≤ 8 mm long. *C. sepium* is regarded here as Critically Endangered because of the apparent replacement by the extremely weedy introduced and hybrid *Calystegias*.

Cotula coronopifolia has been regarded by the Melbourne Royal Botanic Gardens as indigenous at some times and introduced at others. The most recent publication lists it as 'status uncertain'. It has been included in Appendix C with introduced species, but if it were to be regarded as indigenous, it would be listed above as rare (but not threatened) in Knox and not significant in a broader context. It has been recorded in eight sites in Knox, four of them in the 'Reserves' category.

Dichelachne spp.: *Flora of Victoria* (Walsh & Entwistle, 1994) recognises both *Dichelachne rara* and *D. sieberiana*. The distinguishing characteristics they quote are confounding in Knox, with characteristics of both species sometimes seen in individual plants. Although both names are listed in the table above on the basis of specimens collected and identified by Dr Lorimer, he has misgivings that there are scant grounds for recognition of two species.

Juncus holoschoenus: The distinction between *Juncus holoschoenus* and *J. fockei* is obscure. An expert on this group, L.A.S. Johnson, identified some herbarium specimens from the eastern suburbs of Melbourne as the latter species, and some years later changed all of his former identifications to *J. holoschoenus*, despite the fact that his current botanical key indicates otherwise. Regardless, there are two distinct taxa in and around Knox – one whose capsules are narrowly acute and exceed the sepals by about 1 mm, and the other with obtuse capsules that barely exceed the sepals. By the key in *Flora of Victoria* (Walsh and Entwistle, 1994), the former would be regarded as *J. fockei* and is fairly common in wetlands across Knox. In the species list above, we have opted to conform with Johnson's herbarium determinations and call all specimens from Knox *J. holoschoenus*, but with misgivings.

Lepidosperma: The name *Lepidosperma laterale* is widely applied to a range of forms that vary greatly from one another, particularly in size. Such a broad interpretation of *L. laterale* is unsatisfactory in the field as it fails to account for the apparent ecological variation that suggests more than one taxon is involved. In addition, the distinction between *L. laterale* and *L. gunnii* at the small-size extreme and between *L. laterale* and *L. elatius* at the large-size extreme is unclear. We have collected specimens which span the full range between these extremes. It is recognised that some botanists may call the largest specimens in Knox *L. laterale* var. *majus* (a name not presently accepted by the National Herbarium of Victoria) but the name *L. elatius* is used here.

Oxalis perennans: Some botanists recognise *O. exilis* as a distinct species from *O. perennans*, but the distinguishing characteristics of both species are often not discernible. We therefore lump these two entities together in a broad concept of *O. perennans*.

Prasophyllum pyriforme: This name is currently used to include five specimens collected in Knox long ago and initially identified as *P. frenchii*. Further investigation is needed to determine its taxonomic status; some authors treat it as conspecific with the South Australian *P. constrictum* (Backhouse and Jeanes, 1995).

Stylidium armeria/graminifolium: In Knox, even the progeny of a single plant can span the range of characters that are said to distinguish these two taxa. Tasmanian research has called the distinction into question.

Appendix C – Environmental Weeds of Knox

The table below lists 234 naturalised plant species that were recorded within remnant vegetation during fieldwork. A few inconsequential weeds that appear occasionally after recent soil disturbance have been omitted from the list. Nomenclature follows the same conventions as Appendix B.

The scientific names of weeds covered by the *Catchment and Land Protection Act 1994* are underlined.

The column headed 'Severity in Victoria generally' is taken from Carr, Yugovic and Robinson (1992). The categories defined by Carr *et al*. are:

V Very serious threat to one or more vegetation formations;
S Serious threat to one or more vegetation formations;
P Potential threat to one or more vegetation formations;
N Not a threat, but may have negative visual impact.

Presumably, category 'P' also includes weeds that pose some threat but are not serious.

A corresponding categorisation of weeds in Knox appears in the last column of the table below, with the four categories defined more precisely (see p.11). The author has drawn heavily on this project's fieldwork observations – particularly the frequency of each species' occurrence and the highest severity category that was assigned to it (see Section 2.4.3).

Scientific Name	Common Name	Severity in Victoria	Severity in Knox
Acacia baileyana	Cootamundra Wattle	V	P
Acacia decurrens	Early Black Wattle	V	N
Acacia elata	Cedar Wattle	V	P
Acacia floribunda	White-sallow Wattle	P	N
Acacia longifolia v. *longifolia*	Sallow Wattle	V	V
Acacia prominens	Gosford Wattle	S	N
Acacia provincialis (ex *retinodes*)	Wirilda	S	N
Acanthus mollis	Bear's Breach	P	N
Acer negundo	Box Elder	P	S
Acer pseudoplatanus	Sycamore Maple	V	S
Acetosa sagittata	Rambling Dock	-	S
Agapanthus praecox	Agapanthus	S	S
Agrostis capillaris	Brown-top Bent	V	S
Aira caryophyllea	Silvery Hair-grass	S	P
Aira cupaniana	Small Hair-grass	P	P
Aira elegantissima	Elegant Hair-grass	S	P
Allium triquetrum	Angled Onion	V	V
Alopecurus geniculatus	Marsh Fox-tail	S	P
Alopecurus pratensis	Meadow Fox-tail	P	P
Anagallis arvensis	Pimpernel	S	P
Anagallis minima	Chaffweed	P	P
Anthoxanthum odoratum	Sweet Vernal-grass	V	V
Araujia sericifera	White Bladder-flower	P	S
Arbutus unedo	Irish Strawberry Tree	P	P
Arctotheca calendula	Cape Weed	S	P
Arrhenatherum elatius var. *bulbosum*	Onion Twitch, False Oat-grass	P	P
Arundo donax	Giant Reed	P	S
Asparagus asparagoides	Bridal Creeper	V	S
Asparagus scandens	Asparagus Fern	V	V
Aster subulatus	Aster-weed	S	P
Atriplex prostrata	Hastate Orache	S	N
Avena barbata	Bearded Oat	S	N
Berberis darwinii	Darwin's Barberry	P	P
Bidens tripartita	Trifid Burr-marigold	-	S
Billardiera heterophylla	Bluebell Creeper	V	S
Brassica sp. (Lysterfield Rd roadside)	brassica	-	S
Briza maxima	Large Quaking-grass	V	V
Briza minor	Lesser Quaking-grass	P	N
Bromus catharticus	Prairie Grass	V	S
Bromus diandrus	Great Brome	V	S
Bromus hordeaceus	Soft Brome	S	N
Buddleja davidii	Butterfly-bush	S	P
Callitriche stagnalis	Water Starwort	P	S
Calystegia silvatica	Greater Bindweed	S	V
Cardamine flexuosa	Wood Bitter-cress	-	N
Cardamine hirsuta	Hairy Wood-cress	P	N
Centaurium erythraea	Common Centaury	S	S
Centaurium tenuiflorum	Branched Centaury	S	N
Cerastium glomeratum	Common Mouse-ear Chickweed	S	N
Cestrum elegans	Red Cestrum	S	V
Chamaecytisus palmensis	Tree Lucerne	V	S
Chlorophytum comosum	Spider Plant	-	P
Chrysanthemoides monilifera ssp. *monilifera*	Boneseed	V	V
Cicendia filiformis	Slender Cicendia	P	N
Cirsium vulgare	Spear Thistle	S	S
Conium maculatum	Hemlock	S	P
Conyza albida	Fleabane	S	S
Conyza bonariensis	Tall Fleabane	-	N
Coprosma repens	Mirror-bush	V	S
Coprosma robusta	Karamu	V	V
Cordyline australis	NZ Cabbage Tree	P	P
Cortaderia selloana	Pampas Grass	V	S
Cotoneaster divaricatus	Cotoneaster	V	S
Cotoneaster franchetii	Grey Cotoneaster	-	N
Cotoneaster glaucophyllus	Cotoneaster	V	S
Cotoneaster pannosus	Cotoneaster	V	S
Cotula coronopifolia[*]	Water Buttons	S	P
Crassula multicava	Shade Crassula	P	N
Crataegus monogyna	Hawthorn	V	V

[*] Possibly indigenous - see two pages up.

Scientific Name	Common Name	Severity in Victoria	Severity in Knox
Crepis capillaris	Smooth Hawksbeard	S	P
Crocosmia × *crocosmiiflora*	Montbretia	V	V
Cynara cardunculus	Spanish Artichoke	V	N
Cynodon dactylon var. *dactylon*	Couch	V	S
Cynosurus echinatus	Rough Dog's-tail	S	P
Cyperus eragrostis	Drain Flat-sedge	S	S
Cyperus tenellus	Tiny Flat-sedge	P	P
Cytisus scoparius	English Broom	V	V
Dactylis glomerata	Cocksfoot	S	S
Delairea odorata	Cape Ivy	V	V
Dodonaea viscosa	Sticky Hop-bush	-	N
Duchesnea indica	Indian Strawberry	-	P
Echinochloa crus-galli	Barnyard Grass	-	P
Echium plantagineum	Paterson's Curse	S	P
Egeria densa	Dense Waterweed	S	S
Ehrharta erecta	Panic Veldt-grass	V	V
Ehrharta longiflora	Annual Veldt-grass	V	S
Epilobium ciliatum	Glandular Willow-herb	P	P
Erica lusitanica	Spanish Heath	V	V
Erigeron karvinskianus	Seaside Daisy	-	P
Eriobotrya japonica	Loquat	-	N
Euphorbia peplus	Petty Spurge	-	N
Festuca arundinacea	Tall Fescue	S	P
Festuca rubra	Red Fescue	P	N
Foeniculum vulgare	Fennel	V	P
Fraxinus angustifolia	Desert Ash	V	S
Freesia alba x leichtlinii	Freesia	V	N
Fumaria bastardii	Bastards Fumitory	-	P
Fumaria capreolata	Ramping Fumitory	P	P
Galium aparine	Cleavers	V	V
Gamochaeta purpurea	Spiked Cudweed	S	N
Genista linifolia	Flax-leafed Broom	V	S
Genista monspessulana	Montpellier Broom	V	V
Gladiolus undulatus	Wild Gladiolus	V	S
Glyceria declinata	Manna Grass	P	P
Grevillea ×	Grevillea hybrids and cultivars	S	N
Grevillea rosmarinifolia	Rosemary Grevillea	S	N
Hakea salicifolia	Willow-leaf Hakea	V	P
Hedera helix	Ivy	V	V
Helminthotheca echioides	Ox-tongue	S	N
Holcus lanatus	Yorkshire Fog	V	S
Hypericum androsaemum	Tutsan	V	P
Hypericum tetrapterum	St Peter's Wort or Square-stem St John's Wort	P	V
Hypochoeris glabra	Smooth Cat's Ear	S	N
Hypochoeris radicata	Cat's Ear	S	S
Ilex aquifolium	Holly	V	P
Ipomoea indica	Lear's Morning-glory	S	P
Ixia polystachya	Variable Ixia	P	P
Jasminum ?*polyanthum*	Jasmine	-	P
Juncus acutus	Sharp (or Spiny) Rush	V	P
Juncus articulatus	Jointed Rush	V	V
Juncus bulbosus	Bulbous Rush	S	P
Juncus capitatus	Dwarf Rush	P	P
Juncus microcephalus	Tiny Rush	S	P
Juncus tenuis	Slender Rush	-	P
Kennedia rubicunda	Dusky Coral-pea	P	P
Kniphofia uvaria	Red Hot Pokers	P	N
Lactuca serriola	Prickly Lettuce	P	N
Leontodon taraxacoides	Hairy Hawkbit	S	P
Leycesteria formosa	Himalayan Honeysuckle	V	P
Ligustrum lucidum	Large-leafed Privet	P	P
Lilium formosanum	Lily	P	P
Linum trigynum	French Flax	P	S

Scientific Name	Common Name	Severity in Victoria	Severity in Knox
Lolium perenne	Perennial Rye-grass	S	N
Lonicera japonica	Japanese Honeysuckle	V	V
Lotus corniculatus	Bird's-foot Trefoil	V	P
Lotus suaveolens	Hairy Bird's-foot Trefoil	S	P
Lotus uliginosus	Greater Bird's-foot Trefoil	V	S
Lythrum junceum	Mediterranean Loosestrife	S	P
Malus × *domestica*	Domestic Apple	N	N
Medicago polymorpha	Burr Medic	S	N
Melaleuca armillaris	Bracelet Honey-myrtle	V	S
Melilotus indicus	Sweet Melilot	S	N
Mentha pulegium	Pennyroyal	S	N
Mentha spicata	Spearmint	S	P
Mentha ×*piperita*	Peppermint or Lemon Mint	S	P
Modiola caroliniana	Carolina Mallow	P	N
Myoporum insulare	Common Boobialla	-	N
Myosotis laxa subsp. *caespitosa*	Water Forget-me-not	S	P
Myosotis sylvatica	Wood Forget-me-not	S	P
Myriophyllum aquaticum	Parrot's-feather	P	V
Nephrolepis cordifolia	Fishbone Fern	-	N
Omalanthus nutans	Bleeding Heart	-	N
Oxalis incarnata	Pale Wood-sorrel	S	V
Oxalis pes-caprae	Soursob	V	V
Oxalis purpurea	Large-flower Wood-sorrel	S	P
Paraserianthes lophantha	Cape Wattle	V	P
Parentucellia viscosa	Sticky Bartsia	P	N
Paspalum dilatatum	Paspalum	V	V
Paspalum distichum	Water Couch	V	V
Passiflora mollissima	Banana Passionfruit	V	S
Pennisetum clandestinum	Kikuyu	V	S
Persicaria maculosa	Persicaria	P	P
Phalaris aquatica	Toowoomba Canary-grass	V	V
Phalaris arundinacea	Reed Canary-grass	V	P
Phalaris minor	Lesser Canary-grass	S	P
Phytolacca octandra	Red-ink Weed	S	P
Pinus pinaster	Maritime Pine	V	P
Pinus radiata	Monterey Pine	V	V
Pittosporum undulatum	Sweet Pittosporum	V	V
Plantago coronopus	Buck's-horn Plantain	S	P
Plantago lanceolata	Ribwort	S	S
Plantago major	Greater Plantain	P	P
Polygala myrtifolia	Myrtle-leaf Milkwort	V	P
Populus alba	White Poplar	P	P
Prunella vulgaris	Self-heal	-	P
Prunus cerasifera	Cherry-plum	V	S
Prunus laurocerasus	Cherry Laurel	V	P
Psoralea pinnata	Blue Psoralea	V	P
Pyracantha sp.	unidentified Fire-thorn	V	P
Quercus robur	English Oak	-	N
Ranunculus muricatus	Sharp Buttercup	-	N
Ranunculus repens	Creeping Buttercup	S	V
Raphanus raphanistrum	Wild Radish	-	N
Rhaphiolepis indica	Indian Hawthorn		N
Romulea rosea	Common Onion-grass	V	V
Rorippa nasturtium-aquaticum	Watercress	S	S
Rorippa palustris	Yellow Marsh-cress	S	S
Rosa rubiginosa	Sweet Briar	V	P
Rubus anglocandicans	Blackberry	V	V
Rubus ulmifolius	Blackberry	V	S
Rumex conglomeratus	Clustered Dock	S	S
Rumex crispus	Curled Dock	S	S
Rumex pulcher subsp. *pulcher*	Fiddle Dock	-	N
Salix babylonica s.l.	Weeping Willow	S	P
Salix cinerea	Grey Sallow	V	S

Scientific Name	Common Name	Severity in Victoria	Severity in Knox
Salix fragilis	Crack Willow	-	S
Salix × reichardtii	Pussy Willow	-	S
Salix × rubens	White Crack Willow	V	V
Salpichroa origanifolia	Pampas Lily-of-the-Valley	V	P
Selaginella kraussiana	Garden Selaginella	P	S
Senecio jacobaea	Ragwort	P	P
Sieglingia decumbens	Heath Grass	P	P
Sisyrinchium iridifolium	Striped Rush-leaf	P	P
Solanum americanum	Glossy Nightshade	P	P
Solanum mauritianum	Tobacco-bush	P	P
Solanum nigrum	Black Nightshade	S	S
Solanum pseudocapsicum	Madeira Winter-cherry	V	S
Sollya heterophylla – see *Billardiera*		V	S
Sonchus asper	Rough Sow-thistle	S	N
Sonchus oleraceus	Sow-thistle	S	P
Spergularia rubra s.l.	Red Sand-spurrey	P	N
Sporobolus indicus	Indian Rat-tail Grass	S	S
Stellaria media	Chickweed	S	N
Stenotaphrum secundatum	Buffalo Grass	-	P
Taraxacum sp.	Dandelion	P	N
Tradescantia fluminensis	Wandering Jew	V	V
Tragopogon porrifolius	Salsify	P	N
Trifolium campestre	Hop Clover	S	N
Trifolium dubium	Suckling Clover	S	P
Trifolium glomeratum	Cluster Clover	S	N
Trifolium pratense	Red Clover	P	N
Trifolium repens var. *repens*	White Clover	V	P
Trifolium subterraneum	Subterranean Clover	S	N
Tropaeolum majus	Nasturtium	P	P
Typha latifolia	Great Reedmace	V	P
Ulex europaeus	Gorse (Furze)	V	V
Verbena bonariensis	Purple-top Verbena	S	P
Viburnum tinus	Laurustinus	P	N
Vicia disperma	French Tiny Vetch	-	S
Vicia hirsuta	Tiny Vetch	P	S
Vicia sativa	Common Vetch	S	S
Vinca major	Blue Periwinkle	V	S
Viola odorata	Fragrant Violet	P	P
Vulpia bromoides	Squirrel-tail Fescue	V	S
Watsonia borbonica	Rosy Watsonia	S	P
Watsonia meriana var. *bulbillifera*	Bulbil Watsonia	V	V
Zantedeschia aethiopica	White Arum Lily	V	S

Appendix D – Fauna Species of Knox

The following lists include all reliable records of fauna in Knox, either from this study's fieldwork or from other observers who are believed to be reliable.

The numbers in the column headed 'Code' are the species' code numbers in the Atlas of Victorian Wildlife, which are almost the same as in the Census of Australian Vertebrate Fauna in the case of vertebrates. An asterisk before a common name indicates that the species is introduced.

Species with bold entries are listed as threatened under the federal *Environment Protection and Biodiversity Conservation Act 1999* (or EPBC Act). Underlining indicates species listed under the Victorian *Flora and Fauna Guarantee Act 1988*, either for their protection or (in the case of the Red Fox) as a 'threatening process'.

The 'Status' columns, headed 'LCC', 'Vic' and 'EPBC', refer to the species' conservation status as recognised by the Land Conservation Council (1991), the Victorian Department of Sustainability & Environment (2007) and the EPBC Act. The abbreviations in those columns have the following meanings:

- C: Critically Endangered;
- E: Endangered;
- N: Near Threatened;
- R: Rare;
- U: Uncommon;
- V: Vulnerable.

The year of the most recent reliable record of each species is given in the 'Most Recent' column.

Ordering of species in the table follows the current taxonomic sequence used by the Department of Sustainability & Environment.

Birds

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
9	Stubble Quail	*Coturnix pectoralis*				1994	No
10	Brown Quail	*Coturnix ypsilophora*	U	N		1994	No
199	Magpie Goose	*Anseranas semipalmata*	-	V		1994	No
216	Blue-billed Duck	*Oxyura australis*	R	E		2004	Yes
217	Musk Duck	*Biziura lobata*	U	V		1999	No
214	Freckled Duck	*Stictonetta naevosa*	R	E		1994	No
203	Black Swan	*Cygnus atratus*				2002	Yes
207	Australian Shelduck	*Tadorna tadornoides*	U			1999	No
202	Australian Wood Duck	*Chenonetta jubata*				2002	Yes
948	*Mallard	*Anas platyrhynchos*	U			2004	Yes
208	Pacific Black Duck	*Anas superciliosa*				2004	Yes
212	Australasian Shoveler	*Anas rhynchotis*	U	V		1999	No
211	Grey Teal	*Anas gracilis*				2002	Yes
210	Chestnut Teal	*Anas castanea*				2004	Yes
213	Pink-eared Duck	*Malacorhynchus membranaceus*	U			2002	No
215	Hardhead	*Aythya australis*	U	V		2004	Yes
61	Australasian Grebe	*Tachybaptus novaehollandiae*				2004	Yes
62	Hoary-headed Grebe	*Poliocephalus poliocephalus*				2001	No
60	Great Crested Grebe	*Podiceps cristatus*	U			2002	Yes
101	Darter	*Anhinga melanogaster*	U			2003	Yes
100	Little Pied Cormorant	*Phalacrocorax melanoleucos*				2003	Yes
99	Pied Cormorant	*Phalacrocorax varius*	U	N		1999	No
97	Little Black Cormorant	*Phalacrocorax sulcirostris*				2001	No
96	Great Cormorant	*Phalacrocorax carbo*				2002	Yes
106	Australian Pelican	*Pelecanus conspicillatus*				2004	Yes

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
188	White-faced Heron	*Egretta novaehollandiae*				2004	Yes
185	Little Egret	*Egretta garzetta*	U	E		1994	No
189	White-necked Heron	*Ardea pacifica*	U			2001	Yes
187	Great Egret	*Ardea alba*		V		2002	Yes
186	Intermediate Egret	*Ardea intermedia*		C		2002	No
977	Cattle Egret	*Ardea ibis*	U			2004	Yes
192	Nankeen Night Heron	*Nycticorax caledonicus*	U	N		1999	No
195	Little Bittern	*Ixobrychus minutus*	R	E		1994	No
197	Australasian Bittern	*Botaurus poiciloptilus*	R	E		1994	No
179	Australian White Ibis	*Threskiornis molucca*				2004	Yes
180	Straw-necked Ibis	*Threskiornis spinicollis*				2002	Yes
181	Royal Spoonbill	*Platalea regia*		V		2002	Yes
182	Yellow-billed Spoonbill	*Platalea flavipes*				2002	No
232	Black-shouldered Kite	*Elanus axillaris*				2003	Yes
228	Whistling Kite	*Haliastur sphenurus*	U			2004	Yes
226	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	R	V		1996	No
219	Swamp Harrier	*Circus approximans*				2001	No
221	Brown Goshawk	*Accipiter fasciatus*				2002	Yes
220	Grey Goshawk	*Accipiter novaehollandiae*	R	V		1994	No
222	Collared Sparrowhawk	*Accipiter cirrhocephalus*	U			1999	No
224	Wedge-tailed Eagle	*Aquila audax*	U			2000	No
225	Little Eagle	*Hieraaetus morphnoides*	U			2000	No
239	Brown Falcon	*Falco berigora*				2002	Yes
235	Australian Hobby	*Falco longipennis*	U			2002	Yes
236	Grey Falcon	*Falco hypoleucos*		E		1994	No
238	Black Falcon	*Falco subniger*		V		1983	No
237	Peregrine Falcon	*Falco peregrinus*	U			2002	Yes
240	Nankeen Kestrel	*Falco cenchroides*				2002	Yes
46	Buff-banded Rail	*Gallirallus philippensis*	R			2002	Yes
45	Lewin's Rail	*Rallus pectoralis*	R	V		1982	No
50	Baillon's Crake	*Porzana pusilla*	R	V		1999	No
51	Spotless Crake	*Porzana tabuensis*	R			c.1996	No
49	Australian Spotted Crake	*Porzana fluminea*	U			2000	No
58	Purple Swamphen	*Porphyrio porphyrio*				2004	Yes
56	Dusky Moorhen	*Gallinula tenebrosa*				2004	Yes
55	Black-tailed Native-hen	*Gallinula ventralis*	R			1997	No
59	Eurasian Coot	*Fulica atra*				2004	Yes
18	Little Button-quail	*Turnix velox*	R	N		1977	No
14	Painted Button-quail	*Turnix varia*	U			1994	No
168	Latham's (or Japanese) Snipe	*Gallinago hardwickii*	U	N		2004	Yes
157	Common Sandpiper	*Actitis hypoleucos*	U	V		1972	No
162	Red-necked Stint	*Calidris ruficollis*				1994	No
163	Sharp-tailed Sandpiper	*Calidris acuminata*	U			1994	No
161	Curlew Sandpiper	*Calidris ferruginea*				1994	No
146	Black-winged Stilt	*Himantopus himantopus*	U			1994	No
148	Red-necked Avocet	*Recurvirostra novaehollandiae*	R			1972	No
143	Red-capped Plover	*Charadrius ruficapillus*				1988	No
144	Black-fronted Dotterel	*Elseyornis melanops*	U			2004	Yes
132	Red-kneed Dotterel	*Erythrogonys cinctus*	U			2004	No
135	Banded Lapwing	*Vanellus tricolor*	R			1994	No
133	Masked Lapwing	*Vanellus miles*				2004	Yes
125	Silver Gull	*Larus novaehollandiae*				2004	Yes
112	Caspian Tern	*Sterna caspia*	U	N		1998	No
953	Common Tern	*Sterna hirundo*	R			1994	No
110	Whiskered Tern	*Chlidonias hybridus*	U	N		1998	No
957	*Rock Dove	*Columba livia*				2002	No
989	*Spotted Turtle-Dove	*Streptopelia chinensis*				2004	Yes
34	Common Bronzewing	*Phaps chalcoptera*				2004	Yes
35	Brush Bronzewing	*Phaps elegans*				2002	Yes

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
43	Crested Pigeon	*Ocyphaps lophotes*	R			2004	Yes
30	Peaceful Dove	*Geopelia striata*	R			1996	
267	Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*				2002	Yes
268	Gang-gang Cockatoo	*Callocephalon fimbriatum*				2002	Yes
273	Galah	*Cacatua roseicapilla*				2004	Yes
272	Long-billed Corella	*Cacatua tenuirostris*	U			1999	No
271	Little Corella	*Cacatua sanguinea*	U			2004	Yes
269	Sulphur-crested Cockatoo	*Cacatua galerita*				2004	Yes
274	Cockatiel	*Nymphicus hollandicus*	?			1999	No
254	Rainbow Lorikeet	*Trichoglossus haematodus*	U			2004	Yes
256	Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	R			2000	No
258	Musk Lorikeet	*Glossopsitta concinna*	U			2004	Yes
260	Little Lorikeet	*Glossopsitta pusilla*	U			2000	No
259	Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*	U			1999	No
281	Australian King-Parrot	*Alisterus scapularis*	U			2004	Yes
282	Crimson Rosella	*Platycercus elegans*				2003	Yes
288	Eastern Rosella	*Platycercus eximius*				2004	Yes
309	**Swift Parrot**	***Lathamus discolor***	R	E	E	1994	No
295	Red-rumped Parrot	*Psephotus haematonotus*				2004	Yes
306	Blue-winged Parrot	*Neophema chrysostoma*	U			1994	No
307	Elegant Parrot	*Neophema elegans*		V		1999	No
337	Pallid Cuckoo	*Cuculus pallidus*				2000	No
339	Brush Cuckoo	*Cacomantis variolosus*	U			1999	No
338	Fan-tailed Cuckoo	*Cacomantis flabelliformis*				2002	Yes
341	Black-eared Cuckoo	*Chrysococcyx osculans*	R	N		1982	No
342	Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*				2000	No
344	Shining Bronze-Cuckoo	*Chrysococcyx lucidus*				1999	No
248	Powerful Owl	*Ninox strenua*	U	V		2003	Yes
246	Barking Owl	*Ninox connivens*	R	E		1986	No
242	Southern Boobook	*Ninox novaeseelandiae*				2002	Yes
253	Sooty Owl	*Tyto tenebricosa*	U	V		2000	No
249	Barn Owl	*Tyto alba*				1994	No
313	Tawny Frogmouth	*Podargus strigoides*				2002	Yes
317	Australian Owlet-nightjar	*Aegotheles cristatus*				1994	No
334	White-throated Needletail	*Hirundapus caudacutus*				1999	No
335	Fork-tailed Swift	*Apus pacificus*	R			1998	No
319	Azure Kingfisher	*Alcedo azurea*	R	N		1998	No
322	Laughing Kookaburra	*Dacelo novaeguineae*				2004	Yes
326	Sacred Kingfisher	*Todiramphus sanctus*				2001	No
329	Rainbow Bee-eater	*Merops ornatus*	U			1994	No
318	Dollarbird	*Eurystomus orientalis*	R			1983	No
350	Superb Lyrebird	*Menura novaehollandiae*				1999	No
558	White-throated Treecreeper	*Cormobates leucophaeus*				2002	Yes
560	Red-browed Treecreeper	*Climacteris erythrops*	U			1999	No
555	Brown Treecreeper	*Climacteris picumnus*	U	N		1994	No
529	Superb Fairy-wren	*Malurus cyaneus*				2004	Yes
526	Southern Emu-wren	*Stipiturus malachurus*	U			1980	No
565	Spotted Pardalote	*Pardalotus punctatus*				2004	Yes
976	Striated Pardalote	*Pardalotus striatus*				2000	No
506	Pilotbird	*Pycnoptilus floccosus*				1999	No
488	White-browed Scrubwren	*Sericornis frontalis*				2003	Yes
498	Chestnut-rumped Heathwren	*Hylacola pyrrhopygia*	R	V		1972	No
500	Striated Fieldwren	*Sericornis fuliginosus*				1979	No
504	Speckled Warbler	*Chthonicola sagittata*	U	V		1998	No
465	Weebill	*Smicrornis brevirostris*				1998	No
463	Western Gerygone	*Gerygone fusca*	R			1999	No
494	Large-billed Scrubwren	*Sericornis magnirostris*	U			1980	No
453	White-throated Gerygone	*Gerygone olivacea*	U			1977	No
475	Brown Thornbill	*Acanthiza pusilla*				2004	Yes

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
484	Buff-rumped Thornbill	*Acanthiza reguloides*				1999	No
486	Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*				2000	No
471	Yellow Thornbill	*Acanthiza nana*				2000	No
470	Striated Thornbill	*Acanthiza lineata*				2004	Yes
638	Red Wattlebird	*Anthochaera carunculata*				2004	Yes
637	Brush Wattlebird	*Anthochaera chrysoptera*				2004	Yes
585	Striped Honeyeater	*Plectorhyncha lanceolata*				1994	No
645	Noisy Friarbird	*Philemon corniculatus*	U			1998	No
646	Little Friarbird	*Philemon citreogularis*	R			1972	No
603	**Regent Honeyeater**	***Xanthomyza phrygia***	R	C	E	1994	No
633	Bell Miner	*Manorina melanophrys*				2004	Yes
634	Noisy Miner	*Manorina melanocephala*				2004	Yes
605	Lewin's Honeyeater	*Meliphaga lewinii*				1998	No
614	Yellow-faced Honeyeater	*Lichenostomus chrysops*				2002	No
617	White-eared Honeyeater	*Lichenostomus leucotis*				2002	Yes
619	Yellow-tufted Honeyeater	*Lichenostomus melanops*	U			1994	No
625	White-plumed Honeyeater	*Lichenostomus penicillatus*				2002	Yes
583	Brown-headed Honeyeater	*Melithreptus brevirostris*				1999	No
578	White-naped Honeyeater	*Melithreptus lunatus*				2002	No
630	Crescent Honeyeater	*Phylidonyris pyrrhoptera*				1999	Yes
631	New Holland Honeyeater	*Phylidonyris novaehollandiae*				2004	Yes
591	Eastern Spinebill	*Acanthorhynchus tenuirostris*				2003	Yes
448	White-fronted Chat	*Epthianura albifrons*				1994	No
377	Jacky Winter	*Microeca fascinans*				2000	No
380	Scarlet Robin	*Petroica multicolor*				2000	No
381	Red-capped Robin	*Petroica goodenovii*	R			2000	No
382	Flame Robin	*Petroica phoenicea*				2002	Yes
384	Rose Robin	*Petroica rosea*				1999	No
383	Pink Robin	*Petroica rodinogaster*	U			2000	No
385	Hooded Robin	*Melanodryas cucullata*	R	N		1994	No
392	Eastern Yellow Robin	*Eopsaltria australis*				2002	Yes
443	Grey-crowned Babbler	*Pomatostomus temporalis*	R	E		1995	No
421	Eastern Whipbird	*Psophodes olivaceus*				2002	Yes
549	Varied Sittella	*Daphoenositta chrysoptera*				2000	No
416	Crested Shrike-tit	*Falcunculus frontatus*				2001	Yes
405	Olive Whistler	*Pachycephala olivacea*	U			1994	No
398	Golden Whistler	*Pachycephala pectoralis*				2002	Yes
401	Rufous Whistler	*Pachycephala rufiventris*				2002	Yes
408	Grey Shrike-thrush	*Colluricincla harmonica*				2002	Yes
373	Black-faced Monarch	*Monarcha melanopsis*	R			1939	No
365	Leaden Flycatcher	*Myiagra rubecula*	U			1999	No
366	Satin Flycatcher	*Myiagra cyanoleuca*	U			2000	No
369	Restless Flycatcher	*Myiagra inquieta*	U			2002	Yes
415	Magpie-lark	*Grallina cyanoleuca*				2004	Yes
362	Rufous Fantail	*Rhipidura rufifrons*				1999	No
361	Grey Fantail	*Rhipidura fuliginosa*				2003	Yes
364	Willie Wagtail	*Rhipidura leucophrys*				2004	Yes
424	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*				2002	Yes
430	White-winged Triller	*Lalage sueurii*	U			1998	No
671	Olive-backed Oriole	*Oriolus sagittatus*				2000	No
544	Masked Woodswallow	*Artamus personatus*	R			1998	No
545	White-browed Woodswallow	*Artamus superciliosus*	R			1994	No
547	Dusky Woodswallow	*Artamus cyanopterus*				2000	Yes
702	Grey Butcherbird	*Cracticus torquatus*				2002	Yes
700	Pied Butcherbird	*Cracticus nigrogularis*	?			2002	No
705	Australian Magpie	*Gymnorhina tibicen*				2004	Yes
694	Pied Currawong	*Strepera graculina*				2003	Yes
697	Grey Currawong	*Strepera versicolor*				2004	Yes
930	Australian Raven	*Corvus coronoides*				2004	Yes

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
954	Little Raven	*Corvus mellori*				2004	Yes
693	White-winged Chough	*Corcorax melanorhamphos*	U			1994	No
648	Singing Bushlark	*Mirafra javanica*	R			1994	No
993	*Skylark	*Alauda arvensis*				2000	No
647	Richard's Pipit	*Anthus novaeseelandiae*				1994	No
995	*House Sparrow	*Passer domesticus*				2002	Yes
994	*Eurasian Tree Sparrow	*Passer montanus*	U			2000	No
653	Zebra Finch	*Taeniopygia guttata*	?			1977	No
662	Red-browed Finch	*Neochmia temporalis*				2002	Yes
652	Diamond Firetail	*Stagonopleura guttata*	R	V		1994	No
997	*European Greenfinch	*Carduelis chloris*				2000	No
996	*European Goldfinch	*Carduelis carduelis*				2002	Yes
564	Mistletoebird	*Dicaeum hirundinaceum*				2000	No
358	White-backed Swallow	*Cheramoeca leucosternus*	?			1977	No
357	Welcome Swallow	*Hirundo neoxena*				2004	Yes
359	Tree Martin	*Hirundo nigricans*				2002	No
360	Fairy Martin	*Hirundo ariel*	U			2000	No
990	*Red-whiskered Bulbul	*Pycnonotus jocosus*				1999	No
524	Clamorous Reed Warbler	*Acrocephalus stentoreus*	U			2004	Yes
522	Little Grassbird	*Megalurus gramineus*	U			2001	No
509	Rufous Songlark	*Cincloramphus mathewsi*	U			1999	No
508	Brown Songlark	*Cincloramphus cruralis*	U			1994	No
525	Golden-headed Cisticola	*Cisticola exilis*				2004	Yes
574	Silvereye	*Zosterops lateralis*				2002	Yes
779	Bassian Thrush	*Zoothera lunulata*				1999	No
991	*Common Blackbird	*Turdus merula*				2004	Yes
992	*Song Thrush	*Turdus philomelos*	U			2004	Yes
999	*Common Starling	*Sturnus vulgaris*				2004	Yes
998	*Common Myna	*Acridotheres tristis*				2004	Yes

Mammals

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
1001	Platypus	*Ornithorhynchus anatinus*	U			2002	No
1003	Short-beaked Echidna	*Tachyglossus aculeatus*				2003	Yes
1028	Agile Antechinus	*Antechinus agilis*				1994	No
1033	Dusky Antechinus	*Antechinus swainsonii*				1997	No
1092	**Southern Brown Bandicoot**	***Isoodon obesulus obesulus***		N	E	1979	No
1165	Common Wombat	*Vombatus ursinus*				2002	No
1162	Koala	*Phascolarctos cinereus*	U			2002	No
1115	Mountain Brushtail Possum	*Trichosurus caninus*				1980	No
1113	Common Brushtail Possum	*Trichosurus vulpecula*				2003	Yes
1136	Yellow-bellied Glider	*Petaurus australis*	U			1987	No
1138	Sugar Glider	*Petaurus breviceps*				2004	No
1129	Common Ringtail Possum	*Pseudocheirus peregrinus*				2003	Yes
1133	Greater Glider	*Petauroides volans*				1987	No
1147	Feathertail Glider	*Acrobates pygmaeus*	U			1980	No
1265	Eastern Grey Kangaroo	*Macropus giganteus*	U			2003	Yes
1242	Black Wallaby	*Wallabia bicolor*				2003	Yes
1280	**Grey-headed Flying-fox**	***Pteropus poliocephalus***	R	V	V	2002	No
1324	White-striped Freetail Bat	*Tadarida australis*				2001	No
1349	Gould's Wattled Bat	*Chalinolobus gouldii*	U			1999	No

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
1351	Chocolate Wattled Bat	*Chalinolobus morio*				1988	No
1372	Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	U			1988	No
1341	Common Bent-wing Bat	*Miniopterus schreibersii* (grp)	U	CD†		2003	No
1335	Lesser Long-eared Bat	*Nyctophilus geoffroyi*				1998	No
1381	Large Forest Bat	*Vespadelus darlingtoni*				1994	No
1378	Southern Forest Bat	*Vespadelus regulus*				1999	No
1379	Little Forest Bat	*Vespadelus vulturnus*				1999	No
1415	Water Rat	*Hydromys chrysogaster*				2002	No
1438	Broad-toothed Rat	*Mastacomys fuscus*	U	N		1994	No
1412	*House Mouse	*Mus musculus*				2003	No
1395	Bush Rat	*Rattus fuscipes*				2001	No
1398	Swamp Rat	*Rattus lutreolus*				1983	No
1409	*Brown Rat	*Rattus norvegicus*	R			1997	No
1408	*Black Rat	*Rattus rattus*	U			2000	No
1836	*Dog	*Canis familiaris*				1994	Yes
1532	*Red Fox	*Canis vulpes*				2004	Yes
1536	*Cat (feral)	*Felis catus*				1994	Yes
1514	*Pig (feral)	*Sus scrofa*	R			1979	No
1511	*Brown Hare	*Lepus capensis*	U			2002	Yes
1510	*European Rabbit	*Oryctolagus cuniculus*				2004	Yes

† 'CD' stands for 'Conservation Dependent' and means that the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of five years.

Frogs

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
3134	Common Froglet	*Crinia signifera*				2008	Yes
3033	Victorian Smooth Froglet	*Geocrinia victoriana*				2003	No
3058	Southern Bullfrog	*Limnodynastes dumerilii*				2008	Yes
3061	Striped Marsh Frog	*Limnodynastes peronii*	U			2008	Yes
3918	Spotted Marsh Frog	*Limnodynastes tasmaniensis* SCR				2008	Yes
3103	Haswell's Froglet	*Paracrinia haswelli*	U			1981	No
3903	Southern Brown Tree Frog	*Litoria ewingii* (southern)				2008	Yes
3183	*Eastern Dwarf Tree Frog	*Litoria fallax*				2002	No
3204	Peron's Tree Frog	*Litoria peronii*	U			2003	No
3207	**Warty Bell Frog** (Growling Grass Frog)	***Litoria raniformis***	U	E	V	1999	No
3906	Verreaux's Tree Frog	*Litoria verreauxii verreauxii*				2002	No

Reptiles

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
2017	Common Long-necked Tortoise	*Chelodina longicollis*				2002	Yes
2194	Tree Dragon	*Amphibolurus muricatus*				1987	No
2283	Tree Goanna (or Lace Monitor)	*Varanus varius*	U	V		1991	No
2682	Eastern Three-lined Skink	*Bassiana duperreyi*				1994	No

Code	Common Name	Scientific Name	Status			Most Recent	This Study?
			LCC	Vic	EPBC		
2407	Swamp Skink	*Egernia coventryi*	U	V		2000	No
2408	Cunningham's Skink	*Egernia cunninghami*	U			1984	No
2938	Black Rock Skink	*Egernia saxatilis intermedia*				1989	No
2430	White's Skink	*Egernia whitii* (group)	U			1891	No
2986	unidentified water skink	*Eulamprus* sp.				1934	No
2450	Delicate Skink	*Lampropholis delicata*				2000	No
2451	Garden Skink	*Lampropholis guichenoti*				2003	No
2444	McCoy's Skink	*Nannoscincus maccoyi*				2000	No
2462	Metallic Skink	*Niveoscincus metallicus*				1998	No
2994	Southern Grass Skink	*Pseudemoia entrecasteauxii*				1999	No
2683	Glossy Grass Skink	*Pseudemoia rawlinsoni*	U	N		1994	No
2452	Weasel Skink	*Saproscincus mustelinus*	U			2000	No
2578	Blotched Blue-tongued Lizard	*Tiliqua nigrolutea*				2002	Yes
2580	Common Blue-tongued Lizard	*Tiliqua scincoides*				1991	No
2973	Lowland Copperhead	*Austrelaps superbus*				2001	Yes
2665	White-lipped Snake	*Drysdalia coronoides*	U			1989	No
2681	Tiger Snake	*Notechis scutatus*				2001	No
2650	Eastern Small-eyed Snake	*Rhinoplocephalus nigrescens*	U			1984	No

Comment [GSL4]: Scores by Transport Corridor EES

Fishes

Code	Common Name	Scientific Name	Status		Most Recent	This Study?
			Vic	EPBC		
4032	Broadfin Galaxias	*Galaxias brevipinnis*			2002	No
4035	Common Galaxias	*Galaxias maculatus*			2001	No
4041	**Dwarf Galaxias**	***Galaxiella pusilla***	V	V	1998	No
4101	Southern Pigmy Perch	*Nannoperca australis*			1997	No
4043	*Goldfish	*Carassius auratus*			2002	Yes
4046	*Roach	*Rutilus rutilus*			1996	No
4165	Flatheaded Gudgeon	*Philypnodon grandiceps*			2002	Yes
4002	Pouched Lamprey	*Geotria australis*			1985	No
4015	Shortfin Eel	*Anguilla australis*			2002	No
4026	*Rainbow Trout	*Oncorhynchus mykiss*			1997	No
4028	*Brown Trout	*Salmo trutta*			1996	No
4048	*Oriental Weatherloach	*Misgurnus anguillicaudatus*			1997	No
4069	*Mosquitofish	*Gambusia holbrooki*			2004	Yes
4105	*Redfin	*Perca fluviatilis*			1996	No

Comment [GSL5]: Peter Unmack, according to John McGuckin.

Butterflies

Code	Common Name	Scientific Name	Status		Most Recent	This Study?
			Vic	EPBC		
	Symmomus Skipper	*Trapezites symmomus symmomus*			2009	No
	Barred (or Dispar) Skipper	*Dispar compacta*			2002	No
	Doubleday's Skipper	*Toxidia doubledayi*			2002	No
	Spotted Skipper	*Hesperilla ornata ornata*			2002	No
	Bright Shield-skipper	*Signeta flammeata*			2002	No
	Tasmanica Skipper	*Pasma tasmanicus*	†		2002	No

Code	Common Name	Scientific Name	Status		Most Recent	This Study?
			Vic	EPBC		
	Banded Grass-skipper	*Toxidia parvulus*			2002	No
	Yellow-banded Dart	*Ocybadistes walkeri sothis*			2008	Yes
	White Grassdart	*Taractrocera papyria papyria*			2002	No
	Dingy (or Dainty) Swallowtail	*Papilio anactus*			2008	No
	Caper White	*Belenois java teutonia*			2007	Yes
	Wood White or Spotted Jezebel	*Delias agnippe*			2009	No
	Imperial White	*Delias harpalyce*			2003	Yes
	*Cabbage White	*Pieris rapae rapae*			2009	Yes
	Wanderer or Monarch	*Danaus plexippus*			2008	No
	Meadow Argus	*Junonia villida calybe*			2009	No
	Australian Admiral	*Vanessa itea*			2008	Yes
	Australian Painted Lady	*Vanessa kershawi*			2008	Yes
	Cyril's Brown	*Argynnina cyrila*			2008	Yes
	Eastern Ringed Xenica	*Geitoneura acantha ocrea*			2009	Yes
	Klug's Xenica	*Geitoneura klugii klugii*			2009	Yes
	Banks' Brown	*Heteronympha banksii*			2008	No
	Common Brown	*Heteronympha merope merope*			2009	Yes
	Shouldered Brown	*Heteronympha penelope*			2009	No
	Spotted Brown	*Heteronympha paradelpha paradelpha*			recent	No
	Swordgrass Brown	*Tisiphone abeona*			2009	Yes
	Long-tailed Pea-blue	*Lampides boeticus*			2002	Yes
	Doublespotted Lineblue	*Nacaduba biocellata biocellata*			2002	No
	Common Grass-blue	*Zizina labradus labradus*			2009	Yes
5007	Small Ant Blue	*Acrodipsas myrmecophila*	E		1942	No
	Common Imperial Blue	*Jalmenus evagora*			2002	Yes
	Silky Hairstreak	*Pseudalmenus chlorinda*			2001	No

† The Department of Sustainability & Environment regards the status of the Tasmanica Skipper as insufficiently known to conclude whether or not it is threatened.

Notable Other Invertebrates

Both species below are regarded by the Department of Sustainability & Environment as having an 'Data Deficient' conservation status, meaning that they are suspected to be threatened but with too little information to be confirmed. Neither species was seen by the author but both records are quite reliable.

Code	Common Name	Scientific Name	Most Recent	This Study?
5016	Caddisfly	*Plectrotarsus gravenhorstii*	1943	No
5029	Dandenong Freshwater Amphipod	*Austrogammarus australis*	1999	No

Appendix E – Example Bushland Neighbour Policy

22 LOCAL PLANNING POLICIES

22.09 BUSHLAND NEIGHBOURS

This policy applies to all properties that share a common boundary with the following sites of biological significance recognised under Schedule 2 of the Environmental Significance Overlay:

- W.G. Morris Reserve, Wantirna;
- Flamingo Reserve, Wantirna South (southern and western boundaries);
- Redcourt Reserve, Scoresby;
- …

and which are, or may become, subject to fire risk through proximity to native vegetation in the adjoining site of biological significance.

22.09-1 Policy Basis

This policy:

- Implements objectives in the SPPF, particularly the Net Gain policy and the statement, 'Responsible authorities should ensure that the siting of new buildings and works minimises the removal or fragmentation of native vegetation'.
- Responds to one of the threats to biodiversity and sites of biological significance identified in Clause *??* of the MSS. [to be inserted into the MSS]

Buildings that encroach too close to neighbouring bushland can become at risk from bushfire. There is often too little space to create a fire buffer on the same property as the building, leading to pressure for fire prevention works that ecologically damage the adjoining bushland by removal, fragmentation or weed invasion. It is preferable to prevent the encroachment and avoid the environmental damage.

22.09-2 Objectives

- To avoid encroachment of buildings so close to bushland in certain recognised sites of biological significance as to create an unreasonable fire risk.
- To save such bushland from pressure for ecologically harmful fire prevention works that may result from construction of buildings in close proximity.
- To favour fire protection measures on private land that is not biologically significant rather than within significant native vegetation.
- To achieve a net gain in habitat by seeking offsets for any ecological damage done to native vegetation as a result of providing fire protection for permitted buildings and subdivisions.

22.09-3 Policy

It is policy to:

- Refuse construction of buildings if their proximity to native vegetation in a nominated site of biological significance would create a bushfire risk so great as to require an increase in fire prevention work within the site of biological significance.
- Require management activities or installation of fire protection equipment in association with construction of buildings that would otherwise offend the policy above.
- Require that subdivision of allotments adjoining the nominated sites of significance must provide an adequate buffer for fire protection without materially harming native vegetation.
- Impose offset conditions that achieve a net gain in habitat if loss of native vegetation is unavoidable.

22.09-4 Decision guidelines

Before deciding on an application, the responsible authority will consider:

- The degree to which the objectives set out in Clause 22.09-2 above are expected to be achieved, and the degree of confidence in that expectation.
- The proximity of the proposed building (or potential building sites, in the case of subdivision) to significant native vegetation;
- For subdivision applications, the benefits offered by the use of building envelopes for meeting the objectives set out in Clause 22.09-2.
- The expected change in fire risk that would result from the proposed building or subdivision;
- The degree to which building construction will be accompanied by management activities or equipment installation on the same property that would reduce fire risk;
- The possible ecological damage that may be done to native vegetation by any increase in fire prevention work that would have to be done in the adjoining site of biological significance.
- The adequacy of any measures that compensate for any loss of native vegetation.

Glossary and Abbreviations

Alluvial An adjective referring to soil deposited by a stream or floodwater.

Biodiversity The range of flora, fauna, ecological communities and genetic material.

Biogeography The study of the geographical distributions of different types of flora and fauna, and the geographical factors which influence those distributions.

Conservation Significance This term has special meaning under Victoria's Native Vegetation Framework (NRE 2002a), in which it is defined by Table 5 (p.53) on the basis of such matters as the conservation status of the EVC present, the Habitat Score and the presence of listed wetlands, National Estate values or rare or threatened species.

DSE Department of Sustainability & Environment

EVC 'Ecological Vegetation Class', a type of vegetation or wetland recognised in a statewide system of classification developed by the Department of Sustainability and Environment. An EVC may include multiple vegetation 'communities' or 'associations' with different mixtures of species, but similar ecological and topographic conditions.

Habitat Score A measure of vegetation condition or quality within any area that is fairly uniform in its ecological characteristics, taking into account tree density, diversity of plant sizes and forms, weediness, degree of natural regeneration of flora, organic litter cover and presence of logs. It is a number in the range 0-1. The procedure for determining it is described by Parkes *et al*. (2003)

Herb In botanical terminology (and hence this report), a plant without any woody parts; e.g. an orchid, lily, rush or grass.

Invertebrate Fauna without backbones, such as insects, spiders, crustaceans and molluscs.

LPPF Local Planning Policy Framework, a section within any planning scheme in Victoria.

MSS Municipal Strategic Statement, a section in a planning scheme where the Council describes its strategic basis and framework for town planning.

Perennial Adjective. A perennial stream or water body is one that does not normally dry out.

Precautionary Principle The principle that (as written in the National Strategy for the Conservation of Australia's Biological Diversity) *'Lack of full knowledge should not be an excuse for postponing action to conserve biological diversity*, or as defined more generally in the Intergovernmental Agreement on the Environment: *'Where there are threats of serious or reversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by: (i) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and (ii) an assessment of the risk-weighted consequences of various options.'* This also appears (with slight re-wording) in Section 1C of the Victorian *Environment Protection Act 1970*.

Riparian An adjective meaning 'occurring beside a stream'. A riparian zone occurs along a stream and is directly influenced by the flowing water. A subriparian zone may occur adjacent to this.

SPPF State Planning Policy Framework, a section within any planning scheme in Victoria.

Vertebrate Fauna with backbones, including mammals, birds, amphibians, reptiles and fish.

VPPs Victoria Planning Provisions, on which all Victorian planning schemes are based.