Conservation Plan

for the
Barmah Landscape Zone

**Biodiversity Action Planning
in the
Shepparton Irrigation Region**

For Further Information:

Further information about Biodiversity Action Planning can be found at the following websites: www.dpi.vic.gov.au, www.dse.vic.gov.au and/or www.gbcma.vic.gov.au.

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EXECUTIVE SUMMARY

The **ultimate aim** of Biodiversity Action Planning (BAP) is to achieve broad-scale conservation of native biodiversity. BAP identifies priorities for the conservation of native biodiversity, as part of the implementation of the Victorian Biodiversity Strategy 1997. It is not a 'stand-alone' project; rather a process for translating objectives set out in Victoria's Biodiversity Strategy to Regional, Catchment and Local level (Victoria's Biodiversity Strategy fulfils a statutory requirement under Section 17 of the *Flora and Fauna Guarantee Act 1988* and provides the biodiversity action plan for Victoria).

To **translate objectives** from State to Regional, Catchment and Local Landscape level, Victoria was first divided on a bioregional basis (Bioregions) and then at a Landscape level (Landscape Zones). The 'Murray Fans Bioregional Plan' and the 'Shepparton Irrigation Region North Landscape Zone Plan' outline biodiversity priorities at the bioregional level. This 'Conservation Plan for the Barmah Landscape Zone' has been developed at the local (landscape) level and is intended to assist government agencies (primarily extension staff) and the community, to work in partnership towards achieving Catchment targets, by setting priority areas for protection and enhancement of native biodiversity. This Plan is also intended to enable biodiversity priorities, data and advice, to be disseminated through existing planning processes, to landholders and agencies.

The **methodology** used to develop this Plan is according to the 'Developer's Manual for Biodiversity Action Planning in the Goulburn Broken Catchment (GBCMA 2004a)'. Two important components of the BAP process are the 'focal species' approach and the 'key biodiversity assets' approach. The **focal species** approach uses the habitat requirements of a particular species, or a group of species, to define the attributes that must be present in a landscape, for these species to persist. Seven focal species have been suggested for the Barmah Landscape Zone including, Grey-crowned Babbler (*Pomatostomus temporalis*), Bush Stone-curlew (*Burhinus grallarius*), Superb Parrot (*Polytelis swainsonii*), Tree Goanna (*Varanus varius*), Squirrel Glider (*Petaurus norfolensis*), Brolga (*Grus rubicunda*) and Brown Treecreeper (*Climacteris picumnus*).

The **key biodiversity asset** approach is a method of grouping assets (e.g. birds, animals and plants) that use the same type of habitat. Seven key biodiversity assets were identified for the Barmah Landscape Zone including, Waterways, Wetlands, Public Land (Road/Rail/Bush Reserves), Plains Woodlands, Riverine Woodlands, Open Woodlands/Grasslands and Sand Woodlands. The grouping of these assets will assist in targeting the Very High value sites first, down to the lowest priority sites.

The **Barmah Landscape Zone** is located within the Goulburn Broken Catchment of Victoria. The Zone, which is approximately 154,057 hectares, is within the Murray Fans Bioregion and the Local Government areas of Moira, Campaspe and Greater Shepparton City Council. Significant remnant vegetation exists within the Zone that contains a higher proportion of remnant vegetation in comparison to other Zones in the Shepparton Irrigation Region.

Four hundred and six **priority environmental sites** were identified within the Barmah Landscape Zone. The priority sites have been determined and ranked (Very High, High, Medium or Low) based on factors such as; size, quality, Ecological Vegetation Class (EVC) conservation status, threatened species, landscape context and field surveying. These sites contain remnant vegetation and vary greatly in size, from a stand of paddock trees, to areas such as the Barmah Forest. In general, the surveyed sites within the Zone were found to have an average abundance of fallen timber, presence of native vegetation regeneration (recruitment) and good understorey at a range of sites.

Management actions (advisory only) have been developed for the Barmah Landscape Zone, based on the results of desktop analysis and surveying. It is intended that government agencies and the community work together to incorporate these actions into existing documents, projects and strategies for the benefit of biodiversity conservation in the Barmah Landscape Zone, as well as the Shepparton Irrigation Region and the Goulburn Broken Catchment.

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Individual Site Management Plans

Figure 1: BAP Process

The ultimate aim of Biodiversity Action Planning (BAP) is to achieve broad-scale conservation of native biodiversity. BAP identifies priorities for the conservation of native biodiversity as part of the implementation of the Victorian Biodiversity Strategy (Crown 1997). In particular, it aims to;

- Conserve native biodiversity[1] by maintaining viable examples of the range of ecosystems that occur naturally in Victoria,
- Promote a more strategic and cost-effective expenditure of public funds for the protection, restoration and ongoing management of priority biodiversity sites, and
- Achieve community support for biodiversity landscape planning and the conservation of strategic assets in rural landscapes (Platt & Lowe 2002).

In order to achieve these aims, effective planning for native biodiversity also requires detailed planning at a Bioregional and Landscape level. Therefore, Victoria was first divided on a Bioregional basis (Appendix 1) and then at a landscape level (Landscape Zones) (Appendix 2).

At the Regional scale the 'Bioregional Strategic Overview for the Murray Fans Bioregion' and more specifically (to the Shepparton Irrigation Region (SIR)), the 'Landscape Plan for the Goulburn Broken Catchment – SIR - North Zones', identify the broad priorities for biodiversity conservation in the Region. They also provide the foundation for producing detailed plans, such as the 'Conservation Plan for the Barmah Landscape Zone' (Ahern *et al* 2003). At the Landscape level, this Plan is intended to provide a biodiversity conservation resource for the community. Figure 1 illustrates the BAP process and where the Conservation Plan for the Barmah Landscape Zone (as per underlined) fits within a policy context.

1.2 OBJECTIVES

The 'Conservation Plan for the Barmah Landscape Zone' has been developed at the local (Landscape) level and is intended to assist government agencies (primarily extension staff) and the community, to work in partnership towards achieving Catchment targets and set priority areas for the protection and enhancement of native biodiversity. This Plan aims to assist in private and public resources being expended and targeted to priority sites for priority actions. It identifies 406 priority sites, ranging across Very high, High, Medium or Low value. The protection and management of these priority sites is important for the conservation of flora and fauna in the Zone area. This Plan is intended primarily for use by extension officers, as well as the community, to guide the strategic and coordinated management of conservation in the area.

Broadly, this Plan details;
- The landscape, vegetation and significant flora and fauna of the Barmah Landscape Zone,
- Conservation vision for the Barmah Landscape Zone,
- Priority assets to be conserved, their biodiversity value and threatening processes,
- Actions to protect and restore these assets, and
- Monitoring opportunities for the Barmah Landscape Zone.

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[1] Biodiversity: the natural variety of life: the sum of our native plants and animals, the genetic variations they contain, and the natural ecosystems they form (GBCMA 2000).

1.3 A VISION FOR CONSERVATION

The Goulburn Broken Regional Catchment Strategy (RCS) identifies a vision for biodiversity in the catchment. The vision is that "the community will work in partnership with Federal and State Governments and other agencies, to protect and enhance ecological processes and genetic diversity, to secure the future of native species of plants, animals and other organisms in the Catchment" (GBCMA 2003 p87). The Conservation Plan for the Barmah Landscape Zone aims to assist in achieving this vision through providing a basis for a strategic and coordinated tool for the conservation of priority assets.

The RCS also identifies targets and priorities for the Catchment (refer to Appendix 3 for further detail). It is intended that the actions outlined in this Plan will complement the targets of the RCS and other policy/strategies pertinent to the State, Catchment and Region (e.g. Victoria's Native Vegetation Management – A Framework for Action (NRE 2002a); Goulburn Broken Native Vegetation Management Plan (GBCMA 2000); and the Victorian River Health Strategy (NRE 2002b)). This Plan is also intended to integrate such policies (e.g. targets and legislative requirements) into the one document, for use by local communities. For example this Plan incorporates aspects of legislation (e.g. Action Statements prepared under the *Flora and Fauna Guarantee Act 1988*), into recommended on-ground actions, for the conservation of threatened species and communities.

The BAP process uses current scientific knowledge to produce an 'ideal' landscape for biodiversity conservation. This 'ideal' landscape provides for the current level of species abundance, diversity and interactions. BAP also attempts to take a strategic approach to the conservation of threatened and declining species and vegetation types, by looking for opportunities to conserve groups of species in appropriate or 'ideal' ecosystems (Platt & Lowe 2002). The approaches used in Biodiversity Action Planning (e.g. focal species and assets) also provide additional tools for the community and allow for the use of principles of landscape ecological science to conserve biodiversity. It is therefore intended that this Conservation Plan for the Barmah Landscape Zone will assist government agencies and the community to work in partnership towards achieving Catchment targets and an 'ideal' landscape, by setting priority areas for protection and enhancement of native biodiversity.

This Plan is not intended to be a method of 'taking over' land, but rather a resource document that assists with identifying priority assets and methods of action, to protect or restore valuable assets, through voluntary extension principles. This document may be used by agencies and community groups for informing existing projects and for strategic planning. However it must be remembered that this document is by no means 'comprehensive', as the BAP process relies on the regular updating of information, to keep it accurate and timely. This Plan has been developed to be adaptive so as to enable management actions and information to be modified in response to further information (e.g. monitoring). This Plan also forms the basis for the explanation of the Biodiversity Action Planning process and the associated mapping tool.

Therefore this Plan will be reviewed when necessary to ensure that it remains a 'living' document. It is also intended that extension staff will utilise Geographical Information System (GIS) programs, databases and other agency staff, to fully identify and understand the BAP process and to provide further information to the community. Consultation (refer to Appendix 4) and extension with relevant stakeholders, including agencies and community groups, was conducted (and will continue to occur) throughout the development and implementation of this Plan. A Communication Plan was also developed in order to guide Biodiversity Action Planning. In summary, it is envisaged that this Plan will be a valuable resource for identifying priority biodiversity sites and initiating further conservation works in the Zone and that at a later stage will lead to further sites and projects being identified by interested individuals and groups.
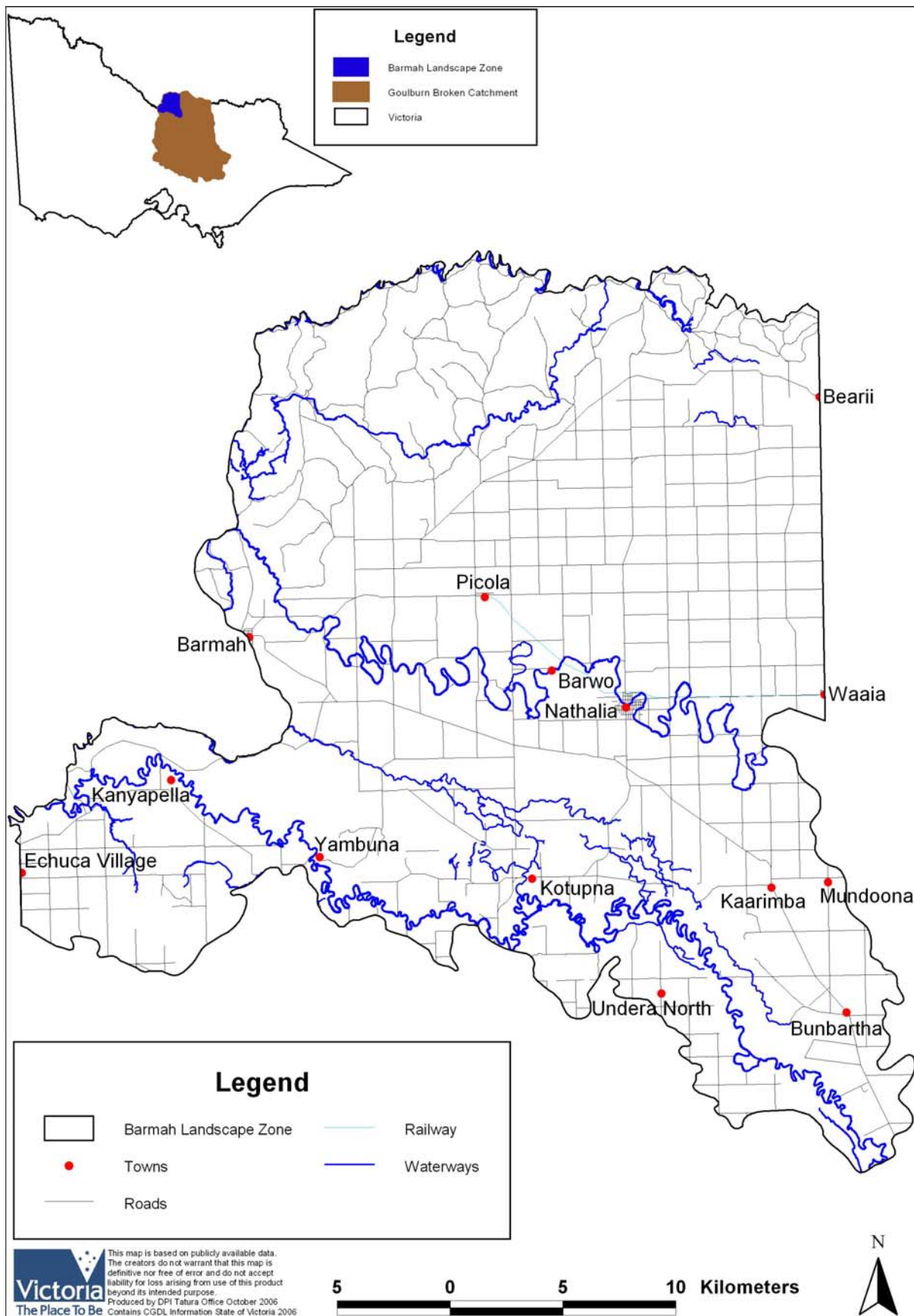
Figure 2a: (Main) Barmah Landscape Zone
Figure 2b: (Inset) Victoria, the Goulburn Broken Catchment and the Barmah Landscape Zone

2.1 LANDSCAPE

The Barmah Landscape Zone (Figure 2a) is located within the Goulburn Broken Catchment of Victoria (Figure 2b). The Zone (approximately 154,057 hectares) falls within the Murray Fans Bioregion and the Local Government areas of Moira, Campaspe and Greater Shepparton City Council. The Zone is bounded to the North by the Murray River, the South by the Murray Fans Bioregional boundary (South of the Goulburn River) and to the East by the Waaia-Bearii Road. The Western boundary extends South from Echuca Village to the Murray Valley Highway. The Murray Valley Highway and the Goulburn Valley Highway are the major regional roads traversing the Zone (Ahern *et al* 2003).

Two main land systems are present within the Zone – floodplain and riverine plain. The floodplain landform is approximated by the distribution of River Red Gum (*Eucalyptus camaldulensis*) forests, typically along the Murray River, whilst the riverine plain component is characteristically well drained. Within both landforms a number of distinct and significant landscape components exist. Some of these include the Barmah Forest, Goulburn River floodplain, Broken Creek, Kanyapella Basin and the Deep Creek System (Ahern *et al* 2003).

The Zone falls across two drainage basins, the Goulburn and Broken River Basins. These basins are separated just South of the Broken Creek (LCC 1989). The Broken Creek flows East-West through the Zone and enters the Murray River North of the Barmah Township. The Goulburn River flows North-West through the Zone and enters the Murray River to the West of Kanyapella Basin. Drainage diversion points occur along the Goulburn River to service irrigation channels. The Deep Creek System (incorporating Skeleton and Sheepwash Creeks) is a depression that exists between the Goulburn and Broken Creek, commencing near Kaarimba and entering the Murray River at Lower Moira (Ahern *et al* 2003).

The Barmah Landscape Zone has the lowest proportion of private (freehold) land to public land of any in the Shepparton area (Ahern *et al* 2003). Private land covers approximately 80% of the Zone (CGDL 2005). A significant proportion of private land contains large stands of remnant vegetation including the Lower Goulburn area, wetlands and billabongs along the riverine plain of the Deep Creek system and remnants adjacent to the Barmah Forest. Within the freehold land area, land use is varied due to the differing soils and the large extent of the Zone (e.g. from Echuca to Bunbartha to Picola). Some examples of land-use include dairy, cropping, mixed cropping and grazing (sheep and beef), horticulture and lifestyle (Ahern *et al* 2003).

Public land covers approximately 20% of the Zone (CGDL 2005). It is predominantly associated with the floodplain land systems, along the Murray and Goulburn Rivers (e.g. Barmah Forest). Barmah Forest supports one of the most extensive tracts of River Red Gum forest in Victoria and is in the *Ramsar List of Wetlands of International Importance* (EA 2002) and in *A Directory of Important Wetlands in Australia* (EA 2001). Other significant examples of public land include river and creek frontages (e.g. Goulburn River and the Broken Creek), associated forests (e.g. Echuca Regional Park and Kanyapella Basin), roadsides (e.g. Murray Valley Highway and the Shepparton-Barmah Road), Bushland Reserves (e.g. Yielima and Kaarimba) and Rail Reserves (e.g. Picola-Numurkah Railway Line) (Ahern *et al* 2003).

Plate: The Yielima Bushland Reserve is an example of 'public land' in the Barmah Landscape Zone

2.2 VEGETATION

Ecological Vegetation Class (EVC) is a vegetation classification system, derived from groupings of vegetation communities based on floristic, structural and ecological functions. Mosaics (combinations of EVCs) are a mapping unit, where the individual EVCs could not be separated, at the scale of 1:100,000 (Berwick 2003).

Prior to European settlement 24 EVCs[2] were known to have been present within the Barmah Landscape Zone (Figure 3). The floodplain system consisted of a mixture of River Red Gum (*Eucalyptus camaldulensis*) dominated EVCs, including Riverine Grassy Woodland/Sedgy Riverine Forest/Wetland Formation Mosaic, flanked in places by patches of Sand Ridge Woodland. Parts of the Riverine Plain directly adjacent to the floodplain system (e.g. Picola area) typically supported Riverine Grassy Woodland, Riverine Chenopod Woodland or Riverine Grassy Woodland/Plains Woodland/Riverine Chenopod Woodland Complex. Drainage Line Complex EVC would have characterised the Deep Creek system. On the riverine plain further away from the drainage lines, Plains Grassy Woodland and Plains Woodland would have dominated. Grey Box (*Eucalyptus microcarpa*), Buloke (*Allocasuarina leuhmannii*) and White Cypress-pin (Murray Pine) (*Callitrus glaucophylla*) would have dominated these better-drained woodlands, whilst Black Box (*Eucalyptus largiflorens*), would have been more prevalent towards the Murray River (Ahern *et al* 2003).

Plains Woodland communities on the riverine plains would typically have consisted of open woodlands, with an understorey of scattered shrubs and a high species diversity of grasses, lilies, orchids, herbs and sedges. The overstorey component was generally comprised of Grey Box, White Box (*Eucalyptus albens*) and/or Yellow Box (*Eucalyptus melliodora*). Wattles (*Acacia spp*) and Pea species (e.g. *Daviesia spp*.) provided the majority of the understorey component, whilst the groundcover would have generally comprised of grasses (e.g. *Austrodanthonia* and *Stipa spp*) and chenopods (e.g. *Atriplex spp*) (Berwick 2003).

Creekline Grassy Woodland and Drainage Line Complex EVC were typically located along ephemeral drainage lines (e.g. creeks) on the riverine plains and floodplains. The creeks and major depressions typically supported an overstorey of River Red Gum, an understorey of Wattles and were generally lined with tall sedges (e.g. *Carex spp*). The Drainage Line Complex EVC typically varied from grassy wetlands to open herblands, sedgelands and may have developed to Red Gum Wetlands in some areas (Berwick 2003).

Wetlands typically differed in their structure due to seasonal and temporal variations. Red Gum Wetlands were typically dominated by River Red Gum, sedges (e.g. *Eleocharis spp*) and rushes (e.g. *Juncus spp*). Plains Grassy Wetlands would have occurred in shallow depressions on the alluvial plains, where meanders of prior steams occurred. These shallow seasonal wetlands were typically treeless, with a grassland structure grading into sedgeland or herbland (Berwick 2003).

The current extent of native vegetation in the Zone has reduced (Figure 4) since European settlement. Figures 3 and 4 are included primarily to illustrate the comparison between vegetation cover from European settlement to the current extent. Table 1 further identifies the EVCs in the Barmah Landscape Zone, including their Bioregional Conservation Status (BCS), their pre-European settlement extent and current (as of 2003) extent (in hectares and % cover). Table 1 also identifies the area of 'Private Land No Tree Cover' and Unknown/Unclassified EVCs (Ahern *et al* 2003).

The Goulburn Broken Regional Catchment Strategy (RCS) identifies goals and targets that have been set for the vegetation communities within the Catchment (Appendix 3). This includes 'increasing the cover of all 'Endangered' and 'Vulnerable' (where applicable[3]) EVCs to at least 15% of their pre-European vegetation cover by 2030' (GBCMA 2003). A number of EVCs within the Barmah Landscape Zone are below the 15% target (Table 1) and are therefore considered 'Endangered' (17) or 'Vulnerable' (6) at the Bioregional level (Ahern *et al* 2003).

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[2] For further information on each EVC, refer to the Department of Sustainability and Environment website at www.dse.vic.gov.au
[3] Applicable to Ecological Vegetation Classes that are 'Vulnerable' and are below 15%
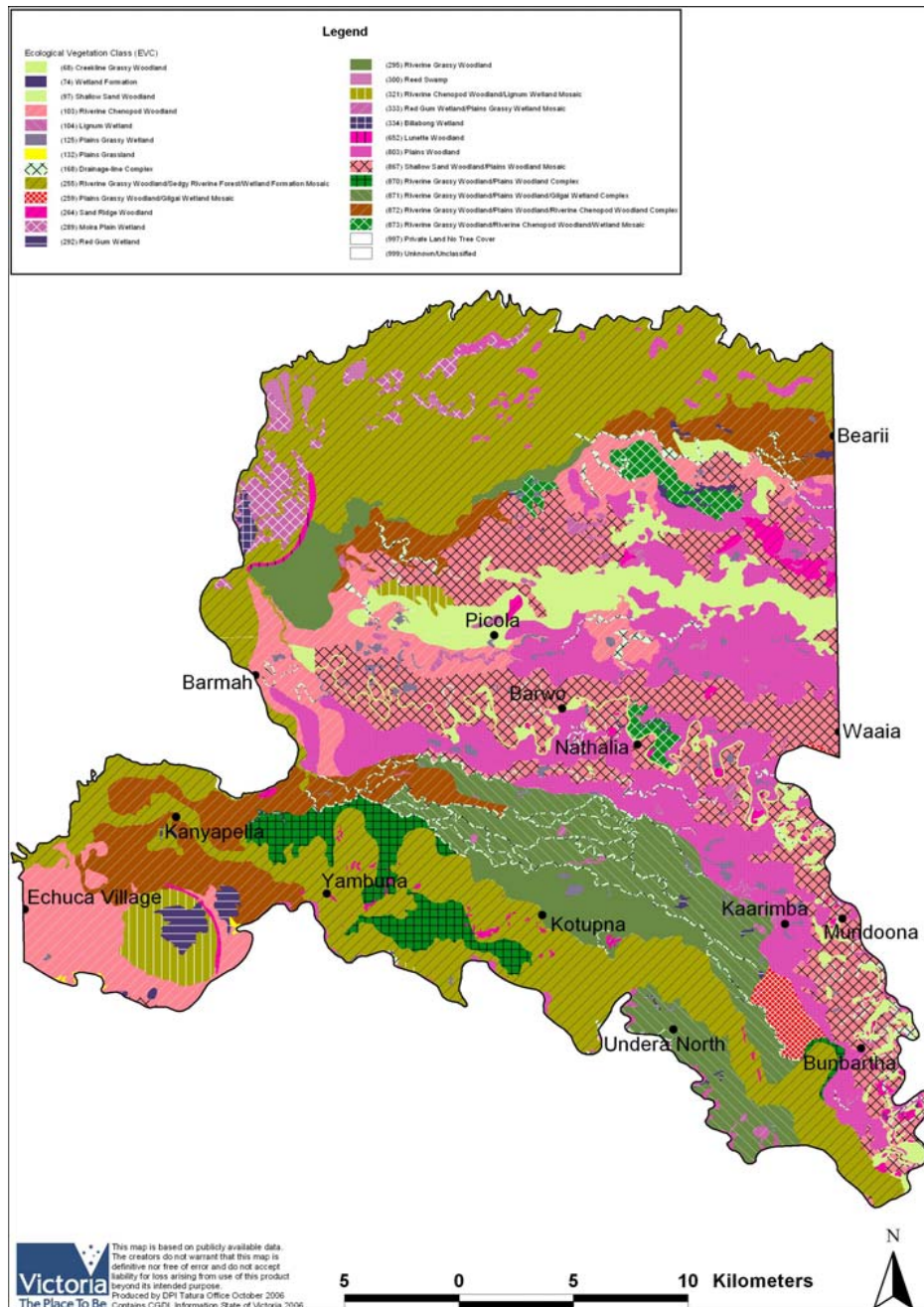
Figure 3: Pre-European Native Vegetation Cover in the Barmah Landscape Zone
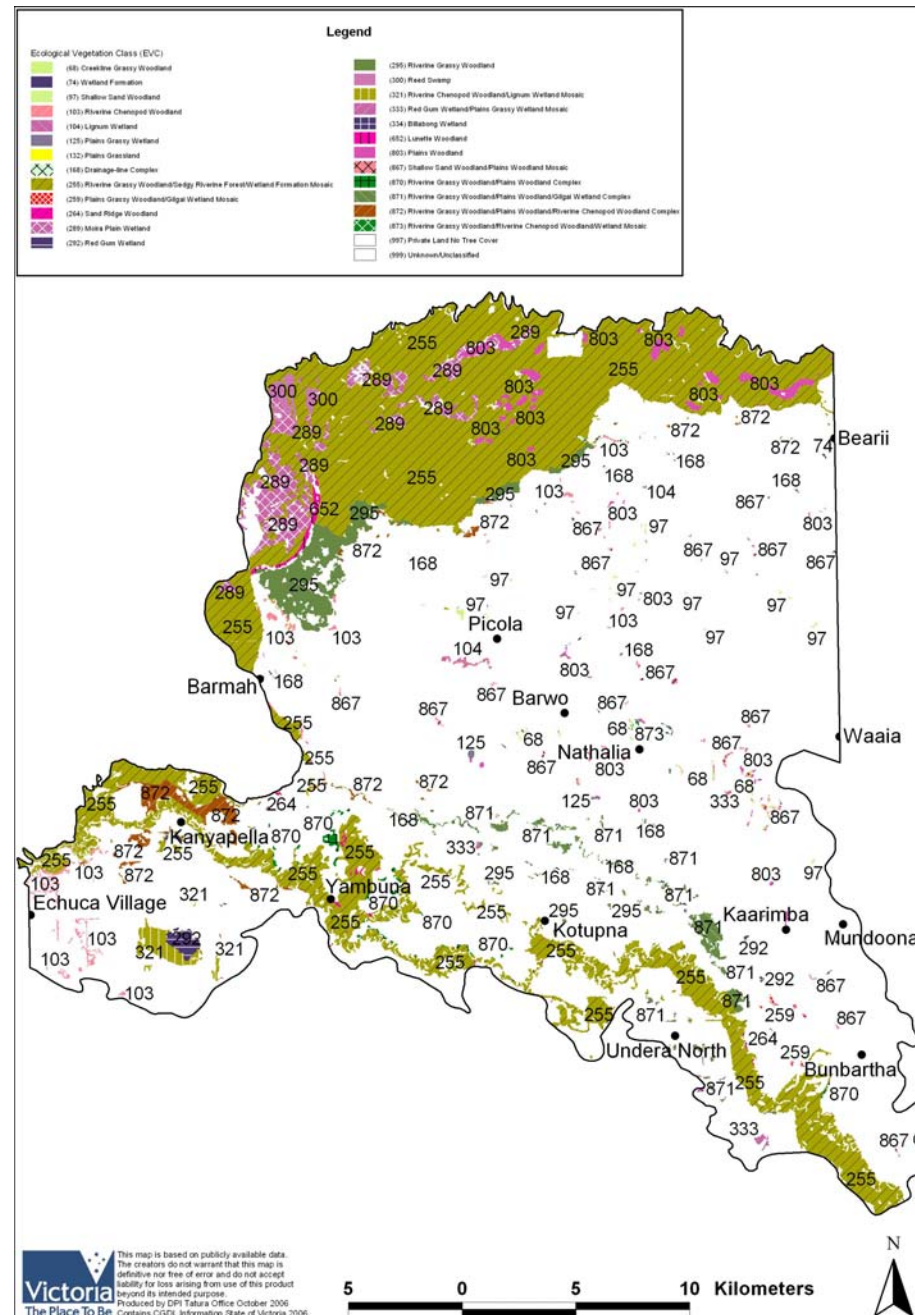
Figure 4: Current Extent of Native Vegetation Cover in the Barmah Landscape Zone

EVC Number	EVC Bioregional Conservation Status	Ecological Vegetation Class (EVC) Name#	Pre-1750 Vegetation Area (ha) *	Current Area of Vegetation (ha) *	Current Area of Vegetation (%)	Catchment (15%) Target (ha)*
68	E	Creekline Grassy Woodland	751	63	8.39%	113
74	E	Wetland Formation	257	3	1.17%	39
97	V	Semi-arid Woodland	8796	66	0.75%	1319
103	E	Riverine Chenopod Woodland	11812	327	2.77%	1772
104	V	Lignum Wetland	260	50	19.23%	39
125	E	Plains Grassy Wetland	1338	25	1.87%	201
132	E	Plains Grassland	71	0	0.00%	11
168	E	Drainage Line Complex (Aggregate)	3175	298	9.39%	476
255	V	Riverine Grassy Woodland/Sedgy Riverine Forest/Wetland Formation Mosaic	42007	31612	75.25%	6301
259	E	Plains Grassy Woodland/Gilgai Wetland Mosaic	1088	28	2.57%	163
264	E	Sand Ridge Woodland	1547	54	3.49%	232
289	D	Moira Plain Wetland	2295	2039	88.85%	344
292	E	Red Gum Wetland (Swamp)	950	251	26.42%	143
295	V	Riverine Grassy Woodland	5745	1935	33.68%	862
300	V	Reed Swamp	461	395	85.68%	69
321	E	Riverine Chenopod Woodland/Lignum Wetland Mosaic	2265	421	18.59%	340
333	E	Red Gum Wetland/Plains Grassy Wetland Mosaic	889	51	5.74%	133
334	E	Billabong Wetland	332	16	4.82%	50
803	E	Plains Woodland	21009	837	3.98%	3151
867	E	Shallow Sand Woodland/Plains Woodland Mosaic	20217	145	0.72%	3033
870	E	Riverine Grassy Woodland/Plains Woodland Complex	3885	183	4.71%	583
871	E	Riverine Grassy Woodland/Plains Woodland/Gilgai Wetland Complex	11377	669	5.88%	1707
872	E	Riverine Grassy Woodland/Plains Woodland/Riverine Chenopod Woodland Complex	11298	843	7.46%	1695
873	V	Riverine Grassy Woodland/Riverine Chenopod Woodland/Wetland Mosaic	1743	16	0.92%	261
		TOTAL	**153761**	**40460**	**26.31%**	**23064**
997	NA	Private Land No Tree Cover	0	113300	N/A	N/A
999	NA	Unknown/Unclassified	488	428	N/A	N/A

Table Information including column A & B modified from Ahern *et al* 2003 & CGDL 2005   *A*   *B*   *C*   *D*

Column C derived from (column B divided by column A) multiplied by 100 (for %)

Column D derived from (column A divided by 100) multiplied by 15

*   *Rounded to Nearest Unit (Whole Number)*

EVC names have altered since Ahern et al 2003 & are listed according to current corporate date (CGDL 2005)

Explanation of Terms:
- 'EVC Number' - the unique number attributed to that EVC in available literature (e.g. CGDL 2005).
- 'EVC Bioregional Conservation Status' (BCS) - the threatened status of the EVC. Endangered (E) means 'less than 10% of the pre-European extent remains, Vulnerable (V) is defined as 'less than 10-30% pre-European extent remaining' and (D) is 'depleted' (Platt 2002).
- 'Ecological Vegetation Class (EVC) Name' - the name given to that unique community.
- 'Pre-1750 Vegetation Area' - vegetation cover (ha) prior to clearance (e.g. Pre-European Settlement).
- 'Catchment (15%) Target (ha)' - the Goulburn Broken Regional Catchment Strategy target of "increasing the cover of all 'Endangered' and 'Vulnerable' EVCs to at least 15% of their pre-European vegetation cover by 2030" (GBCMA 2003) (refer to Appendix 3 for further information).

2.3 SIGNIFICANT FLORA AND FAUNA

2.3.1 Flora

Plate: Gold-dust Wattle (Acacia acinacea) is an example of a plant species recorded within the Barmah Landscape Zone (Joel Pike 2005)

A range of native flora is found within the Barmah Landscape Zone. Some overstorey species include River Red Gum (*Eucalyptus camaldulensis*), Grey Box (*Eucalyptus microcarpa*), Black Box (*Eucalyptus largiflorens*), Yellow Box (*Eucalytpus melliodora*), White Cypress-pine (Murray Pine) (*Callitrus glaucophylla*) and Buloke (*Allocasuarina luehmannii*). The range of small trees and shrubs includes species such as Lightwood Wattles (*Acacia implexa*), Mallee Wattle (*Acacia montana*), Golden Wattle (*Acacia pycnantha*), Gold-dust Wattle (*Acacia acinacea*), Emubush (*Eremophila longifolia*) and Lignum (*Muehlenbeckia spp*). Some groundcover plants include Wallaby Grass (*Austrodanthonia spp*) and Spear Grass (*Austrostipa spp*), herbs (e.g. Leafless Bluebush (*Maireana aphylla*)) and Peas (e.g. Silky Swainson-pea (*Swainsona sericea*)). Plants that favour moist environments, such as Western Water-starwort (*Callitriche cyclocarpa*), Moira Grass (*Pseudoraphis spinescens*) (associated with Moira Plain Wetlands, i.e. Barmah Forest) and Nardoo (*Marsilea drummondii*) can also be found (Ahern *et al* 2003).

There are twenty-nine species of threatened flora recorded within the Barmah Landscape Zone (NRE 2002e). These species are noted in Appendix 5 along with their threatened status (as per the Flora Information System (NRE 2002e)), the State Level (*Flora and Fauna Guarantee Act* (*FFG Act*) *1988)* and the National Level (*Environmental Protection and Biodiversity Conservation Act (EPBC) 1999*) (Ahern *et al* 2003).

Examples of threatened plant species recorded in the Barmah Landscape Zone include:
➢ Rigid Water-milfoil (*Myriophyllum porcatum*) (Vulnerable in Australia and Victoria),
➢ Yarran Wattle (*Acacia omalophylla*) (endangered in Victoria),
➢ Weeping Myall (*Acacia pendula*) (endangered in Victoria),
➢ Hooked Needlewood (*Hakea tephrosperma*) (vulnerable in Victoria),
➢ Leafless Bluebush (*Maireana aphylla*) (vulnerable in Victoria),
➢ Mueller Daisy (*Brachyscome muelleroides*) (Vulnerable in Australia and endangered in Victoria),
➢ Small Scurf-pea (*Cullen parvum*) (Endangered in Australia and endangered in Victoria), and
➢ River Swamp Wallaby-grass (*Amphibromus fluitans*) (Vulnerable in Australia) (Ahern *et al* 2003).

Plate: Rigid Water-milfoil (Myriophyllum porcatum) is an example of a threatened plant species recorded in the Barmah Landscape Zone (Tobi Edmonds 2005)

2.3.2 Fauna

There are forty-five threatened fauna species recorded in the Barmah Zone (NRE 2002f) (refer to Appendix 6 for a list of species, their threatened status and relevant acts) (Ahern *et al* 2003). Multiple records of these threatened species are recorded within the Zone, especially within the Barmah Forest area (e.g. Superb Parrot (*Polytelis swainsonii*)) (CGDL 2005).

Examples of threatened woodland species recorded in the Barmah Landscape Zone include:

➢ Bush Stone-curlew (*Burhinus grallarius*) (Threatened in Australia and endangered in Victoria),
➢ Superb Parrot (*Polytelis swainsonii*) (Vulnerable in Australia and endangered in Victoria),
➢ Barking Owl (*Ninox connivens*) (Threatened in Australia and endangered in Victoria),
➢ Grey-crowned Babbler (*Pomatostomus temporalis*) (endangered in Victoria),
➢ Brown Treecreeper (*Climacteris picumnus*) (poorly known), and
➢ Diamond Firetail (*Stagonopleura guttata*) (Threatened in Australia and vulnerable in Victoria) (Ahern *et al* 2003).

Plate: Diamond Firetail (*Stagonopleura guttata*) is an example of a threatened species recorded in the Barmah Landscape Zone (Ian McCann NRE 2002f)

Some other notable birds also included the migratory Rainbow Bee-eater (*Merops ornatus*), Flame Robin (*Petroica phoenicea*) and Red-capped Robin (*Petroica goodenovii*).

Examples of threatened species recorded within the Barmah Landscape Zone, predominantly associated with wetlands include:

➢ Brolga (*Grus rubicunda*) (vulnerable in Victoria),
➢ Hardhead (*Aythya australis*) (vulnerable in Victoria),
➢ Australasian Shoveller (*Anas rhynchotis*) (vulnerable in Victoria),
➢ Australasian Bittern (*Botaurus poiciloptilus*) (endangered in Victoria),
➢ Painted Snipe (*Rostratula benghalensis*) (critically endangered in Victoria),
➢ Musk Duck (*Biziura lobata*) (vulnerable in Victoria),
➢ Freckled Duck (*Stictonetta naevosa*) (endangered in Victoria), and
➢ Little Egret (*Egretta garzetta*) (endangered in Victoria) (Ahern *et al* 2003).

Plate: Murray Cod (*Smaccullochella peelii peelii*) is an example of a threatened fish species recorded in the Barmah Landscape Zone (NRE 2002f)

Examples of threatened fish recorded within the Barmah Landscape Zone include:

➢ Golden Perch (*Macquaria ambigua*) (vulnerable in Victoria), and
➢ Murray Cod (*Maccullochella peelii peelii*) (Vulnerable in Australia and endangered in Victoria) (Ahern *et al* 2003).

An example of a threatened reptile recorded in the Barmah Landscape Zone includes:

➢ Tree Goanna (*Varanus varius*) (vulnerable in Victoria) (Ahern *et al* 2003).

An example of a threatened mammal recorded in the Barmah Landscape Zone includes:

➢ Squirrel Glider (*Petaurus norfolcensis*) (endangered in Victoria and *FFG Act 1988* Listed).

Note: other mammals (e.g. Bats, Possums and Koalas) are also notable species that occur within the Zone. Surveys for bats in the Northern Plains area (includes parts of the Barmah Zone such as Picola) have identified a diversity of bats in the area (e.g. Chocolate Wattled Bat (*Chalinolobus morio*)) (Bennett 1998). Protection of these species is vital to biodiversity conservation in the Zone.

3.0 PREPARING A CONSERVATION PLAN

3.1 METHODOLOGY

The methodology used to develop this Conservation Plan is based on the 'Goulburn Broken Biodiversity Action Planning Developer's Manual' (GBCMA *in prep.*). This document provides the background information relating to BAP in the Goulburn Broken Catchment, and is designed to ensure consistency during the development of the Plans.

The methodology used to prepare this Plan contained eight main elements. These were;
1) Identification of Conservation Features and Threatened Species,
2) Ground-truthing of Potential BAP Sites,
3) Field Surveying of BAP sites,
4) Prioritisation of BAP sites,
5) Generation of Focal Species List,
6) Generation of Key Biodiversity Asset List,
7) Development of Actions for Key Biodiversity Assets, and
8) Landscape Context Analysis.

Step 1. Identification of Conservation Features and Threatened Species
Features in the landscape that are of potential priority for conservation were identified, as well as flora and fauna species of conservation significance (e.g. threatened under State or Commonwealth legislation). This involved desktop analysis of data (e.g. literature review; spatial data (e.g. EVC, tree cover, wetlands, flora and fauna records and aerials)); corporate databases (e.g. Biosites, Victorian Fauna Display and Flora Information Systems); local knowledge investigations; and the Landscape Context Model (refer to Step 8). From this analysis, a series of sites likely to have conservation values and threatened species, were identified and mapped using GIS (CGDL 2005).

Step 2. Ground-Truthing of Potential BAP Sites
This involved surveying the Zone from the roadside to compare desktop analysis data (Step 1) to the actual on-ground area, in regard to presence/absence, type of vegetation and raw condition.

Step 3. Field Surveying of BAP Sites
Sites were prioritised for survey as per the 'Goulburn Broken Biodiversity Action Planning Developer's Manual' (GBCMA *in prep.*). This prioritisation method is shown in Appendix 7. One hundred of the sites requiring ground-truthing were field surveyed (on-site or from the nearest public land). This involved;
3.1) Bird Surveys: Undertaken in accordance with the Birds of Australia – Atlas Search Method of 'Area Search' (1 hectare (as per VQA survey), twenty minutes, any shape) (Birds Australia 2001).
3.2) Vegetation Quality Assessment (VQA)(DSE 2004): Site-based habitat and landscape components were assessed against a pre-determined 'benchmark' relevant to the vegetation type being assessed (e.g. grasslands, wetlands, plains grassy woodlands) (Refer to Appendix 8).
3.3) Threat Identification: Whilst undertaking the Vegetation Quality Assessment (DSE 2004), a list of threatening processes (e.g. pest plants and animals) at the priority sites, were recorded according to the Actions for Biodiversity Conservation (ABC) database (DSE 2005a).

Step 4. Prioritisation of BAP Sites
One hundred sites were given a ranked value of Very High (VH), High (H), Medium (M) or Low (L), based on a range of factors (e.g. conservation status of the EVC, presence of threatened species, size and VQA score). Sites not surveyed, nor automatically ranked (as per Appendix 7), were given a ranked value to the lesser of the available options (until surveying occurs).

Step 5. Generation of Focal Species List

The focal species approach (Lambeck 1997) uses the habitat requirements of a particular species, or group of species, to define the attributes that must be present in a landscape for these species to persist. It is acknowledged that the approach will not ensure the conservation of all biota. However, broadly the concept recognises that if a species which requires the largest remnant size is selected, then fulfilling the needs of that species may assist in the conservation of other species, with smaller remnant size requirements (GBCMA *in prep.*). Huggett 2007 identifies strengths of the approach as; its ability to provide quantitative and spatial advice for strategically restoring landscapes; its use of landscape ecological science principles to build new habitat for targeted taxa; and its ability to provide a tool that can be applied in the community (social values).

Therefore, focal species were identified for each Zone based primarily on landscape ecological science principles (e.g. species with particular spatial, composition or functional requirements that may help address the functionality of the systems in the Zone) (GBCMA *in prep.*). Other factors such as social values (e.g. to entice the community to conserve biodiversity) and the practical application of the species in the community (e.g. for on-ground works) was also considered.

Step 6. Generation of Key Biodiversity Asset List

The identified environmental or managerial features including flora and fauna species were categorised into a series of 'nested' environmental assets. For example, similar species or environmental features may be located in 'nested assets' such as creeklines, wetlands or ecological vegetation classes. Public land (e.g. roadsides), whilst not a biodiversity asset *per se*, has been included as an asset category, primarily due to their function in the landscape and for practical application in the field. Where sites have been identified as 'public land', attempt has been made to also identify an environmental asset category (e.g. 'Riverine Woodland') to allow querying of information (refer to Appendix 12 on how to obtain further information for each site).

Step 7. Development of Actions for Key Biodiversity Assets

This step involved the development of a list of actions aimed at protecting and enhancing the biodiversity values in the Zone, by reducing the identified threats for each key biodiversity asset (as determined in Step 6). Actions were based on improving the size/extent of a site, the condition of the site and landscape processes (e.g. habitat connectivity). Available information (e.g. Actions for Biodiversity Conservation (ABC) database) (DSE 2005a) and the SIR North Landscape Plan (Ahern *et al* 2003) were also used to compile suggested actions.

Step 8. Landscape Context Analysis

To achieve long-term viability of the priority 'BAP' sites, they need to be linked and/or increased in size and total tree cover to form a viable functioning landscape. The Landscape Context Model (LCM) (Ferwerda 2003) uses a model of 'known habitat' (based on mapping for tree cover, wetland and major watercourses) to identify large remnants, key remnant clusters and the key linkages between them. However, because of potential limitations of the input data, areas of conservation significance (particularly grasslands and sparse woodlands) may not be identified. Similarly, areas with minimal conservation significance may be included, because habitat quality data is not included in the model.

However, the Landscape Context Model is useful as a background to BAP mapping, as it identifies areas that have the highest (or least) probability of containing additional sites of conservation interest (as per Step 1). Therefore the model can be used to identify areas of the landscape that should be used to link and strengthen a network of conservation sites, and create a sustainable landscape. The Barmah Landscape Zone priority (BAP) sites and Landscape Context Model are shown in Appendix 9.

4.0 IDENTIFYING PRIORITY SITES

In the Barmah Landscape Zone 406 sites were identified as Biodiversity Action Planning (BAP) priority sites for conservation management. These sites are termed BAP sites. They contain remnant vegetation and vary greatly from a stand of paddock trees, to large forested areas such as the significant Barmah State Forest. One hundred of these BAP sites have been ground-truthed and surveyed. A summary of these results is provided in Section 5.0. Note: Sites such as Barmah Forest were not surveyed as they were automatically valued as 'Very High' (refer to Appendix 7).

In order to identify the BAP sites, each site was assigned a number that identifies its location and the associated data. This unique number has been calculated using the map-index (map reference) number (1:25,000 Map) and a site number (e.g. 1-406). An example of the site identification numbering system (e.g. how the site(s) are identified using the site number system) is illustrated below (Figure 5). An example of the data that is contained in the database (referred to as 'Attribute Table') for each BAP site is detailed below (Figure 6).

For further information on obtaining data relating to the 406 BAP sites (e.g. mapping data) refer to Appendix 12.
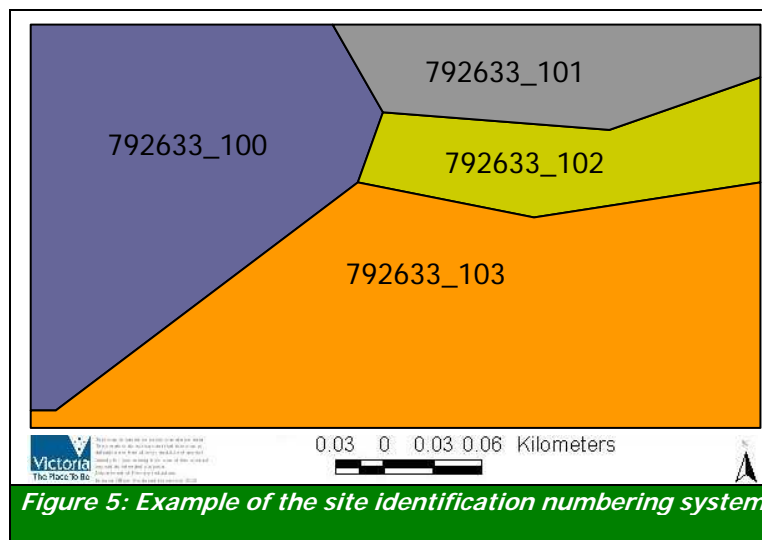
Figure 5: Example of the site identification numbering system

Site Number:	792633_100
Biodiversity Asset	Plains Woodland (Section 6.2)
Priority Status	Very High (VH)
Bioregion	MF (Murray Fans)
EVC	803 (Section 2.2)
EVC Conservation Status	E (Endangered)
Focal Species	Bush Stone-curlew (*Burhinus grallarius*) (Section 6.1)
Threatened Flora	Leafless Bluebush (*Marieana aphylla*)
Threatened Fauna	Diamond Firetail (*Stagonopleura guttata*)
Vegetation Quality Score	16/20 (Section 5.1)
Landholder	Private
Threats	Pest Plants (230), Land Clearance (293)

Figure 6: Example of the data contained in the database (Attribute Table)

5.0 SUMMARY OF SITE SURVEYING

5.1 VEGETATION QUALITY ASSESSMENTS

One hundred[4] of the 406 BAP sites were assessed based on habitat features of, 1) Large trees, 2) Canopy Cover, 3) Understorey, 4) Weediness, 5) Recruitment, 6) Organic Litter, 7) Logs (and Landscape Component Scores) 8) Size, 9) Neighbourhood and 10) Core Area. They were scored out of a maximum score of 20 (assumed intact habitat). An example of the assessment sheet is provided in Appendix 8. Graphical illustration of the results is also provided in Appendix 10.

The one hundred sites surveyed in the Barmah Landscape Zone were not necessarily the highest quality sites. For example, sites such as Barmah Forest were not surveyed as they were automatically valued as 'Very High' value (refer to Appendix 7). However, the sites that were surveyed in the Barmah Landscape Zone scored between 5 and 19 (Appendix 10). The highest scored site (19) was at the Kaarimba Bushland Reserve (South-Eastern area of the Zone). The lowest scored site (5) was also in the South-eastern area of the Zone and was a private woodland remnant that was heavily grazed and had a high level (70%) of weeds as understorey.

The graphical results (Appendix 10) highlight some of the challenges and some of the positives for biodiversity conservation in the Barmah Landscape Zone. In summary, the assessments identified that;
- Only 24% of surveyed[5] sites had more than 7 large trees per hectare,
- 10% of surveyed sites scored the highest for understorey (>75% cover),
- 42% of surveyed sites had more than 25% weed cover,
- 63% of surveyed sites had 70% or more regeneration,
- Only 24% of surveyed sites had more than 50 metres per hectare of logs,
- 60% of surveyed sites were larger than 10 hectares and 39% between 2-10 hectares, and
- Only 40% of surveyed sites were surrounded (1km radius) by more than 50% vegetation.

The surveys indicate that overall there is a good diversity of understorey, a high level of regeneration (recruitment), presence of pest plants, relatively good connectivity and a good range of large (>10ha) sized remnants. It was evident from the surveys that there is excellent opportunity to target a number of remnants for high biodiversity benefit. There is also opportunity to survey the remaining 306 sites in the Zone (e.g. sites that were automatically given a 'Very High' priority (such as Barmah Forest) which were not surveyed in the initial process but can be surveyed over time). It could be assumed that these sites would score well on the VQA and bird surveys.

5.2 BIRD SURVEYS

One hundred of the 406 priority sites had bird surveys completed. Fifty-six species of birds were surveyed. A list of surveyed birds at the 100 sites is provided in Appendix 11.

Threatened species that were identified during surveying included, Grey-crowned Babbler (*Pomatostomus temporalis*)(endangered) and Brown Treecreeper (*Climacteris picumnus*)(poorly known). Other notable species included; Flame Robin (*Petrocia phoenicea*) (migratory), Wedge-tailed Eagle (*Aquila audax*), White-throated Treecreeper (*Cormobates leucophaea*) and Barn Owl (*Tyto alba*). A list of threatened fauna (including birds) recorded in the Zone, is shown in Appendix 6. For further information on obtaining data relating to threatened birds in the Barmah Landscape Zone refer to Appendix 12. It is recommended that further wildlife surveying occur in the Zone for species such as mammals, reptiles, bats and frogs.

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[4] The majority of the one hundred sites that were surveyed are sites that were not automatically given a very high value status during prioritisation (see Appendix 7). However, a few sites that received very high value status were surveyed to compare the assessment system with the prioritisation system.
[5] Surveyed sites scored in relation to requirements for Ecological Vegetation Class Benchmark. Refer to Appendix 8 for further information on surveying.

5.3 CONSERVATION THREATS

Whilst undertaking the Vegetation Quality Assessments (DSE 2004), a list of threatening processes at the priority sites, were recorded according to the Actions for Biodiversity Conservation (ABC) database (DSE 2005a). These included;

- Vegetation Clearance (Land Clearance – removal of native vegetation),
- Habitat Fragmentation/Edge Effects (includes 'Adjacent Land Use Practices'),
- Animals – Domestic Stock (Inappropriate[6] grazing management (e.g. timing, stocking rate)),
- Waterways (instream barriers) (Changes in hydrological regimes e.g. wetlands),
- Firewood Collection & Cleaning Up (Removal of Habitat),
- Animals – e.g. Pest Species - Foxes and Rabbits,
- Invasion by Environmental Weeds (Pest Plants),
- Recreational Activities – motorised (Transport and Recreation), and
- Removal of Rocks/Soil (Impacts of Roadworks on Roadside Vegetation).
- The overall threat of salinity (high watertable) is also discussed below, although not listed against specific sites. It is an example of an overarching threat that is primarily a result of historical activities and can have repercussions on the biodiversity in the Zone.

Vegetation/Land clearance (a key threatening process under the *EPBC Act 1999*) (Wierzbowski *et al* 2002) particularly occurred in the past however it continues to be a threat to conservation values within the Zone. Practice's such as inappropriate[7] earth works (e.g. removal of natural depressions/wetlands and removal of native vegetation cover) and illegal tree removal is a threat to biodiversity values. Broad-scale spraying of roadsides is also a threatening process in the Zone, as it removes native vegetation thus reducing competition against pest plants (allows pest plant growth).

Habitat fragmentation (a potentially threatening process for fauna in Victoria under the *FFG Act 1988* (Wierzbowski *et al* 2002)) is primarily the result of historical land clearance. A range of species such as the Superb Parrot (*Polytelis swainsonii*) and Grey-crowned Babbler (*Pomatostomus temporalis*) are detrimentally affected by habitat fragmentation. It affects their ability to source food and suitable habitat required for their survival (e.g. leads to less effective immigration, emigration and breeding success). The Northern part of this Zone is one of the most important habitats for Superb Parrot and is a high priority for protection. Habitat fragmentation also favours species such as Noisy Miners (*Manorina melanocephala*) (Bennett 1993). Elevated competition from these aggressive species (although native to Australia) threatens species diversity, by the exclusion of less aggressive species (e.g. Grey-crowned Babblers) from remnants.

Adjacent land use practices (e.g. intensive irrigation and inappropriate earthworks) (*refer to footnote 7*), can also lead to **edges effects** such as the colonisation of fragmented remnant areas by weeds, waterlogging of vegetation, high watertable, nutrient run-off and an increase in sediment input in to rivers and streams (DPI 2005). Programs in the area such as Whole Farm Planning and Surface Water Management Systems are designed to alleviate these issues.

Inappropriate grazing management (*refer to footnote 6*) affects biodiversity conservation through soil compaction; removal of vegetation; changed nutrient levels; tree dieback and results in competition for fodder by native animals, which require tussocky grass for shelter (Wilson & Lowe 2002). Whilst 10% of the surveyed sites had a diverse range of understorey (e.g. more than 75% cover), 24% of surveyed sites were heavily grazed resulting in minimal (e.g. less than 20% cover) shrub or ground cover.

Changes in hydrology (e.g. hydrological regimes) threaten biodiversity, particularly wetlands, which have evolved to function with the natural cycles of flood and drought. Alteration to natural flow regimes of rivers and streams is listed as a threat to Victorian waterways under the *FFG Act 1988* (Wierzbowski *et al* 2002). A change in water regimes (including temperature and water quality) can dramatically alter system appearance and functioning, disrupt natural productivity cycles and cause changes in vegetation and habitat. This in turn affects the fauna that relies on

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[6] The term inappropriate (in this sense) refers to grazing native vegetation without consideration of stock capacity, time of year or length of time.
[7] The term inappropriate (in this sense) refers to the purposeful movement of soil/vegetation without consideration of the natural landscape (e.g. water flow).

wetlands (e.g. for resources and breeding) (Howell 2002). A number of integrated projects in the region are designed to reinstate the appropriate hydrological regime to wetlands and the protection of significant sites. These include the development of Management Plans (e.g. Green's Swamp and Kanyapellla Basin), Surface Water Management Systems (e.g. Murray Valley 11) and Environmental Water Allocation (EWA) bids (e.g. Barmah Forest and Kanyapella Basin).

The removal of fallen timber (or 'cleaning up') was evident along roadsides and within private remnants. Removal of fallen timber can result in a loss of habitat for birds; mammals, reptiles and insects, exposing them to predation by introduced predators. With a reduction in insect populations, timber removal also reduces the number of insect-eating birds in an area. For example, the Bush Stone-curlew (*Burhinus grallarius*) is just one of the species that is severely impacted upon by timber removal, due to loss of insects and the loss of fallen timber, that is used as habitat and camouflage for the protection of chicks (DSE 2005a). Burning of 'cleaned-up' timber, roadsides and the spraying of chemicals on roadside vegetation was also evident in the Zone.

Pest Animals are a threat to the conservation values of the area. Predation of native wildlife by the Cat (*Felis catus*) and by the introduced Red Fox (*Vulpes vulpes*) are listed as potentially threatening processes under the *FFG Act 1988* (Wierzbowski *et al* 2002), due to their impact on native species. The European Rabbit (*Oryctolagus cuniculus*) and European Hares (*Lepus europaeus*) compete for habitat, remove native vegetation and disturb soil structure.

Pest Plants (Weeds) are a major threat to biodiversity because they compete with native species, for essentials (e.g. space, light and nutrients). Invasion of native vegetation by environmental weeds is listed as a potentially threatening process under the *FFG Act 1988* (Wierzbowski *et al* 2002). Examples of weeds evident in the Zone include, Paterson's Curse (*Echium plantagineum*), Horehound (*Marrubium vulgare*), Sweet Briar (*Rosa rubiginosa*), Peppercorns *(Schinus molle)*, Boxthorn (*Lycium ferocissimum*), Arrowhead (*Sagittaria graminea*) (especially areas such as the Broken Creek) and Bridal Creeper (*Asparagus asparagoides*). **Removal of Rocks and Soil** was evident (e.g. along roadsides) where machinery had caused impact on native vegetation. This results in an increase in pest plants due to a loss of native species competition. **Transport** and **Recreational** pursuits (e.g. motorised activities) can also result in loss of native vegetation (DSE 2004).
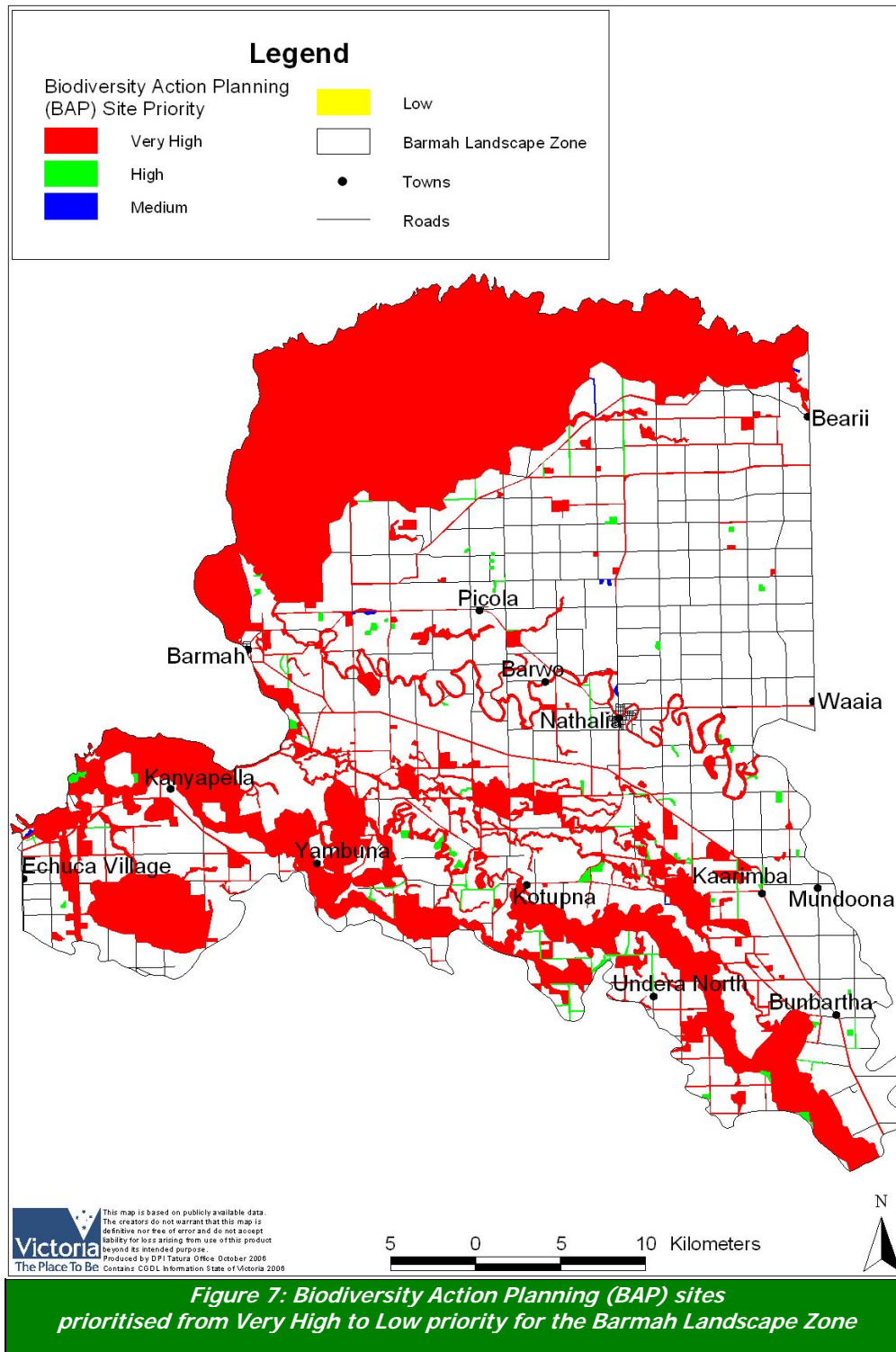
Salinity is an overarching potential threat to the area as a result of a high watertable (DSE 2005c). In 1996 (used as the 'representative' year) watertable depths in the Zone ranged from 0-1 metres (North-East of Nathalia to Waaia) to more than 3 metres (surrounding areas) (CGDL 2005). The impacts of salinity were evident at the site pictured (e.g. vegetation loss). Within the Zone sites have also been identified through the High Value Environmental Features (HVEF) project, which are either currently or potentially at risk of degradation as a result of a high watertable. This data has been used during the development of this Plan, including the inclusion of survey data for 17 sites (refer to Appendix 12) and recommendations from the HVEF report (DPI 2006c).

Plate: An example of a site in the Barmah Landsape Zone of low biodiversity value due to threatening processes (both historical and current)

5.4 SITE PRIORITISATION

Figure 7 illustrates the 406 BAP sites that have been given a priority status (ranked value) of Very High (VH), High (H), Medium (M) or Low (L) based on a range of factors (conservation status of the EVC, presence of threatened species, size and score). This prioritisation occurred at 3 stages; prior to surveying; following surveying and for unsurveyed sites. For example prior to surveying, large sites with an EVC conservation status and threatened species that did not require ground-truthing were automatically given a priority status of 'Very High' (VH). Following surveying (refer to 5.1, 5.2 & 5.3), the sites were given a priority status based on the three factors above and the Vegetation score (Appendix 8). Unsurveyed sites that required ground-truthing but were not able to be surveyed (e.g. more than 100 sites that required ground-truthing), nor able to be automatically ranked as 'Very High' prior to surveying, were given a ranked value to the lesser of the available rankings (until surveying can be conducted) (refer to Appendix 7).

Figure 7: Biodiversity Action Planning (BAP) sites prioritised from Very High to Low priority for the Barmah Landscape Zone

6.0 BIODIVERSITY ASSETS

6.1 FOCAL SPECIES

Research shows that different species have different types of responses to landscape change. The focal species approach (Lambeck 1997) uses the habitat requirements of a particular species or group of species, to define the attributes that must be present in a landscape for these species to persist. Broadly, the concept recognises that if a species which requires the largest remnant size is selected then fulfilling the needs of that species may assist in the conservation of other species, with smaller remnant size requirements. The focal species are also predicted to be the most sensitive species (in a given landscape) to a threat or ecological process, such that, their conservation should also conserve other less-sensitive species found in the same vegetation type (GBCMA *in prep.*).

Whilst it is acknowledged that the focal species approach will not ensure the conservation of all biota (Huggett 2007), its key strengths and ability to define and guide targets (e.g. patch size and connectivity) for our landscape restoration strategies (Lambeck 1997) is recognised. Other strengths of the approach is its ability to provide quantitative and spatial advice for strategically restoring landscapes and its use of landscape ecological science principles to build new habitat for targeted taxa (Huggett 2007). The approach also allows for the monitoring of actions (e.g. can undertake regular surveys to establish if focal species are increasing in number and/or using new sites) and provides the community with an 'iconic/focal' species (a 'social-hook') (Huggett 2007) to enhance enthusiasm for implementing works.

The seven focal species identified in the Barmah Landscape Zone and their ecological requirements (thresholds[8]) are identified below (Table 2). Definitions of the ecological terms used include;
➢ Minimum patch size (patch size threshold) – refers to the minimum patch size of vegetation required for the species to maintain viable populations,
➢ Critical distance between habitat patches (isolation threshold) – refers to the size of the gap between habitats, beyond which, on a daily basis, the animal doesn't generally cross (GBCMA *in prep.*),
➢ Dispersal threshold – refers to the distance (km) for which the species has been known to travel (e.g. for breeding and migration), but generally does not on a daily basis,
➢ Ecological Vegetation Class (EVC) – the vegetation community that the species prefers, and
➢ Other requirements – identifies some other known requirements (not comprehensive) for the species to survive, or to inhabit an area.

An example of two focal species project already occurring in the Shepparton Region are the Grey-crowned Babbler (*Pomatostomus temporalis*) project and the Superb Parrot (*Polytelis swainsonii*) project. In the first year of the Grey-crowned Babbler project 28,000 indigenous plants were planted and 10 kilometres of fencing constructed. If we look at the patch size required to maintain viable Grey-crowned Babbler populations (minimum of 2 hectares), preferably with mature trees, with less than a 500-metre gap between remnants, this valuable information can assist in the future direction of on-ground works for such projects (e.g. we can model the best places to increase existing patch size or create new patches, through BAP and the Landscape Context Model approach).

It is envisaged that community groups and agencies may target one, or a combination of the focal species identified (Table 2) for planning and implementation of on-ground works in the Zone. For example (based on Table 2) we know that we want to establish patches of at least 1-2 hectares in size and no greater than 2 kilometres from one another (connectivity) to aim to conserve targeted taxa in the Zone. Note: The focal species are only a suggestion of species to focus on-ground works.

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[8] Thresholds refer to the point at which relatively rapid change occurs (e.g. loss of species). Therefore, these should be used as a minimum target only.

Table 2: Focal Species and their Habitat Requirements – Barmah Landscape Zone

Grey-crowned Babbler (*Pomatostomus temporalis*) (e)

Minimum patch size (threshold)	>2ha, >1km continuous roadside
Critical distance between patches	<500m from known site
Dispersal threshold	<2km, very few records >10km
Ecological Vegetation Class	Woodlands
Some other requirements (general)	Mature trees, shrubs (>6m), linkages

Bush Stone-curlew (*Burhinus grallarius*) (e)

Minimum patch size (threshold)	>1ha, >40m wide
Critical distance between patches	<1km
Dispersal threshold	<2km from known site
Ecological Vegetation Class	Creeklines, Woodlands
Some other requirements (general)	Ground timber, fox control

Superb Parrot (*Polytelis swainsonii*) (e)

Minimum patch size (threshold)	Larger the better
Critical distance between patches	Varies for breeding/non breeding
Dispersal threshold	Varies for breeding/non breeding
Ecological Vegetation Class	Woodlands, Forests (River Red Gum)
Some other requirements (general)	Hollows, shrubs, corridors, dead trees

Brown Treecreeper *(Climacteris picumnus)* (k)

Minimum patch size	>30ha
Critical distance between patches	<500m from known site
Dispersal threshold	<1km
EVC utilised	Woodlands, edges, forest clearings
Some other requirements (general)	Mature trees, fallen timber*, linkages

Tree Goanna (*Varanus varius*) (v)

Minimum patch size (threshold)	>2km roadside/streamside patches
Critical distance between patches	<2km
Dispersal threshold	<2km
Ecological Vegetation Class	Most except wetlands
Some other requirements (general)	Mature trees, fox control, logs

Brolga (*Grus rubicunda*) (v)

Minimum patch size (threshold)	>50ha or clusters of wetlands
Critical distance between patches	Varies
Dispersal threshold	Varies
Ecological Vegetation Class	Wetland (ephemeral, 20-30cm depth)
Some other requirements (general)	Fox control, Canegrass, *Eleocharis spp*

Squirrel Glider (*Petaurus norfolcensis*) (e)

Minimum patch size (threshold)	>0.5ha, >1km length
Critical distance between patches	<50 metres
Dispersal threshold	<1km
Ecological Vegetation Class	Woodlands, Forests
Some other requirements (general)	Mature trees, Hollow-dependant#

* Habitat requirements include fallen timber at >40 tonne/hectare (MacNally 2006).
# Tree-hollows (with tight-fitting entrance hole) are essential to Squirrel Gliders for breeding and den sites.

Victorian threatened status definitions: (e) = endangered, (v) = vulnerable, (k) = poorly known.

Habitat Requirement Source: Variety of Sources (GBCMA *in prep.*) and DSE 2005a.

Photo Credits: Grey crowned Babbler (Graeme Chapman), Bush Stone-curlew (Ian McCann), Tree Goanna (Peter Robertson) and Squirrel Glider (John Seebeck) (NRE 2002f); Superb Parrot and Brown Treecreeper (Dr. Neville. R. Bartlett 2006); and Brolga (Paul O'Connor 1992).

6.2 KEY BIODIVERSITY ASSETS

BAP attempts to take a more strategic approach toward the conservation of threatened and declining species and vegetation types, by looking for opportunities to conserve groups of species in appropriate ecosystems. The identification of the appropriate biodiversity assets to focus conservation effort is an important part of the process. This approach has been used to group together species that utilise the same type of habitat. By protecting these assets we aim to conserve habitat for a suite of species associated with that habitat (Table 3). Specific actions (Section 7.0) based on the requirements of each asset can be developed and implemented (GBCMA *in prep.*). The 406 BAP sites have been categorised according to seven key assets (Figure 8). Public land (e.g. roadsides), whilst not a biodiversity asset *per se*, have been included as an asset category, primarily due to their function in the landscape and for practical fapplication in the field. A number of sites can be grouped based on two assets (e.g. Barmah Forest). Refer to Appendix 12 for further information on obtaining data, as only the primary asset type is identified on the map below.

Figure 8: Location of Key Biodiversity Assets in the Barmah Landscape Zone
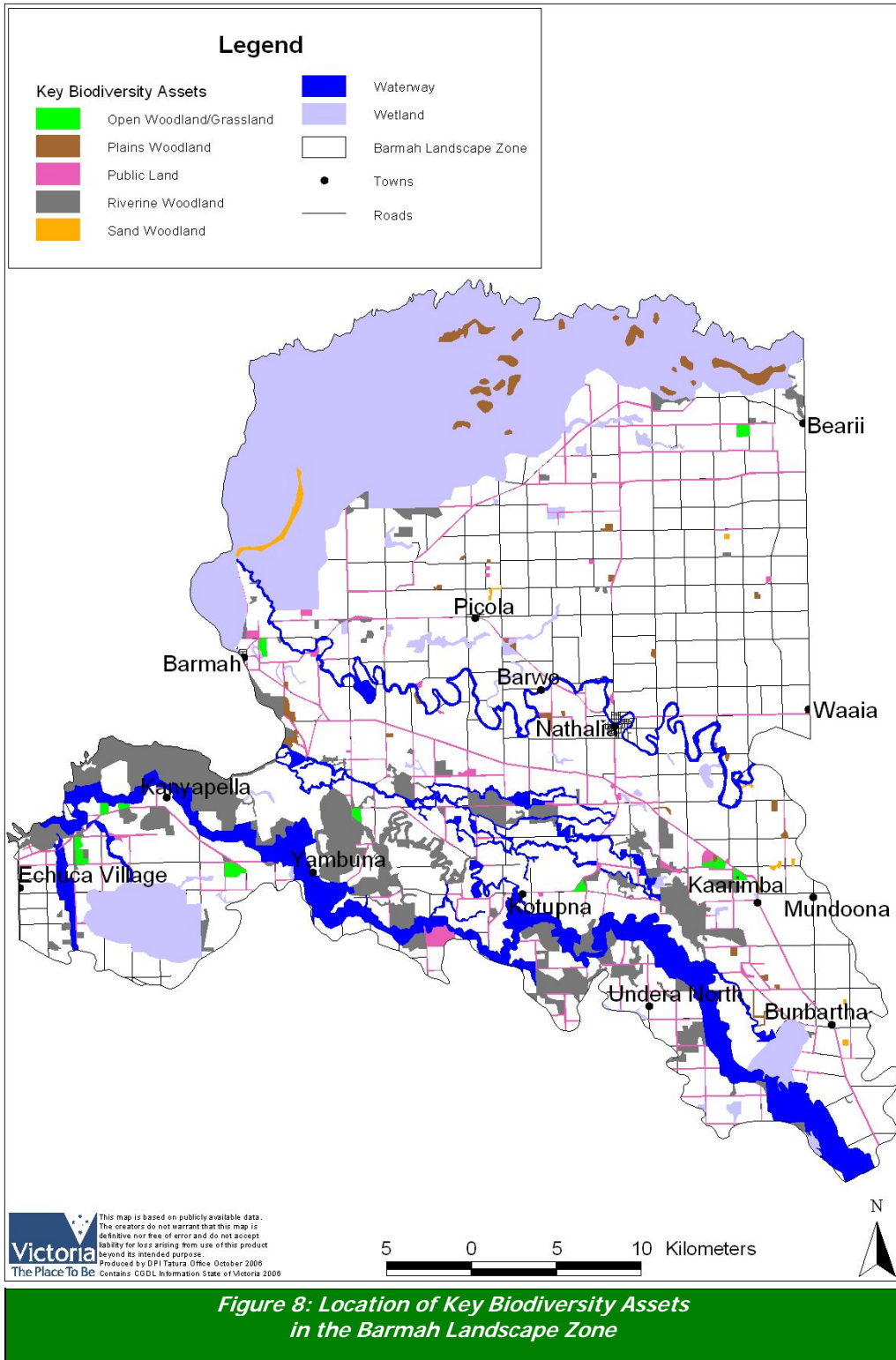
Table 3: Key Biodiversity Assets – Barmah Landscape Zone

Key Biodiversity Assets	Examples of Threatened and Notable Species
*1) Waterways Major bioregional and local habitat links for terrestrial fauna. Includes areas such as Murray River, Goulburn River, Broken Creek, Skeleton Creek and Deep Creek.	Bush Stone-curlew (*Burhinus grallarius*), Hardhead (*Aythya australis*), Musk Duck (*Biziura lobata*), Golden Perch (*Macquaria ambigua*), Murray Cod (*Maccullochella peelii peelii*) and Squirrel Glider (*Petaurus norfolcensis*).
2) Wetlands Distinctive ecosystems primarily associated with waterways such as the Murray River (e.g. Barmah Forest - of National/International significance and adjacent floodplain systems), the Goulburn River (e.g. Kanyapella Basin and Loch Garry). Private wetlands also occur within the Zone that are of high value.	Nationally significant Barmah Forest Wetlands, Brolga (*Grus rubicundus*), Australasian Bittern (*Botaurus poicilopiilus*), Painted Snipe (*Rostratula benghalensis*), Great Egret (*Ardea alba*), Freckled Duck (*Stictonetta naevosa*), Barking Marsh Frog (*Limnodynastes fletcheri*), Western Water-starwort (*Callitriche cyclocarpa*), Button Rush (*Lipocarpha microcepahala*) and Ridged Water-milfoil (*Myriophyllum porcatum*).
3) Public Land # Public land in this instance refers primarily to Road/Rail and Bushland Reserves. Other sites (e.g. Barmah Forest) have been grouped as wetlands primarily and secondly as public land.	Murray Cod, Barking Owl (*Ninox connivens*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*), Tree Goanna (*Varanus varius*), Squirrel Glider, Mueller Daisy (*Brachyscome muelleroides*), Woodland birds (e.g. Superb Parrot (*Polytelis swainsonii*)) and Grassland species.
4) Plains Woodlands Incorporates Plains Woodland, Semi-arid Woodlands and Plains Grassy Woodland/Gilgai Wetland Mosaic Ecological Vegetation Classes.	Small Scurf-pea (*Cullen parvum*), Mallee Golden Wattle (*Acacia notabilis*), Umbrella Wattle (*Acacia oswaldii*), Grey-crowned Babbler (*Pomatostomus temporalis*), Tree Goanna, Bush Stone-curlew and Woodland bird community.
5) Riverine Woodlands Associated with River Red Gum (*Eucalyptus camaldulensis*) and provides crucial habitat (e.g. hollows) for a range of hollow-dependent species. Mainly mapped as private land sites and listed secondly for a number of public land sites (e.g. Roadsides and Reserves).	Sedges (*Carex spp*), Small Scurf-pea, Grey-crowned Babbler, Tree Goanna, Barking Owl, Superb Parrot, Bush Stone-curlew, Squirrel Glider, Rainbow Bee-eater (*Merops ornatus*), Diamond Firetail (*Stagonopleura guttata*), River Swamp Wallaby-grass (*Amphibromus fluitans*), Mueller Daisy, Yarran Wattle (*Acacia omalophylla*) and Weeping Myall (*Acacia pendula*).
6) Open Woodlands/Grasslands Includes critical habitats of Plains Grassy Woodland/Gilgai Wetland Mosaic and open patches of grassland areas within woodland EVCs. Generally associated with agricultural paddocks and roadsides (listed under Key Biodiversity Asset 2).	Small-Scurf Pea, Bluebush (*Maireana spp*), Long Eryngium (*Eryngium paludosum*), Swainson-pea (*Swainsona spp*), Sida (*Sida spp*), Native Grasses (e.g. Spear Grass (*Stipa spp*) and Wallaby Grass (*Austrodanothinia spp*)) and Bush Stone-curlew.
7) Sand Woodlands Includes Endangered EVCs such as Shallow Sand Woodland and Sand Ridge Woodlands/Mosaics. Usually associated with higher landforms (e.g. Sandhills).	Buloke (*Allocasuarina luehmanii*), Buloke Mistletoe (*Amyema linophyllum ssp. orientale*), Weeping Myall, Umbrella Wattle, Tree Goanna, Grey-crowned Babbler, Bush Stone-curlew, Rainbow Bee-eater and Superb Parrot.

* The numbering of the Key Biodiversity Assets (1-7) is only intended to assist with the identification of the asset throughout the remainder of the report. Scientific names listed only once.

Whilst public land (e.g. roadsides), is not a biodiversity asset *per se*, it has been included as an asset category, primarily due to their function in the landscape and for practical application in the field.

Note: There are two asset columns (Asset 1 and Asset 2) included in the data (Appendix 12). All sites have been categorised based on the consistent Asset type (Asset 1) (e.g. Rivers are listed as 'Waterways'). For sites that have two asset types (e.g. Rivers may also be 'Public Land'), this is also listed (Asset 2) to allow querying of actions for land managers and to include as much data on each site applicable to its management as possible.

7.0 PRIORITY ACTIONS – KEY BIODIVERSITY ASSETS

Priority actions for the Zone have been developed and grouped based on each 'Key Biodiversity Asset'. There are two columns (Asset 1 and Asset 2) included in the data (refer to Appendix 12 for further information). All sites have been categorised based on a consistent Asset type (e.g. Rivers are listed as 'Waterways' - as illustrated in Figure 8). For sites that have two asset types (e.g. Rivers may also be 'Public Land'), both assets have been listed in the data to allow further querying of actions for land managers. The actions listed below include actions for the consistent asset type (Asset 1) and also acknowledge where sites cover more than one asset type (Asset 2).

Priority actions for the assets were developed based on the following factors, (1) size/extent (2) condition and (3) landscape processes (e.g. habitat connectivity and hydrological regimes). The condition (2) section was also further split in relation to, education/extension; on-ground works; threatened species; and pest plants and animals. For example, an action relating to the condition of a remnant, due to rabbits, can be found under; 'condition' – 'pest plants and animals'.

The actions identified below are intended to assist in the protection of natural features within the Zone. This Plan does not provide detailed management actions for all sites (e.g. Barmah Forest), as such sites are being investigated and managed through other (e.g. State) processes (e.g. VEAC 2006). The actions do however consider the landscape value of the Zone as a whole, which incorporates all sites both public and private (e.g. encouraging the linking of high priority public and freehold sites).

For each of the seven key biodiversity assets (1-7), the following pages identify;
A) An introduction to the asset in the Barmah Landscape Zone,
B) Photographic example of the asset in 'good condition' for the Zone, and
C) Proposed actions for the asset in the Zone (broader actions in Ahern *et al* 2003).

Plate: Biodiversity Action Planning sites in the Barmah Landscape Zone have been grouped based on seven 'Key Biodiversity Assets' (e.g. wetlands).

It is proposed that the community and agencies in the Zone investigate options for implementing the actions into existing projects, policies and documents. The actions are designed to work with existing documents (e.g. Local Area Plans) and provide further guidance on priority sites. For example, BAP sites in each asset type should be targeted in order of priority (Very High, High, Medium to Low). This forms the basis of BAP, where the very high value sites that require less cost for long-term protection can provide the highest prospect for conservation (GBCMA *in prep.*).

Note: Actions that identify the source as DSE 2005a are developed based on a rigorous legislative process (Acts of Parliament) and are therefore of high priority. These actions originate from the Flora and Fauna Guarantee Act 1988 that provides for the listing of Victoria's threatened plant and animal species, ecological communities and potentially threatening processes. Under the Act an Action Statement must be prepared. Action Statements outline what is required for the species conservation. For further information refer to the 'Actions for Biodiversity Conservation Database' (ABC) (DSE 2005a).

Acts of Parliament exist that must be adhered to when planning and implementing actions. For example, the Archaeological and Aboriginal Relics Preservation Act 1972 protects all Aboriginal places and relics in Victoria. For further information visit: http://www.dms.dpc.vic.gov.au/

7.1 WATERWAYS

A) Introduction - Waterways:

Waterways such as rivers, streams, creeks and lagoons are the lifeblood upon which most of the other assets depend. There are a number of significant waterways in the Barmah Landscape Zone including the Murray River, Goulburn River, Broken Creek, the Deep Creek System (including Skeleton Creek and Sheepwash Creeks) and Tullah Creek (within Barmah Forest). All of these areas are of 'Very High' conservation value, as they provide essential corridors for species movement and provide habitat, food and shelter for a range of species (Ahern *et al* 2003).

The majority of waterways within the Zone are crown land (publicly owned) (e.g. Murray River, Goulburn River, Broken Creek and parts of the Deep Creek System). Sections along these waterways are leased by private landholders. The Goulburn River downstream of Shepparton is a very important are for species such as the Squirrel Glider (*Petaurus norfolcensis*) and transverses throughout the Southern part of the Zone. A number of other waterways (e.g. parts of the Deep Creek System) are on private land. There are old prior streams (e.g. North of the Broken Creek) and depressions (e.g. South of Nathalia), that are privately owned that are also significant sites for biodiversity within the Zone.

Threats to waterways include vegetation/land clearing, edge effects/adjacent land use practices (e.g. nutrient run-off), changes to hydrological regimes, grazing and pest plants and animals. The actions identified below are intended to assist with the conservation of waterways within the Barmah Landscape Zone. However these actions are specific to the Zone and are by no means comprehensive for the region. Other strategies, such as the Victorian River Health Strategy (NRE 2002b) and the Draft Goulburn Broken River Health Strategy (GBCMA 2004b) provide a framework for managing and restoring rivers, streams and floodplains in Victoria and are overarching strategies for all areas. Whilst these strategies include other mechanisms for prioritising waterways (e.g. Index of Stream Condition), a Vegetation Quality Assessment can also be a useful tool for site management.

B) Photographic Example - Waterways:

Example of a (surveyed) Waterways BAP Site of 'Good Condition'* for the Barmah Landscape Zone
* Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

The site (792542_249) pictured, is part of the Deep Creek (Skeleton Creek) system, South of Nathalia. It is within a public land reserve known as 'Deep Creek (K7) Reserve'. The EVC is Riverine Grassy Woodland/Plains Woodland/Gilgai Wetland Complex. The site scored 18 out of a possible 20 on the Vegetation Quality Assessment (VQA) and is a 'Very High' value site for the Zone.

Plate: An example of a (surveyed) Waterways site (part of Skeleton Creek) of 'Good Condition' for the Barmah Landscape Zone

C) Actions Proposed – Waterways:

Size/Extent Related Actions:
- **Encourage** the buffering of all identified waterways in the Zone.
- **Increase the extent (buffering)** of the Deep Creek system (e.g. Skeleton Creek) and the Goulburn River, through liaisons with adjacent landholders.

Condition Related Actions:
Education/Extension:
- **Promote** the benefits of protecting and enhancing native vegetation in the in-stream and riparian environments, through extension and voluntary programs (e.g. incentives).
- **Work** with local community groups/landholders to **promote** the protection of sites from threatening processes, through extension principles, community education and/or incentives.
- **Promote** the use of direct seeding (where appropriate) to increase efficiency of revegetation.
- **Encourage** the retention of fallen timber on all waterways and adjoining remnants.
- **Encourage** the retention of trees (e.g. old and dead trees) for threatened species (e.g. Squirrel Glider (*Petaurus norfolcensis*)) (DSE 2005a).
- **Undertake** targeted community education programs to promote conservation of waterways and the threats.
- **Consult** with licensees of waterways to fence the creeklines (waterway incentives) and encourage the removal of stock, especially during set times to allow regeneration.

On-ground Works:
- **Protect** high priority sites, through covenants or incentives with an aim to fence all sites.
- **Give priority for protection and management** of the Murray River, Goulburn River, Broken Creek, Deep Creek and Skeleton Creek.
- **Establish off stream watering points** for all affected sites on waterways, with priority to high value sites, especially along the Broken Creek.
- **Encourage** the planting of alternative timber supplies to reduce the impact of firewood collection on roadsides, remnants and waterways.
- **Monitor the condition** of stream frontages, especially with respect to fencing and grazing, giving priority to well-connected water frontage corridors.
- **Protect** biodiversity values of the Beattie Floodway (Bay of Biscay) (Ahern *et al* 2003).
- **Ensure** that Aboriginal places and relics are identified and protected (across all asset types).

Threatened Species:
- **Modify stocking levels and grazing times**, as necessary, to benefit threatened species (e.g. River Swamp Wallaby-grass (*Amphibromus fluitans*)).
- **Provide habitat requirements** for a range of birds utilising waterways (e.g. shallow feeding sites) for affected species (e.g. Painted Snipe (*Rostratula benghalensis*)).
- **Ascertain management requirements** of the Yellow-tongue Daisy (*Brachyscome chrysoglossa*), Small Scurf-pea (*Cullen parvum*), Mallee Golden Wattle (*Acacia notabilis*) and *Azolla spp.* on the Broken Creek (Ahern *et al* 2003).
- **Support and encourage further research** that directly relates to the management of the Superb Parrot (*Polytelis swainsonnii*), Squirrel Gliders (DSE 2005a) and *Antechinus spp.*

Pest Plant and Animals:
- **Implement** ongoing integrated control of **feral animals** (e.g. foxes, cats and pigs).
- **Target pest plants** (e.g. Arrowhead (*Sagittaria graminea*)) **and animals** (e.g. European Carp (*Cyprinus carpio*)) in waterways as per the Catchment's Waterways Program.

Landscape Process Related Actions (e.g. regimes, connectivity):
- **Increase connectivity** between the Goulburn River, the Deep Creek System and the Broken Creek (e.g. **promote regeneration** of Public Land Water Frontages to improve connectivity with one another and with the adjacent riverine forests) (Ahern *et al* 2003).
- **Enhance linkages** between revegetation sites in Picola and the Broken Creek, and consequently with the Deep Creek System and the Goulburn River (e.g. focus on high value remnants and plantings in close proximity to one another to link to the creek).
- **Reintroduce ecological flooding regimes** for waterways (and associated habitats) so as to equate as far as possible, with pre-European frequencies (Ahern *et al* 2003).
- **Enhance flow regimes** to benefit Royal Spoonbill (*Platalea regia*), White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and Great Egret (*Ardea alba*) (Ahern *et al* 2003).

7.2 WETLANDS

A) Introduction – Wetlands:

Wetlands are amongst the most important, productive and valuable ecosystems in the region. They perform vital functions including water purification, nutrient processing, flood management and maintenance of the watertable. They provide habitat, refuge, and breeding (nursery areas) for many common and threatened species (e.g. Brolga (*Grus rubicunda*)) (Howell 2002).

High value wetlands in the Zone on public land include the majority of the Barmah Forest (associated wetlands, lakes, swamps, lagoons and floodplains), Kanyapella Basin and wetlands along the Goulburn River (e.g. Loch Garry). These sites have been included as the asset 'wetlands' (Asset 1) and secondly as the asset 'public land' (Asset 2) (refer to Appendix 12 to obtain data). Private wetlands in the Zone include a number of significant Lignum Wetlands and Plains Grassy Wetlands, particularly along the Green's Swamp Complex and old prior streams (Ahern *et al* 2003).

Barmah Forest is the Victorian component of the Barmah-Millewa Living Murray Significant Ecological Asset (icon site). It supports one of the most extensive tracts of River Red Gum (*Eucalyptus camaldulensis*) forest in Victoria and is in the *Ramsar List of Wetlands of International Importance* (EA 2002) and *A Directory of Important Wetlands in Australia* (EA 2001). It is a River Red Gum dominated floodplain which contains seven Ecological Vegetation Classes including Plains Woodland, Riverine Grassy Woodland (mosaics), Riverine Sedgy Forest, Moira Plain Wetland, Billabong Wetland, Reed Swamp and Sand Ridge Woodland (CGDL 2005). It is predominantly State Forest, managed by the Department of Sustainability and Environment (DSE) under the Mid Murray Forest Management Plan (NRE 2002d). There are also significant areas of State Park, Reference Areas and River Reserve which is managed by Parks Victoria under the Barmah Management Plan (DSE 2003) (DSE & GBCMA 2005b).

Kanyapella Basin is another high priority wetland identified in the Zone. It is a publicly managed 2,950-hectare depression located on the floodplain of the Lower Goulburn and Murray Rivers, East of Echuca. It is listed as a wetland of national importance in *A Directory of Important Wetlands in Australia* (EA 2001). The Kanyapella Management Plan (DPI 2006a) identifies the significance of this site and the actions required for biodiversity outcomes. It identifies the vision for Kanyapella Basin as an 'ecologically healthy wetland community of River Red Gum Swamp, Lignum Wetland and floodplain community…managed with community participation for the conservation of flora and fauna…providing opportunities for recreation and research' (DPI 2006a p3-4).

Privately owned wetlands within the Barmah Landscape Zone are also priority for protection. The Green's Swamp complex is over 100 hectares in size and is a priority area for protection due to its biodiversity and landscape context values (Ahern *et al* 2003). A 'Preliminary Wetland Management Plan for Murray Valley Drain 11 Wetland Complex' (SKM *in prep*) is being developed for Green's Swamp. Significant sites within the Green's Swamp complex have been identified for protection. This includes a very high priority site within the complex that has threatened species recordings (e.g. Brolga, Painted Snipe (*Postratula benghalensis*) and Ridged Water-milfoil (*Myriophyllum porcatum*)) (Ahern *et al* 2003).

The actions identified below aim to complement current activities as part of the Regional Catchment Strategy (GBCMA 2003) (e.g. Environmental Program and Surface Water Management Program). These actions are primarily for privately owned wetlands and are by no means comprehensive for the region. Other documents (e.g. Wetlands Directions Paper for the Goulburn Broken) (Howell, 2002) provide direction for protecting wetlands in the Catchment. Various management agreements and strategies (e.g. State level) for the protection of the Barmah Forest and associated wetlands exist. Strategies such as the 'Asset Environmental Management Plan: Barmah' (DSE & GBCMA 2005b), the 'River Red Gum Forests Investigation' (VEAC 2006) and *Ahern et al 2003* provide broader recommendations for the Barmah Forest area. Therefore the actions identified below are not intended to be comprehensive for the Barmah Forest, as the above strategies already identify detailed actions and the VEAC (2006) study will identify any further recommendations for the area.

B) Photographic Example – Wetlands:

Example of a (surveyed) Wetland BAP Site of 'Good Condition'* for the Barmah Landscape Zone
* Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

The site (792544_324) pictured is located near Picola on James Bridge Road. The Ecological Vegetation Class (EVC) is Lignum Wetland, which is an Endangered EVC. The site scored 11.5 on the Wetlands VQA and is a 'Very High' value site. Other wetland sites (e.g. wetlands of the Barmah Forest, Kanyapella Basin and Loch Garry) which are of value were not surveyed, as they were automatically given a 'Very High' value prior to surveying (Appendix 7).

Plate: An example of a (surveyed) Wetlands site of 'Good Condition' for the Barmah Landscape Zone

C) Actions – Wetlands:

Size/Extent Related:
• **Implement a buffer Zone** around all identified wetlands (as far out beyond the rim of the basin as possible) to increase the size of wetlands and provide for their protection.

Condition Related:

Education/Extension:
- **Provide extension** to all landholders with wetlands in the Zone to assist with recognition of the benefits of wetlands and associated flora and fauna on their properties.
- **Provide opportunities for education** of landholders and school children regarding the benefits of wetlands on farms (e.g. a campaign on the productive value of intact wetlands, in coordination with agriculture).
- **Investigate the development of a site management plan** for all identified wetlands in the Zone that are not currently under a Management Plan (e.g. privately owned).
- **Work with** Local Area Planning (LAP) Groups and associated community groups (e.g. Landcare) to **encourage landholders** with wetlands to protect (fence/manage stock).
- **Undertake further research** and investigation into the grazing of wetlands.
- **Encourage the appropriate use of chemicals** and other water contaminants on farms and within local communities.
- **Encourage** local LAP groups, Landcare Groups and schools to promote World Wetlands Day as a focus for increasing community awareness of wetlands.
- **Encourage** monitoring of wetlands and the adoption of new wetland monitoring sites, in consultation with the 'Waterwatch' Program and the Goulburn Murray Landcare Network.
- **Prevent** further removal of wetlands through education (and legislation where required).
- **Investigate** the use of 'Index of Wetland Condition Assessments' (DSE 2006) in conjunction with Vegetation Quality Assessments (still required to allow priority comparisons).
- **Compare the prioritisation system** for the development of Wetland Management Plans against the methodology used in the BAP process to identify priority sites and opportunities for integration of the processes/priority list (e.g. for Loch Garry).
- **That community** be involved and informed in the management of public land sites, including the Barmah Forest (e.g. ecological burning strategies, draft ecological grazing strategies, habitat prescriptions for timber harvesting and environmental water allocations) (Ahern *et al* 2003).

On-ground Works:
- **Protect** all identified wetlands in the Zone from threatening processes, commencing with very high value sites (Ahern *et al* 2003).
- **Encourage the community to protect** the 'old prior stream' of the Broken Creek.
- **Implement the** seven major objectives for management of Kanyapella Basin, as determined by the Steering Committee in the agreed Management Plan (DPI 2006a).
- **Finalise the Management Plan** for the Green's Swamp Complex (SKM *in prep*) and implement recommendations as soon as possible.
- **Implement** environmental assessment recommendations for Murray Valley 11 as part of the Surface Water Management System project.
- **Revegetate** native vegetation around (e.g. edges/batter stabilisation) built systems (e.g. Surface Water Management Systems and Reuse Systems) for environmental benefits.
- **Fence priority** sites to manage grazing, particularly when wet or prior to being wet, to allow flowering and seed-set of native plants.
- **Identify a demonstration site** (showcasing a very high value site) for educational purposes.
- **Seek approval** from the Shepparton Irrigation Region Implementation Committee for the Environmental Incentives program to provide off-stream-watering points for private wetlands.
- **Evaluate** the effectiveness of the current Environmental incentives for wetlands in the SIR and investigate options for providing further opportunities for constructed wetlands (e.g. reuses).
- **Ensure full** implementation of the Barmah State Forest and Barmah State Park Management Plan, including actions relating to timber harvesting, protection of old-growth stands, threatened species protection, grazing management, fire and ecological flooding (Ahern *et al* 2003).
- **Fully consider recommendations** (when available) made through the *VEAC 2006* process in relation to the condition, management and use of Riverine Red Gum Forests and their associated wetlands in the Zone (e.g. Barmah Forest and the Goulburn River).

Threatened Species:
- **Protect and enhance native vegetation communities** and the flora and fauna that they contain within Barmah State Park, Top Island and Top End Reference Areas, Barmah Regional Park, Loch Garry and Kanyapella Basin (Ahern *et al* 2003).
- **Monitor growth** of nesting habitat in wetlands to ensure that grazing does not remove habitat for Brolga (*Grus rubicunda*) (e.g. allow time for growth of vegetation prior to Brolga and other birds searching for breeding sites).
- **Monitor** stocking levels, flow regimes and pest plants to benefit the Western Water-starwort (*Callitriche cyclocarpa*) (Vv) (e.g. Murray Road site) (Ahern *et al* 2003).
- **Manage grazing** pressure in forests from macropods and introduced herbivores to benefit River Swamp Wallaby-grass (*Amphibromus fluitans*) (Ahern *et al* 2003).
- **Identify** Ridged Water-milfoil (*Myriophyllum porcatum*) in **farm dams/wetlands** and **provide extension** to landholders regarding its significance (Vulnerable (Vv). **Encourage** the **dispersal of seed** and transplanted material between wetlands.
- **Survey** the presence of frogs within the SIR and opportunities for protection (e.g. habitat creation in storage dams) (Herring *et al* 2007).

Pest Plants and Animals:
- **Extend** the current **integrated fox control programs** within the Picola/Nathalia area to adjacent areas, for the benefit of threatened species.
- **Investigate** predator-control fences for known Brolga breeding sites.
- **Target pest plants** (e.g. Arrowhead (*Sagittaria graminea*)) **and animals** (e.g. European Carp (*Cyprinus carpio*)) in wetland/creek environments (also refer to Waterways - Section 7.1).

Landscape Processes (e.g. regimes, habitat connectivity):
- **Form clusters of wetlands** by giving priority to protecting wetlands that are in close proximity to one another, or in close proximity to a high value site.
- **Restore and deliver natural hydrological regimes** to wetlands for the benefit of flora and fauna, through liaison with landholders, DSE and Goulburn-Murray Water.
- **Encourage the** restoration of natural flooding regimes to the Goulburn and Murray Rivers, and therefore the Barmah Forest and associated wetlands (Ahern *et al* 2003).
- **Continue to seek** Environmental Water Allocations (EWA) for priority wetlands.

7.3 PUBLIC LAND (Road/Rail/Bush Reserves)

A) Introduction – Public Land:

Public land comprises approximately 20% of the Barmah Landscape Zone. The Zone contains the highest proportion of public versus private land than any other Zone in the region. Actions for public land as per this asset type (Asset 1) refer primarily to Road/Rail and Bushland Reserves. Other public land sites such as the Barmah Forest, the Goulburn River, Broken Creek and Kanyapella Basin have been identified primarily (Asset 1) as the key biodiversity asset type of waterways or wetlands and secondly (Asset 2) as the key biodiversity asset 'public land' to allow for consistency of groupings.

There are a number of high priority sites of Road/Rail and Bushland Reserves in the Barmah Landscape Zone. There is an extensive network of roadsides containing significant habitats for flora and fauna. For example, the Murray Valley Highway (between Kotupna and Yalca), the Barmah-Shepparton Road (from Bunbartha to Barmah) and the Picola-Barmah Road (from Barmah to Picola) are the main roads throughout the area linking the network of roadsides. This network supports significant species such as the Grey-crowned Babbler (*Pomatostomus temporalis*) and Superb Parrot (*Polytelis swainsonii*). Railway Reserves of high priority include the Picola-Nathalia and Nathalia-Numurkah Railway Lines (Ahern *et al* 2003). Examples of Bushland Reserves include Wyuna, Narioka, Yielima, Yalca, Nathalia North and Kaarimba Bushland Reserves.

The actions identified below are intended to assist in the protection of Bushland Reserves, Railway Reserves and Roadsides, within the Barmah Landscape Zone. As stated above, this Plan does not provide detailed management actions for all public land areas (e.g. Barmah Forest), as such sites are being investigated and managed through other processes. Examples include the VEAC Riverine Red Gum Forests Investigation (VEAC 2006), the Living Murray Initiative (MDBC 2002), Mid-Murray Forest Management Plan (NRE 2002d), Asset Environmental Management Plan, Barmah Significant Ecological Asset (DSE & GBCMA 2005b) and the Barmah Forest Ramsar Site: Strategic Management Plan (DSE 2003). Therefore for further detailed information relating to Barmah Forest/Regional Parks refer to the documents identified above or Ahern *et al* 2003 for broader recommendations.

B) Photographic Example – Public Land:

Example of a (surveyed) Public Land BAP Site of 'Good Condition'* for the Barmah Landscape Zone
* Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

Kaarimba Bushland Reserve (792513_123) is a 17hectare reserve that is listed as a 'Biosite'. The Ecological Vegetation Class is Plains Grassy Woodland/Gilgai Wetland Mosaic. The site scored 19 (the highest in the Zone) on the VQA and is of 'Very High' value. Examples of species surveyed at the site include Brown Treecreeper (*Climacteris picumnus*) and a potential sighting of a Yellow-footed Antechinus (*Antechinus flavipes*).

Plate: An example of a (surveyed) Public Land site (Bushland Reserve) of 'Good Condition' for the Barmah Landscape Zone

C) Actions – Public Land (Road/Rail/Bush Reserves):

Size/Extent Related:
• **Buffer** all Bushland Reserves (e.g. Yalca/Kaarimba/Yielima) through landholder consultation.   • **Buffer** native vegetation communities on the Picola-Nathalia and Nathalia-Numurkah Railway Reserves, and high value roadsides (e.g. Murray Valley Highway and Shepparton-Barmah Road), through landholder consultation (e.g. fencing and promotion of natural regeneration).

Condition Related:
Education/Extension: • **Liaise** with stakeholders regarding current management of the Bushland Reserves.   • **Investigate** the development of local site plans for smaller reserves (e.g. Kaarimba Reserve).   • **Encourage** local school group involvement and stewardship of reserves (e.g. Yalca, Wyuna, Yielima and Kaarimba Reserves).   • **Promote** flora values of Railway Lines and high value roadsides.   • **Promote** rubbish dumping in allocated areas, rather than on roadsides and remnant vegetation.   • **Encourage** the retention of logs and leaf litter, as habitat for all species (e.g. reptiles and bats).   • **Encourage** the retention of trees (e.g. old and dead trees) for threatened species (e.g. Squirrel Glider (*Petaurus norfolcensis*)) (DSE 2005a).   • **Encourage** the protection of roadsides from threats (e.g. grazing and cropping) (through legislative processes where required).   • **Encourage** roadside management training for Local Government staff and contractors.   On-ground Works: • **Protect** sites from threatening processes, starting with very high value sites (Ahern *et al* 2003).   • **Protect** good quality remnant vegetation adjacent to Bushland Reserves (e.g. Kaarimba area).   • **Investigate** with stakeholders, options for signage for high value roadsides, as per the DSE Significant Roadside System or 'Enviromark' (Greening Australia) method.   • **Develop** a community education campaign, regarding conservation of roadsides and reserves (e.g. no illegal firewood collection, rubbish dumping, chemical use or burning of leaf litter).   • **Ensure** maintenance of roads in the Zone has minimal impact on biodiversity values (e.g. Roadside Management Plans) (Moira Shire Council 1998).   • **Protect** all unused roadsides (e.g. disused roads) and investigate options for lease negotiations.   • **Encourage** the incorporation of databases (e.g. Local Government data) with the BAP database.   • **Implement** recommendations for all Management Plans (e.g. Kanyapella Basin (DPI 2006a), Wyuna Bushland Reserve (DPI 2006b) and Yielima Bushland Reserve).   • **Protect** public land sites at risk of high watertable levels as identified in the HVEF project (DPI 2006c) (e.g. Very High Priority to protect Yielima, Kempsters Bridge and Nathalia Reserves).   • **Pursue** appropriate mechanisms to protect the Railway Line between Picola and Numurkah (e.g. as a 'Conservation Reserve') (Ahern *et al* 2003).   Threatened Species: • **Provide** Local Governments with the location of threatened species along roadsides, for inclusion in the permit process (e.g. stock droving).   • **Protect** the Small Scurf-pea (*Cullen parvum*) area west of Fairmans's Bridge, Picola.   • **Manage grazing** pressure from macropods and introduced herbivores in sites containing River Swamp Wallaby-grass (*Amphibromus fluitans*) (Ahern *et al* 2003).   • **Further** investigate the presence of Yellow-footed Antechinus (*Antechinus flavipes*) in the Zone.   Pest Plants and Animals: • **Undertake integrated pest plant management** at all priority sites.   • **Undertake integrated pest animal management** (e.g. foxes, feral pigs) in areas adjoining Reserves to benefit threatened fauna (e.g. Bush Stone-curlew (*Burhinus grallarius*)).   • **Educate** the community about the spread of 'escaped' agricultural plants on to roadsides.

Landscape Processes (e.g. hydrological regime, habitat connectivity):
• **Increase** connectivity of Bushland Reserves with nearby vegetation (e.g. Yielima Bushland Reserve with Barmah Forest) to enhance biodiversity corridors for threatened species.   • **Develop further linkages** between priority sites (e.g. Roadsides, Railway Reserves, forests and creeks) using the Landscape Context Model (Ferwerda 2003) to identify sites.   • **Extend linkages** of the Murray Valley Highway with nearby vegetation in accordance with EVC requirements and existing vegetation (e.g. native grasses).

7.4 PLAINS WOODLANDS

A) Introduction – Plains Woodlands:

The key biodiversity asset 'Plains Woodland' is comprised of Plains Woodland, Semi-arid Woodland and Plains Grassy Woodland/Gilgai Wetland Mosaic Ecological Vegetation Classes (EVC). These EVCs were historically one of the main vegetation types in the riverine plain part of the Barmah landscape, but are now endangered. The majority of Plains Woodland communities (generally attributed to an overstorey of Grey Box (*Eucalyptus microcarpa*)) in the Zone occur on private land, roadsides and scattered on the edges of forests (e.g. Barmah). These remnant types serve many important functions, including aesthetic values, habitat values, sources of native seed and sources of food, shelter and nesting sites for a range of woodland birds (Lunt 1998).

The majority of this asset type is located in the central area of the Zone (Figure 8). Many of the areas in the Zone that once contained these vegetation types have been cleared for agriculture, leaving fragmented remnants. Whilst fragmented remnants remain important sites for species such as Bats, it is important for a range of other species, to provide connectivity and understorey for these sites.

Threats to this asset include edge effects/adjacent land use practices, grazing management and pest plants and animals. The actions identified below are intended to assist in the protection of the remaining remnants within the Zone. However these actions are specific to the Barmah Landscape Zone and are by no means comprehensive for the Region.

Note: there are other BAP sites within the Zone that contain Plains Woodland or Mosaic EVCs (e.g. Roadsides). Whilst these could be classified as part of this Plains Woodland asset type, they have been categorised primarily based on the dominant factor to ensure consistency of actions. Both sets of actions for each listed asset can be used (e.g. Plains Woodland and Public Land).

B) Photographic Example – Plains Woodlands:

Example of a (surveyed) Plains Woodland BAP Site of 'Good Condition'* for the Barmah Landscape Zone
*Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

Site number (782511_3) is an 8 hectare privately owned remnant located between the towns of Nathalia and Barmah. The site scored 13.5 on the VQA. The Ecological Vegetation Class (EVC) is Plains Woodland, which is an endangered EVC. The site is within proximity to State Forest and the Broken Creek and high value roadsides. It is a very high value site for the Zone.

Plate: An example of a (surveyed) Plains Woodland site of 'Good Condition' for the Barmah Landscape Zone

C) Actions – Plains Woodlands:

Size/Extent Related:
Encourage the implementation of buffer strips around Plains Woodland sites.   **Encourage landholders to increase the size** of priority remnants (e.g. fence to promote natural regeneration), to establish new areas of indigenous species of trees and shrubs, and to retain or establish buffer zones of unimproved, uncultivated pasture around woodland (DSE 2005a).

Condition Related:

Education/Extension:
- **Encourage** landholders to leave fallen branches and debris on the ground, especially at known Bush Stone-curlew (*Burhinus grallarius*) sites (DSE 2005a).
- **Encourage** the retention of dead trees as habitat for Birds, Reptiles, Insects and Mammals (e.g. Bats).
- **Work** with local community groups/landholders to **implement community education activities** relating to the importance of Plains Woodlands and associated flora and fauna, specifically targeting priority remnants in paddock environments.
- **Develop a demonstration site** (showcasing a very high value site) for educational purposes.
- **Investigate** the use of Environmental Management Systems (EMS) in the Zone.

On-ground Works:
- **Encourage the protection (fencing)** of all Plains Woodland remnants and grazing management (e.g. encourage the exclusion of domestic grazing in remnants to allow plants to set seed and regenerate. Manage stock grazing for the benefit of native vegetation once plants set seed).
- **Maintain the health**, diversity and cover of native species in the long-term, by reviewing with stakeholders the location of stock holding areas and relocating these activities away from native vegetation (DSE 2004).
- **Enhance** priority sites with indigenous vegetation if regeneration has not occurred following fencing (e.g. no existing viable seed source).
- **Further investigate** the effects of high watertable on priority BAP sites though use of the HVEF project (DPI 2006c) priority system.

Threatened Species:
- **Plant corridors** to supplement habitat for all focal species, using current projects as examples (e.g. Superb Parrot (*Polystelis swainsonii*) and Grey-crowned Babbler (*Pomatostomus temporalis*)).
- **Liaise** with stakeholders regarding current Bush Stone-curlew programs in the Nathalia area and options to expand or use as a demonstration project for other areas.
- **Buffer remnants** (at least 15 metres wide and 500 metres long) adjacent to roadside habitats that contain Grey-crowned Babbler (Ahern *et al* 2003).
- **Manage domestic grazing** in sites with threatened flora (Ahern *et al* 2003).

Pest Plants and Animals:
- **Manage** pest plants for the benefit of Plains Woodland flora and liaise with stakeholders (e.g. DPI Pest Management Officers) regarding their management.
- **Undertake integrated fox control programs** in areas with known records of threatened species (e.g. Bush Stone-curlew and Tree Goanna (*Varanus varius*)).
- **Undertake integrated rabbit management** in all priority remnants (in consultation with DPI) and investigate redeveloping a 'Rabbit Busters' program.
- **Investigate** including pest plant and animal incentives as part of the environmental incentives.

Landscape Processes (e.g. hydrological regime, habitat connectivity):
Increase connectivity of Plains Woodland sites with nearby sites, regardless of asset type.   **Develop further linkages** between priority sites, using the Landscape Context Model (Ferwerda 2003) to identify potential sites.   **Map all superb parrot** plantings and annual survey data and overlay with priority sites and Catchment incentive sites to investigate further options for habitat connectivity.   **Encourage the linking** of priority sites to the Barmah Forest, Broken Creek, Deep Creek system, Goulburn River and to Superb Parrot and incentive project sites.

7.5 RIVERINE WOODLANDS

A) Introduction – Riverine Woodlands:

The key biodiversity asset 'Riverine Woodlands' is comprised of Riverine Grassy Woodland (and mosaics), Riverine Chenopod Woodland and Riverine Sedgy Forests Ecological Vegetation Classes (EVCs). These EVCs occur on the riverine floodplain at elevations of 100-200m and an annual general rainfall of 400-700mm. The dominant overstorey are River Red Gum (*Eucalyptus camaldulensis*), occasionally with Black Box (*Eucalyptus largiflorens*) on the margins (e.g. on the Murray Valley Highway near Yalca). The understorey is typically grassy, with herbs (e.g. Bluebells), Sedges (*Carex spp*) and Daisies (e.g. *Brachyscome spp*) (DPI 2003).

This asset type is primarily associated with waterways and associated creeklines and depressions (Figure 8). A number of sites are located North of Kotupna to Picola, between the townships of Barmah and Nathalia. Large sites also exist between Bunbartha, Nathalia and Kotupna. This area was recently part of a proposed buy-back system in the Catchment and contains significant flora and fauna. During surveying it was identified that a large proportion of riverine woodland remnants (e.g. near Picola, Echuca East, Yambuna and Kaarimba) contained valuable native grasses and regeneration. They are of very high value to the Zone and should be protected.

Pest plants and animals, management of grazing, edge effects and changed hydrological cycles, are examples of threats to this asset. The actions identified below are intended to assist in the protection of the remaining remnants within the Barmah Landscape Zone. However, these actions are specific to the Zone and are by no means comprehensive for the region.

As per the Plains Woodland asset, there are other BAP sites within the Zone that contain Riverine Woodland or Mosaic EVCs (e.g. roadsides and Barmah Forest). Whilst these could be classified as part of this Riverine Woodland asset type, they have been categorised primarily based on the dominant factor to ensure consistency of actions. Both sets of actions for each asset can be used (e.g. Riverine Woodland and Public Land).

B) Photographic Example – Riverine Woodlands:

Example of a (surveyed) Riverine Woodland BAP Site of 'Good Condition'* for the Barmah Landscape Zone
* Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

Site (782512_42) is located near Yambuna and scored 16 on the VQA. The site contains healthy overstorey, understorey and ground cover species and is a very high value site for the Zone. The Ecological Vegetation Class (EVC) of the site is Riverine Grassy Woodland Mosaic.

Plate: An example of a (surveyed) Riverine Woodland site of 'Good Condition' for the Barmah Landscape Zone

C) Actions – Riverine Woodlands:

Size/Extent Related:
- **Encourage the implementation of buffer strips** around Riverine Woodland sites.
- **Encourage landholders to increase the size** of priority remnants (e.g. fence to promote natural regeneration), to establish new areas of indigenous species and to retain or establish buffer zones of unimproved, uncultivated pasture around woodland (DSE 2005a).

Condition Related:

Education/Extension:
- **Encourage** landholders to leave fallen branches and debris on the ground, especially at known Bush Stone-curlew (*Burhinus grallarius*) sites (*ABC database*) (DSE 2005a).
- **Encourage** the retention of dead trees as habitat for Birds, Reptiles, Insects and Mammals.
- **Work** with local community groups/landholders to **implement community education activities** relating to the importance of Riverine Woodlands and associated flora and fauna, specifically targeting high priority remnants in paddock environments.
- **Develop a demonstration site** (showcasing a very high value site) for educational purposes.
- **Promote** the benefits of native grasses in remnants, through education (e.g. values and management techniques).
- **Implement extension activities** to encourage landholders with priority remnants to enhance the long-term viability of the sites and encourage long-term (covenant) protection.

On-ground Works:
- **Encourage the protection (fencing)** of all Riverine Woodland remnants to allow flowering and seed set of native plants. Retain access for controlled grazing to manage weeds, where necessary. Manage stock grazing for the benefit of native vegetation once plants set seed.
- **Maintain the health**, diversity and cover of native species in the long-term, by reviewing with landholders the location of stock holding areas and relocating these activities away from native vegetation remnants (DSE 2004).
- **Enhance** priority sites with indigenous species if regeneration has not occurred following fencing.
- **Encourage** the purchase of priority sites in proximity with waterways (e.g. Deep Creek system).
- **Further investigate** the effects of high watertable on priority BAP sites though use of the HVEF project (DPI 2006c) priority system.

Threatened Species:
- **Plant corridors** to supplement focal species habitat, using current projects as examples (e.g. Superb Parrot (*Polystelis swainsonii*) and Grey-crowned Babbler (*Pomatostomus temporalis*)).
- **Actively discourage** the removal of firewood from all priority sites for the benefit of threatened fauna.
- **Support and encourage further research** that directly relates to the management of the Superb Parrot (Weber & Ahern 1992; DSE 2005a) and Squirrel Gliders (*Petaurus norfolcensis*) (DSE 2005a) (Ahern *et al* 2003).
- **Collect seed** from threatened flora (e.g. Mueller Daisy (*Brachyscome muelleroides*) and River Swamp Wallaby Grass (*Amphibromus fluitans*)) within the Zone and encourage propagation.

Pest Plants and Animals:
- **Manage** pest plants for the benefit of Riverine Woodland flora and liaise with DPI Pest Management Officers and the land manager, regarding their management.
- **Undertake integrated fox control programs** in areas with known records of threatened species (e.g. Bush Stone-curlew).
- **Undertake integrated rabbit management** in all high priority remnants (consult with Pest Management Officers) and investigate re-introducing a program like 'Rabbit Busters'.
- **Investigate management** of Noisy Miners (*Manorina melanocephala*) in areas of significant corridors and known sites inhabited by Grey-crowned Babblers (e.g. Barmah-Shepparton Road).

Landscape Processes (e.g. hydrological regime, habitat connectivity):
- **Link** high value Riverine Woodland remnants using the Landscape Context Model (Ferwerda 2003) as a guide (e.g. link with native vegetation on public land, particularly areas adjacent to forests/reserves i.e. adjacent to the Barmah Forest and the Goulburn River).
- **Identify further opportunities to link high value sites** by mapping all sites planted as part of the Grey-crowned Babbler and Superb Parrot projects.

7.6 OPEN WOODLANDS/GRASSLANDS

A) Introduction – Open Woodlands/Grasslands:

Open woodlands are areas of woodland (e.g. Plains Woodland or Riverine Woodland EVCs) that have a scarce number of trees, but contain valuable grassland characteristics (the open spaces within woodlands). **Native grasslands** are areas dominated by native grasses, with few, if any, widely spaced trees. Native grasslands were typically treeless prior to European settlement however others have been created since settlement due to clearing or heavy grazing (DSE 2004).

Private land sites that contain significant grassland characteristics within the Barmah Landscape Zone have been identified as predominantly 'open woodland/grassland' areas, even though they may contain Plains Woodland and Riverine Woodland related EVCs, rather than Grassland related EVCs (e.g. Plains Grassland EVC).

Grassland characteristics include annual grasses and herbs, perennial herbs, saltbushes, perennial grasses and small patches of bare ground with no tree cover (Ahern *et al* 2003). Roadsides that contain grassland characteristics have also been identified secondly (Asset 2) as 'open woodland/grassland' and primarily as 'public land'. However these sites are also important for protection of grassland characteristics and can be queried by land mangers across both asset types (refer to Appendix 12 for further information).

Threats to open woodlands/grasslands include factors such as vegetation/land clearance, edge effects/adjacent land use practices, pest plants and species diversity decline. Lack of awareness in previous times regarding the value of these sites has also led to their degradation. The actions identified below are intended to assist in the protection of the remaining sites and any other pockets of open areas within woodlands, which contain native grasses (in the Zone). Therefore general actions relating to groundcover species have also been included on the following page, to assist in grassland species protection throughout the Zone.

B) Photographic Example – Open Woodlands/Grasslands:

Example of a (surveyed) Open Woodland/Grassland BAP Site of 'Good Condition'* for the Barmah Landscape Zone
* Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

Site (792513_134) is a roadside near Bunbartha that scored 13.5 on the VQA. It is listed primarily for (Asset 1) as 'public land' and secondly (Asset 2) as 'open woodland/ grassland'. Although conditions were very dry at the time of surveying, the site contains a range of Native Grasses, Herbs (e.g. Drumsticks (*Pycnosorus globosus*)), Bluebush (*Marieana spp.*) and Pea's (*Swainsona spp*).

Plate: An example of a (surveyed) Open Woodlands/Grasslands site of 'Good Condition'

C) Actions – Open Woodlands/Grasslands:

Size/Extent Related:

- **Encourage landholders to increase the size** of sites through buffering (e.g. fence to allow natural regeneration).
- **Encourage the buffering** of site 792513_134 and other grassland sites within the Zone.

Condition Related:

Education/Extension:
- **Liaise with landholders** of all identified sites, regarding their past and future management.
- **Promote the benefits/uniqueness** and management requirements of diverse native grasslands/open woodlands (e.g. a field day at one of the identified sites).
- **Discourage the planting of trees and shrubs** in identified sites.
- **Liaise** with Native Grass Officer (DSE) regarding inclusions of grassland sites on the Native Pasture Management layer and their ongoing management.
- **Encourage** extension officers, Landcare Groups and landholders to report significant grassland communities, for the possible inclusion on the Native Pasture Mapping layer (DSE).
- **Provide stakeholders** (and especially those with identified sites) with the SIR Flora Booklet to assist with the identification of grassland species.

On-ground Works:
- **Develop a site management plan** for identified sites and implement recommended actions.
- **Survey all roadsides** adjacent to identified sites during Spring.
- **Encourage** Local Government to protect all roadsides adjoining grassland sites (e.g. signage using the 'Enviromark' method or the 'DSE system').
- **Encourage landholders** to protect sites for the long-term (e.g. covenants).
- **Support landholders** and community groups in the protection of all sites (e.g. environmental incentives and extension).
- **Conduct trials for on-ground works** (e.g. fire management, stock management and replanting) in consultation with all relevant stakeholders and scientists/experts.
- **Investigate funding options** for successfully trialed management options (as trialed above).
- **Create conditions** for recruitment (where required, appropriate and agreed) through management techniques (e.g. reduced competition and grazing pressure, scarifying soil).
- **Liaise** with Trust for Nature (Vic) regarding trials at Naringaningalook Grasslands (e.g. fire and fencing) for use in other sites.
- **Review current pasture management** of sites (e.g. reduced grazing, slashing) to enable recruitment of existing species to occur (DSE 2004).
- **Control the spread** of pasture grasses from adjacent cropping land (Ahern *et al* 2003).

Threatened Species:
- **Protect known records** of threatened species within sites (e.g. *Swainsona spp.*) by providing stakeholders with extension regarding their protection and enhancement.
- **Collect seed** from threatened flora within the Zone and encourage propagation.

Pest Plants and Animals:
- **Protect sites** through the management of pest plants, grazing and reduced vehicle movement.
- **Manage** pest plants for the benefit of grassland flora and liaise with DPI Pest Management Officers and the land manager, regarding their on-going management.

Landscape Processes (e.g. hydrological regime, habitat connectivity):

- **Link** priority sites with roadsides (where possible) and investigate linking sites by the creation of corridors.
- **Identify further opportunities to link priority sites,** by mapping all sites planted as part of the Grey-crowned Babbler (*Pomatostomus temporalis*) and Superb Parrot (*Polytelis swainsonii*) projects.

Note: The actions identified in this section could be implemented for other areas that contain ground-cover species and characteristics in the Barmah Landscape Zone.

7.7 SAND WOODLANDS

A) Introduction – Sand Woodlands:

The key biodiversity asset 'Sand Woodlands' is comprised of Shallow Sand Woodland Ecological Vegetation Class (EVC) and Sand Ridge Woodland EVC. These EVCs typically occur on natural high sand ridges or dunes, typically formed by large rivers, depositing the deep sandy soils at elevations of 100-125m. They are generally a grassy ecosystem with an overstorey of Yellow Box *(Eucalyptus melliodora)*, White Cypress-pine (Murray Pine) (*Callitrus glaucophylla*), Buloke (*Allocasuarina leuhmanii*), and sometimes Grey Box (*Eucalyptus microcarpa*). The shrub layer generally consists of Wattles (*Acacia spp*) such as Lightwood (*Acacia implexa*), Grey Mulga (*Acacia brachybotrya*), Golden Wattle (*Acacia pycnantha*), Mallee Wattle (*Acacia montana*), Gold-dust Wattle (*Acacia acinacea*), Weeping Pittosporum (*Pittosporum phylliraeoides*), Emubush (*Eremophila longifolia*) and Drooping Cassinia (*Cassinia spp.*) (Ahern *et al* 2003).

This asset type primarily occurs in conjunction with Plains Woodland EVC, on sandier rises (e.g. Sand Ridge Track within the Barmah Forest). The largest remnants of this asset exist in the North of the Zone (e.g. Picola and Kotupna). They are subject to threats including, grazing management, edge effects/adjacent land use practices, pest plants and pest animals (rabbits). A number of threats also result in a lack of species diversity (e.g. no understorey) which threatens the long-term viability of sites. The sites are of high priority for the area, especially for species such as Bush Stone-curlew (*Burhinus grallarius*) and Rainbow Bee-eaters (*Merops ornatus*). Whilst a number of sites had on-ground works that had previously taken place (see picture below), further work is needed to protect and manage the sites for biodiversity. The actions identified below are intended to assist in the protection of the remaining remnants within the Zone. However, these actions are specific to the Zone and are by no means comprehensive for the Region.

B) Photographic Example – Sand Woodlands:

Example of a (surveyed) Sand Woodland BAP Site of 'Good Condition'* for the Barmah Landscape Zone
* Based on the Vegetation Quality Assessment (VQA) scores for sites surveyed in the Zone

Although this site (792633_378) only scored 7 on the VQA, it is an endangered EVC (Sand Ridge Woodland). The site is over 7 hectares in size and has recently been planted with shrubs (e.g. *Acacia spp.*) along the Northern extent. The site contains overstorey such as White-Cypress Pine (*Callitris glaucophylla*) and Buloke (*Allocasuarina luehmannii*) and records of birds such as Rainbow Bee-eaters (*Merops ornatus*).

Plate: An example of a (surveyed) Sand Woodland site of 'Good Condition' for the Barmah Landscape Zone

C) Actions – Sand Woodlands:

Size/Extent Related:
• **Encourage landholders to increase the size** of existing remnants, to establish new areas of indigenous species of trees and shrubs, and to retain or establish buffer zones of unimproved, uncultivated pasture around woodland (DSE 2005a).   • **Extend remnants** and create corridors to combat the affect of isolation of remnants (e.g. loss of a healthy gene pool such as Buloke (*Allocasuarina luehmanii*)).

Condition Related:

Education/Extension:
- **Encourage** landholders to leave fallen branches and debris on the ground, especially at known Bush Stone-curlew (*Burhinus grallarius*) sites (DSE 2005a).
- **Encourage** the retention of dead trees as habitat for Birds, Reptiles, Insects and Mammals.
- **Work** with local community groups/landholders to **implement community education activities** relating to the importance of Sand Woodlands and associated flora and fauna species, specifically targeting priority remnants in paddock environments.
- **Develop a demonstration site** (showcasing a high value site) for educational purposes.
- **Promote** the benefits and value of native grasses in remnants, through education/extension.

On-ground Works:
- **Encourage the protection (fencing)** of all Sand Woodland remnants and manage grazing practices (e.g. encourage the exclusion of domestic grazing in remnants to allow plants to seed and regenerate (especially during Summer/Autumn). Manage stock grazing for the benefit of native vegetation once plants set seed) (NRE 2002c).
- **Enhance** priority sites with indigenous vegetation if regeneration has not occurred following fencing (e.g. no existing viable seed source).
- **Collect seed** from sites over Summer and direct seed by hand in early Autumn (or have propagated by nursery) if not having success with natural regeneration.
- **Keep irrigation run-off** at least 20-metres away from the base of trees (ideally further).
- **Encourage the development of site management plans** for all Sand Woodland sites.
- **Survey** the presence and habitat requirements of Rainbow Bee-eaters (*Merops ornatus*) at all Sand Woodland sites, commencing with sites of known records (e.g. during October-February).
- **Encourage the protection** of sites with known records of Rainbow Bee-eaters (e.g. Picola and Bunbartha areas).
- **Create conditions** for recruitment (where required, appropriate and agreed) through management techniques (e.g. reduced competition and grazing pressure and scarifying soil).
- Conduct further **wildlife surveying** (e.g. for species of mammals, reptiles, bats and frogs) as per the method utilised in the Murray Catchment (NSW) (Herring *et al* 2007).

Threatened Species:
- **Investigate** all identified sites for the presence of both male and female (or combined) Buloke trees to determine ability to regenerate (other than from root disturbance).
- **Survey** the presence of reptiles in the SIR and opportunities for protection (Herring *et al* 2007).

Pest Plants and Animals:
- **Manage pest plants** for the benefit of Sand Woodland flora and liaise with DPI Pest Management Officers and the land manager, regarding their management.
- **Undertake integrated fox programs** in areas with known records of threatened species.
- **Encourage integrated rabbit management** in all high priority (in consultation with DPI).
- **Evaluate** current extension processes for managing rabbits and investigate options within the Environmental Incentives, to provide assistance with rabbit management prior to enhancement.
- **Develop a rabbit management brochure**, for all extension officers to provide to landholders wishing to uptake environmental incentives, particularly for Sand Woodlands.
- **Undertake weed control** (particularly during Summer/Autumn) to encourage regeneration of seed (e.g. White Cypress-pine (Murray Pine) (*Callitris glaucophylla*) and Buloke) (NRE 2002c).

Landscape Processes (e.g. hydrological regime, habitat connectivity)
• **Link** priority Sand Woodland remnants using the Landscape Context Model (Ferwerda 2003).   • **Extend linkages** along roadsides that contain Sand Woodland type EVCs (e.g. near Kotupna) in accordance with EVC requirements (and native grass management).

8.0 MONITORING

Monitoring is a fundamental component of all management activities and an important tool, which can be used to enhance the knowledge of biodiversity assets and manage for their on-going protection (Robinson *in prep.*).

The following table (Table 4) provides a basis for monitoring in the Barmah Landscape Zone. Where possible this information will feed into the various Goulburn Broken Catchment monitoring programs. It identifies a general monitoring outline, including actions that may be conducted to determine progress towards achieving Catchment biodiversity targets. It identifies the key biodiversity asset, key indicators for monitoring and the suggested frequency/intensity of monitoring.

It is important to note that many of the monitoring activities listed below are already taking place, through a variety of mechanisms (e.g. collection of data via Local, Catchment and Statewide databases and processes). Where existing mechanisms are already in place, they will continue to be used. However there are other monitoring activities that are needed, to provide useful information and allow for accurate assessment of the Goulburn Broken Catchment progress towards meeting the Biodiversity Resource Condition Targets (RCTs).

A wide variety of monitoring actions are listed below. However this does not result in a binding commitment of organisations (e.g. time or funding) to undertake all of the monitoring. Rather, this table is intended to be a source of ideas for agency staff and community groups (e.g. community groups may be interested in conducting further surveys). Interested persons can contact the Goulburn Broken Catchment Management Authority, Shepparton, or the Department of Primary Industries/Department of Sustainability and Environment Offices, Tatura, to discuss ideas and to ensure a coordinated approach (refer to Section 10.0 for contact information).

Whilst Table 4 outlines monitoring actions, evaluation of the BAP process also needs to occur to evaluate its effectiveness (e.g. in engaging people and prioritising works). An evaluation plan is therefore being developed to provide an overarching evaluation process for BAP in the Goulburn Broken Catchment.

Table 4: Monitoring - Barmah Landscape Zone

Key Biodiversity Asset	Key Indicators for Monitoring	Frequency/Intensity
1) Waterways	• Trends in environmental flows and in-stream habitat condition (as measured by ISC).	Five yearly* ISC assessments
	• Trends in water quality.	Once yearly as part of EPA monitoring: five yearly as part of ISC: at least 30 sites (GBCMA 2004b)
	• Monitor the trends in condition and functionality of riparian vegetation/stream frontage condition (resurveying of sites using VQA assessments; area/number fenced; and area/number with restored flows).	Every 5 years, 30 sites: part of ISC; CAMS inputs
	• Surveying of mean habitat width of waterways in Zone.	Every 5 years, all sites (or in accordance with existing waterways monitoring), aerial photography
2) Wetlands	• Monitoring of wetlands using index of wetland condition guidelines, as well as Vegetation Quality Assessments (to allow priority comparison).	Every 5 years
	• Number of significant wetlands with improved hydrological regimes.	Every 5 years
	• Percentage (%) of sites with barriers to natural flow.	Every 5 years
3) Public Land	• Refer to "All Key Biodiversity Sites" below.	See below
4) Plains Woodland	• Refer to "All Key Biodiversity Sites" below.	See below
5) Riverine Woodland	• Refer to "All Key Biodiversity Sites" below.	See below
6) Open Woodlands/ Grasslands	• Refer to "All Key Biodiversity Sites" below.	See below
7) Sand Woodlands	• Refer to "All Key Biodiversity Sites" below.	See below

* Five yearly refers to five times per year

All Key Biodiversity Assets	• Trends in vegetation condition (resurvey sites using VQA assessments) (including the threat data).	Every 5 years: wetlands – 20 sites; woodlands/grasslands – 30 sites
	• Trends in bird survey data (resurvey sites using bird survey method).	Every 5 years: wetlands – 20 sites; woodlands/grasslands – 30 sites
	• Photographic point surveys (re-photograph sites).	Every 5 years: when complete VQA and bird surveys
	• Vegetation Quality Assessments, bird surveys and photographic point surveys at the remaining unsurveyed BAP sites.	Within next 5 years: to allow monitoring of these sites (as outlined above)
	• Inclusion and surveying of up-to-date data and information (if any changes), or addition of sites (e.g. if not already an identified site).	Once yearly: all new information; all sites
	• Trends in Focal Species reporting/sightings (e.g. population size, age distribution, frequency of records, number of birds/pairs recorded, habitat (e.g. number of sites/EVC), breeding success, recruitment).	Initial survey throughout Zone to establish baseline data on population size and structure, subsequent two-yearly as part of bioregional program: across the Zone
	• Monitoring of threatened species against current records.	Every 2 years: across the Zone
	• Undertake surveys for all of listed (threatened) species to establish baseline data on abundance and distribution in accordance with Victorian Rare or Threatened Population (VROTPop) procedures.	Within next 5 years: across the Zone
	• Subsequent assessments of selected populations (as per above threatened populations) to determine population trends.	Within next 5 years (subsequent to above action): across the Zone
	• Trends in connectivity and characteristics of sites within landscape (e.g. size of remnants).	Every 5 years: aerial photography
	• Overlay of on-ground works areas against BAP mapping data.	Once yearly (end financial year): all applicable sites
	• Number of incentives processed and implemented for priority sites for all Key Biodiversity Assets (private land only).	Once yearly: in accordance with incentive mapping and overlaying of on-ground works areas (as per above action)
	• Trends in plants of special concern (e.g. undertake monitoring of River Swamp Wallaby-grass in the Zone to further determine management requirements).	Once: then as required

9.0 FURTHER INFORMATION – PRIORITY SITES

Priority Site Data:

Appendix 12 provides further information on obtaining data for the 406 priority BAP sites within the Barmah Landscape Zone. It is intended that the priority site information and other information detailed in this Plan, will allow groups and staff (e.g. extension staff and community groups) to;

- Be pro-active in targeting sites,
- Act as a basis for informed management of the site,
- Provide a further rationale for applying incentives,
- Provide a tool for landholders and the wider community,
- Provide a tool to show how a site fits into the wider landscape, and
- Provide a benchmark against which future improvements in management can be monitored.

How to Use the Data Provided:

The data provided is intended for use by a range of agencies and community groups, to assist with biodiversity conservation in the Zone. It is particularly targeted towards extension officers. For example, it is anticipated that prior to, or following a site visit, an extension officer will investigate the data associated with a site, such as;

- What is the Ecological Vegetation Class of the site?
- How does the site fit in to the wider landscape?
- Are there any management agreements or incentives for the site (e.g. covenant, bush tender)?
- Are there threatened or notable species recorded at the site or nearby?
- What is the rating of the site and those near it (e.g. Very High, High, Medium or Low)?
- What are the actions recommended for the site (e.g. pest plant management)?
- What are the options available to the landholders to fulfil these actions (e.g. fencing incentive)?
- What are the options for joining the site to public land (e.g. widening roadsides to provide a corridor/link)?
- Use the Landscape Context Map (Appendix 9) to determine where possible linkages (revegetation) may be of the most benefit – think about the landscape, what we could do to help the area?
- It is also important to remember that sites with scattered trees are still a vital link in the landscape and especially in an area where much of the original vegetation has given way to agriculture. Officers need to determine on-site where the best possible linkages could occur, and often this should include scattered vegetation, as although scattered vegetation have not always been identified as sites in this Plan, they form an important element for providing links between the identified sites.

Keeping the Data Current:

The data contained in this report is by no means 'comprehensive', as this process relies on the regular updating of information, to keep it accurate and timely. Therefore this Plan is adaptive so as to enable management actions and information to be modified in response to further information, including monitoring. This Plan will also be reviewed when necessary to ensure that it remains a 'living' document. In order for the data and associated maps to remain as up-to-date and relevant as possible, it is important that site data continue to be added to the database. For example, the Department is not always aware of sightings of flora and fauna by individual landholders or community groups and there are a number of sites that require Vegetation Quality Assessments and Bird Surveys.

Further Information or to Provide Data:

BAP data relies on regular updating to keep the information relevant for users. For clarification of information or to provide further data, please refer to Appendix 12 (CD) or contact bap@gbcma.vic.gov.au, or the Biodiversity Action Planning Officer, Department of Sustainability and Environment, Benalla PO BOX 124, Vic 3672.

10.0 LANDHOLDER ASSISTANCE

There is a range of assistance available for landholders planning for biodiversity conservation and implementing works on their properties. This section is designed to provide an overview of some of the property planning, management tools and incentives available to landholders within the Shepparton Irrigation Region. Also included are some of the programs that could benefit from the information provided in this Plan.

LOCAL AREA PLANS	*WHOLE FARM PLANS*
These Conservation Plans will provide an extra resource for Local Area Planning groups, in relation to their Local Area Plans. It can assist groups with both implementation and in the provision of further information for conducting biodiversity planning in their area.	Protecting biodiversity on farm is an important element when developing and implementing a Whole Farm Plan. Biodiversity Action Planning can inform the process and provide extra information for landholders and extension officers.

Advice and Information:
Please contact your local Department of Primary Industries (DPI)/Department of Sustainability and Environment (DSE) Office, the Goulburn Broken Catchment Management Authority (GBCMA), the Goulburn Murray Landcare Network (GMLN) or Trust for Nature (TfN) (Vic), for further information on biodiversity conservation. There are extension officers within these organisations who can provide advice on a range of aspects such as, Whole Farm Planning, irrigation design, groundwater management, revegetation and protection of remnant vegetation, threatened species protection and best management practices.

Incentives for On-Ground Works:
There are a range of incentives available for landholders within the Shepparton Irrigation Region for Catchment works, including;
♦ Environmental Incentives - (e.g. fencing, direct seeding and revegetation) to assist with the protection and/or enhancement of remnant vegetation, including wetlands and grasslands,
♦ Tree Growing incentives - to assist with the re-establishment of native vegetation, and
♦ Water Use Efficiency Incentives (including Whole Farm Planning, Reuse and Automatic Irrigation).
  For the above three points, contact the Department of Primary Industries, Tatura on (03) 58 335 222.
♦ Waterways Incentives – for on-ground works along rivers and creeks.
  For the above point, contact the GBCMA office Shepparton on (03) 58 201 100.

Management Arrangements:
Programs such as Carbon Tender, Bush Returns, EcoTender and Bush Broker, may provide incentives and advice for long-term conservation management on properties. *Contact the GBCMA Shepparton on (03) 58 201 100 for further information or visit www.gbcma.vic.gov.au*

Permanent Protection:
A Conservation Covenant permanently protects sites for conservation. It may provide assistance for rate relief, tax concessions and incentives for the costs of on-ground works. *TfN (VIC) is the managing organisation in regard to Conservation Covenants; visit their website at www.tfn.org.au*

Other Assistance:
♦ Goulburn Murray Landcare Network Shepparton – Landcare related advice (www.gmln.org.au).
♦ Land for Wildlife – a voluntary scheme aiming to encourage and assist landholders to protect and enhance biodiversity values on their properties. *Managed by the Department of Sustainability and Environment. For further information visit www.dse.vic.gov.au*
♦ Local Government (Moira Shire or Greater Shepparton City Council) – managing authority for native vegetation statutory planning requirements. *For further information visit www.moira.vic.gov.au or www.greatershepparton.com.au*

11.0 REFERENCES

Ahern, L.D., Lowe, K.W., Berwick, S., Robinson, D. & Handley, K. (2003). *Biodiversity Action Planning: Landscape Plans for the Goulburn Broken Catchment Management Authority (GBCMA) - SIR – North Zones*. DSE, Victoria.

Bennett, A.F. (1993). *Fauna conservation in Box & Iron-Box forests: a landscape approach*. Victorian Naturalist 110:15-23.

Bennett, A. (1998). *Fragments for the future: wildlife in the Victorian Riverina*. State of Victoria, Melbourne.

Berwick, S (2003). *Map Unit Descriptions of Lower Goulburn Broken* (draft). State of Victoria, Melbourne.

Birds Australia (2001). *Bird Surveying Techniques*. http://www.birdsaustralia.org.au

CGDL (2005). *Corporate Geographical Database Library* (CGDL). State of Victoria, Melbourne.

Crown (1997). *Victoria's Biodiversity: Directions in Management*. State of Victoria, Melbourne.

DPI (2003). *Riverine Grassy Woodlands/Forest*. State of Victoria, Melbourne. http://www.dpi.vic.gov.au

DPI (2005). *Dairying for Tomorrow: Dairy Sat- The Guide*. State of Victoria, Melbourne.

DPI (2006a). *Kanyapella Basin Environmental Management Plan*. State of Victoria, Melbourne.

DPI (2006b). *Wyuna Reserve Environmental Management Plan*. State of Victoria, Melbourne.

DPI (2006c). *Assessment of High Value Environmental Features in the SIR*. Department of Primary Industries, Victoria.

DSE (2003). *Barmah Forest Ramsar Site: Strategic Management Plan*. State of Victoria, Melbourne.

DSE (2004). *Environmental Management in Agriculture: Worksheet Series 1-8*. State of Victoria, Melbourne.

DSE (2005a). *Actions for Biodiversity Conservation Database* (ABC). DSE, State of Victoria, Melbourne.

DSE & GBCMA (2005b). *Asset Environmental Management Plan: Barmah Significant Ecological Asset*- Draft: 23 March 2005. DSE, Benalla and Goulburn Broken Catchment Management Authority (GBCMA), Shepparton.

DSE (2005c). *Murray-Darling Basin Salinity Management Strategy*. State of Victoria, Melbourne.

DSE (2006). *Index of Wetland Condition: Assessment of wetland vegetation*. State of Victoria, Melbourne.

EA (2001). *Directory of Important Australian Wetlands* (3rd ed). Environment Australia.

EA (2002). *List of Wetlands of International Importance*. Inland Waters – Ramsar Convention. Environment Australia.

Ferwerda, F. (2003). *Landscape Context Model*. State of Victoria, Melbourne.

GBCMA (2000). *Goulburn Broken Native Vegetation Plan*. GBCMA, Shepparton. http://www.gbcma.vic.gov.au

GBCMA (2003). *Goulburn Broken Regional Catchment Strategy*. GBCMA, Shepparton.

GBCMA (2004a), Developer's Manual for Biodiversity Action Planning in the Goulburn Broken Catchment. Goulburn Broken Catchment Management Authority, Shepparton.

GBCMA (2004b). *Goulburn Broken River Health Strategy* (draft). GBCMA, Shepparton.

Herring, M., Webb, D. & Pisasale, M. (2007). *Murray Wildlife – Murray Land & Water Management Plan Wildlife Survey 2005-2006.* Murray Wildlife and Murray Irrigation Limited, NSW.

Howell, M. (2002). *Wetland Directions Paper for the Goulburn Broken Catchment*. GBCMA, Shepparton.

Huggett, A. (2007*). A review of the focal species approach in Australia*. Land and Water Australia, Canberra.

Lambeck, R.J. (1997). *Landscape planning for biodiversity conservation in agricultural regions*. Biodviersity Technical paper No. 2. Commonwealth of Australia, Canberra.

LCC (1989). *Rivers and Streams Special Investigation – Proposed Recommendations*. Land Conservation Council, Victoria.

Lunt, I. (1998). *Protecting our wonderful woodland remnants*. Charles Sturt University, Thurgoona, NSW.

MacNally, R. (2006). *Longer-term response to experimental manipulation of fallen timber on forest floors of floodplain forest in south-eastern Australia*. Forest Ecology and Management, 229, 155-160.

MDBC (2002). *The living Murray – Restoring the health of the River Murray*. Murray Darling Basin Commission, Canberra.

Moira Shire Council (1998). *Roadside Management Plan and Mapping of significant roadsides*. Moira Shire Council, Cobram.

NRE (2002a). *Victoria's Native Vegetation Management: a Framework for Action*. State of Victoria, Melbourne.

NRE (2002b). *Healthy rivers, communities & regional growth: Victorian River Health Strategy*. State of Victoria, Melbourne.

NRE (2002c). *Protecting White cypress-pine and Buloke in the Shepparton Irrigation Region*. State of Victoria, Melbourne.

NRE (2002d). *Forest Management Plan for the Mid-Murray Forest Management Area*. State of Victoria, Melbourne.

NRE (2002e). *Victorian Flora Site Database.* May 2002. State of Victoria, Melbourne.

NRE (2002f). *Atlas of Victorian Wildlife.* March 2002. State of Victoria, Melbourne.

Platt, S.J. (2002). *How to plan wildlife landscapes: a guide for community organisations*. State of Victoria, Melbourne.

Platt, S.J. & Lowe, K.W. (2002). *Biodiversity Action Planning: planning for native biodiversity at multiple scales – catchment, bioregional, landscape, local*. State of Victoria, Melbourne.

Robinson, D. (*in prep.*). *A monitoring, evaluation and reporting strategy for the Longwood Plains Biodiversity Project*. Trust for Nature (TfN) (Vic) & DSE, Benalla.

VEAC (2006). *River Red Gum Forests Investigation – Discussion Paper*. East Melbourne, Victoria.

Weber, R & Ahern, L. (1992*). Action Statement No 33 Flora and Fauna Guarantee Act 1988. Superb Parrot, Polytelis swainsonii*. State of Victoria, Melbourne. http://www.dse.vic.gov.au

Wierzbowski, P., Lowe, K.W., Handley, K, Berwick, S., Robinson, D. & Ahern, L.D. (2002). *Biodiversity Action Planning: Strategic Overview for the Victorian Riverina Bioregion*. State of Victoria, Melbourne.

Wilson, J.A & Lowe, K.W. (2002). *Planning for the conservation of native biodiversity within catchments using biophysical modelling*. State of Victoria, Melbourne.

12.0 ACKNOWLEDGMENTS

13.0 APPENDICES

APPENDIX 1 – VICTORIAN BIOREGIONS
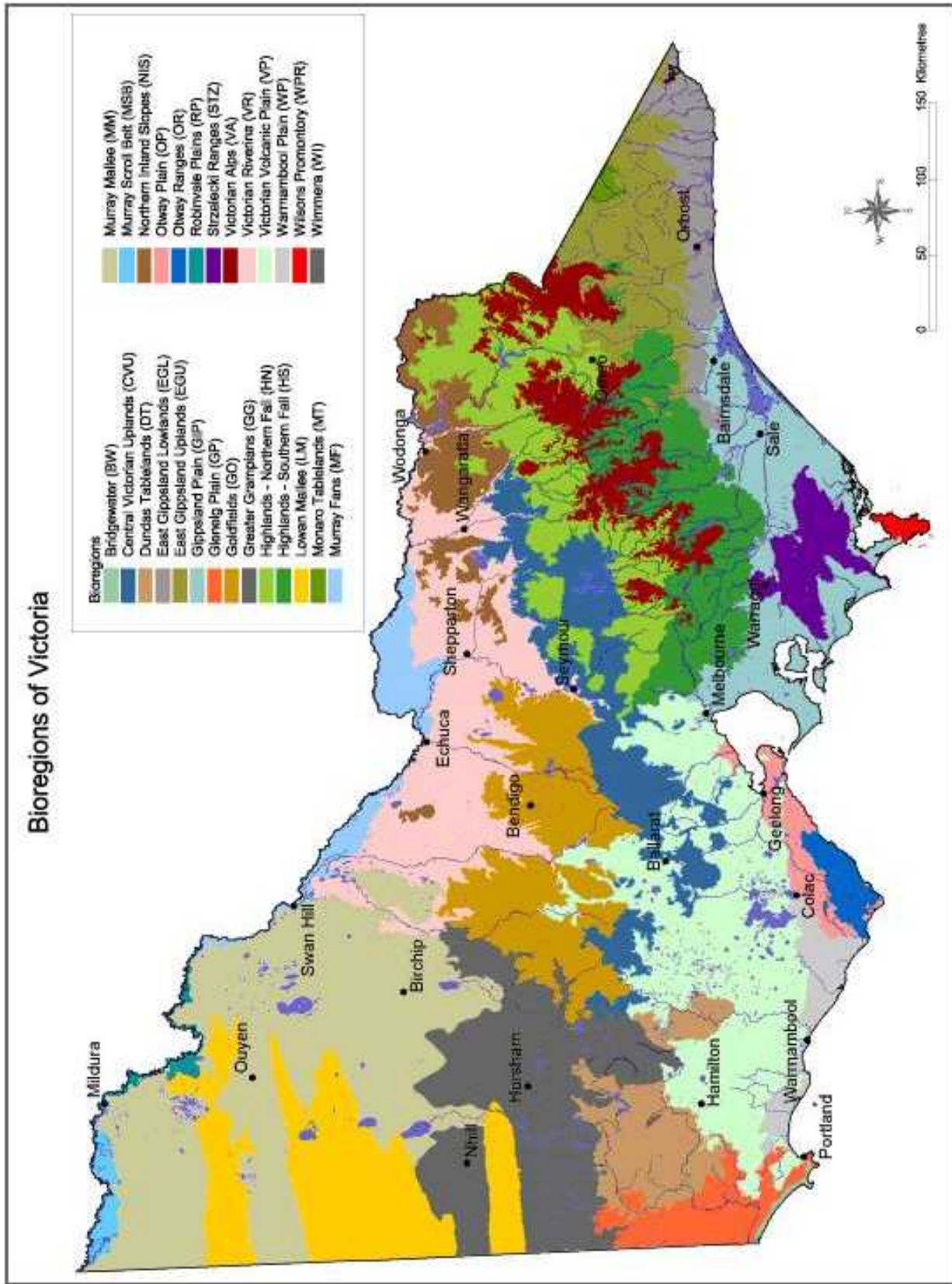
Source: www.dse.vic.gov.au

APPENDIX 2 – VICTORIAN LANDSCAPE ZONES

Landscape Zones for Bioregional Action Planning
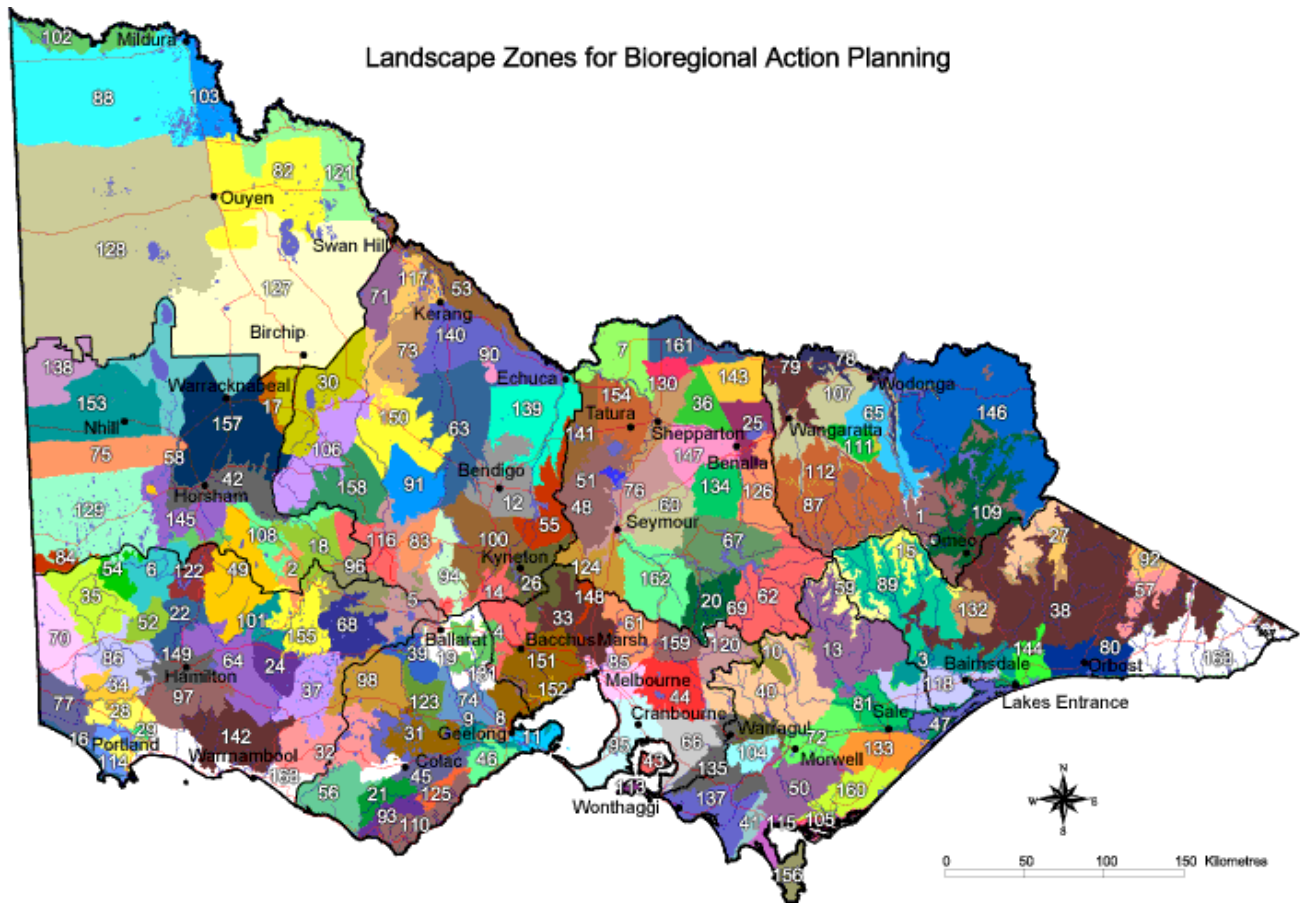
1. Alpine	34. Crawford River	67. Lake Eildon	100. Muckelford	133. Stradbroke
2. Ararat Hills	35. Dergholm	68. Lake Goldsmith	101. Muirhead	134. Strathbogie
3. Bairnsdale foothills	36. Dookie	69. Lake Mountain	102. Murray Scroll Belt	135. Strzelecki West
4. Ballan	37. Dundonnel	70. Lake Mundi	103. Nangiloc - Colignan	136. Tanjil
5. Ballarat	38. East Gippsland Uplands	71. Lalbert	104. Narracan	137. Tarwin/Powlett
6. Balmoral	39. Enfield	72. Latrobe	105. Nooramunga	138. Telopea Downs
7. Barmah Murray Fan	40. Erica	73. Leaghur	106. North Central	139. Tennyson
8. Barrabool	41. Fish Creek	74. Leigh	107. North East	140. Terrick
9. Barwon	42. Flat Grey Plains	75. Little Desert	108. Northern Footslopes	141. Timmering Dryland
10. Baw Baw	43. French Island	76. Longwood	109. Omeo	142. Tower Hill
11. Bellarine	44. Gembrook	77. Lower Glenelg	110. Otway	143. Tungamah
12. Bendigo	45. Gerangamete	78. Lower Kiewa	111. Ovens	144. Tyres
13. Black Range	46. Gherang	79. Lower Ovens	112. Ovens & King	145. Undulating Alluvial
14. Blackwood	47. Gippsland Lakes	80. Lower Snowy	113. Phillip Island	146. Upper Murray Mitta
15. Bogong	48. Goldfields	81. Macallister	114. Portland	147. Violet Town
16. Bridgewater	49. Grampians	82. Manangatang	115. Prom Plain	148. Wallan
17. Brim Lawler	50. Grand Ridge	83. Maryborough	116. Pyrenees	149. Wannon
18. Bulgara	51. Graytown	84. Meereek	117. Quambatook	150. Wedderburn
19. Buninyong	52. Gringegalgona	85. Melbourne	118. Red Gum Plain	151. Werribee
20. Buxton	53. Gunbower	86. Merino	119. Reedy Lake	152. Werribee South
21. Carlisle	54. Harrow	87. Mid King	120. Reefton	153. West Wimmera Plain
22. Cavendish	55. Heathcote	88. Millewa - Carwarp	121. Robinvale - Nyah	154. Western Goulburn
23. Central Creek	56. Heytesbury	89. Mitchell	122. Rocklands	155. Willaura
24. Chatsworth	57. Highlands - Far East	90. Mitiamo	123. Rokewood	156. Wilsons Promontory
25. Chesney	58. Hindmarsh	91. Moliagul	124. SW Goulburn	157. Wimmera Plains
26. Cobaw	59. Howitt	92. Monaro Tableland	125. Sabine	158. Wingallok
27. Cobbera	60. Hughes Creek	93. Moomowroong	126. Samaria/Lake Nillahcootie	159. Yarra
28. Cobboboonee	61. Hurstbridge	94. Moorookyle	127. South East Mallee	160. Yarram
29. Codrington	62. Jamieson/Bulla	95. Mornington	128. South West Mallee	161. Yarrawonga Murray Fan
30. Corack	63. Jarklin	96. Mount Cole	129. South West Wimmera	162. Yea
31. Corangamite East	64. Karabeal	97. Mount Eccles	130. Southern Goulburn	163. unnamed
32. Corangamite West	65. Kiewa	98. Mount Elephant	131. Steiglitz	
33. Craigieburn	66. Koo Wee Rup	99. Mt Talbot	132. Stirling	

Source: www.dse.vic.gov.au

APPENDIX 3 – GOULBURN BROKEN CATCHMENT TARGETS

This Appendix is intended to provide a summary of the Goulburn Broken Regional Catchment Strategy targets and priorities for biodiversity conservation. For further information please refer to GBCMA 2003 or visit www.gbcma.vic.gov.au.

The Goulburn Broken Regional Catchment Strategy identifies the following biodiversity 'Resource Condition Targets' for native vegetation in the Catchment;

1. Maintain the extent of all native vegetation types at 1999 levels in keeping with the goal of 'Net Gain' listed in Victoria's Biodiversity Strategy 1997,
2. Improve the quality of 90% of existing (2003) native vegetation by 10% by 2030,
3. Increase the cover of all endangered and applicable vulnerable Ecological Vegetation Classes to at least 15% of their pre-European vegetation cover by 2030,
4. Increase 2002 conservation status of 80% threatened flora and 60% threatened fauna by 2030,
5. Maintain the extent of all wetland types at 2003 levels where the extent (area and number) has declined since European settlement, and
6. Improve the condition of 70% of wetlands by 2030, using 2003 as the benchmark for condition (GBCMA 2003 p11).

Priorities for action to conserve biodiversity in the Goulburn Broken Catchment (GBC) are driven by the conservation significance of the biodiversity asset. Regional investments in biodiversity conservation in the Catchment are driven by the following goals (in order of priority);

1. **Protecting** existing viable remnant habitats and the flora and fauna populations they contain (e.g. through reservation, covenants, management agreements, fencing and statutory planning),
2. **Enhancing** the existing viable habitats that are degraded (e.g. management of threats such as pest plants and animals, grazing, salinity, promotion of natural regeneration and/or revegetation with understorey), and
3. **Restoring** under-represented biodiversity assets to their former extent by revegetation (to create corridors, buffers, patches of habitat) (GBCMA 2003).

APPENDIX 4 – COMMUNITY ACTIVITIES

A Communication Plan was developed in the Shepparton Irrigation Region, to guide Biodiversity Action Planning community consultation activities. The following list identifies the range of community consultation activities that have occurred during the development of this Plan.

Note: Whilst a large number of activities have occurred in the Goulburn Broken Catchment that led to the development of these plans (e.g. existing biodiversity management programs and strategies), only the most recent activities in relation to this Conservation Plan have been included.

- Steering Committee Meetings – (quarterly) Goulburn Broken Biodiversity Action Planning Steering Committee Meetings. Comprising representatives from; Department of Primary Industries (DPI), Department of Sustainability and Environment (DSE), Goulburn Broken Catchment Management Authority (GBCMA) and Trust for Nature (Victoria) (TfN) (Vic).

- Working Group Memos/Presentations (papers, plan reviews and technical/ community advice from the Shepparton Irrigation Region Technical Committee (SIRTEC) and the Shepparton Irrigation Region Implementation Committee (SIR IC) respectively).

- May 2006 – July 2006 – Field Surveying – Liaisons with Landholders regarding property access, background to BAP process, Field Surveys, Data Collection and Local Knowledge.

- Presentation/Meeting – 6th September 2005 & May 2006 - Nathalia Local Area Planning (LAP) Group.

- Monthly Environmental Management Program report to stakeholders regarding progress of the Barmah Landscape Zone Conservation Plan and Biodiversity Action Planning (on-going).

- Newspaper Article – January 2006 – SIR IC Land and Water Update Column, Country News.

- Newspaper Article – March 28th, 2006, 'Plans for Nature' Country News. Also listed in DPI News - Notes and e-mailed to DPI Staff.

- Biodiversity Celebration Day – September 2006 regarding Biodiversity Action Planning - launch of two Plans and background information.

- Meeting/Presentation – October 2006 – Local Area Planning Facilitator's regarding Biodiversity Action Planning. Nanneella Hall, Nanneella.

- Draft Plan Community Review - November 2006 – January 2007. Community Consultation (letters, phone calls, e-mails and/or meetings) 'Draft Conservation Plan for the Barmah Landscape Zone'. Plan sent for comment to a number of representatives of the following agencies/community groups: SIR IC, SIRTEC, GBCMA, DPI, DSE, TfN (Vic), Goulburn-Murray Water, Parks Victoria, Goulburn Murray Landcare Network, Local Government, Nathalia LAP Group and Nathalia Tree Group.

- Final Plan Review/Approval – February – September 2007 – Environmental Management Program, Steering Committee, SIRTEC and SIR IC.

APPENDIX 5 – THREATENED FLORA

List of threatened flora and their conservation status in the Barmah Landscape Zone (NRE 2002e).
Table modified from Ahern *et al* 2003.

English Name	Latin Name	Australian Status*	Victorian Status*	FFG Listed*	FFG Action Statement Number	BNA Assessment*	Species Number*
Buloke Mistletoe	*Amyema linophylla ssp. orientale*		v				217
Button Rush	*Lipocarpha microcephala*		v			Un	2020
Downs Nutgrass	*Cyperus bifax*		v			Un	913
Fat Spectacles	*Menkea crassa*		e	L			4734
Hooked Needlewood	*Hakea tephrosperma*		v			Un	1572
Large River Buttercup	*Panunculus papulentus*		k			Un	2900
Leafless Bluebush	*Maireana aphylla*		v			Un	2096
Long Eryngium	*Eryngium paludosum*		v			Un	1238
Mallee Golden Wattle	*Acacia notabilis*		v				65
Mountain Swainsona-pea	*Swainsona recta*	E	e	L		Un	3326
Mueller Daisy	*Brachyscome muelleroides*	V	e	L			465
Nealie	*Acacia loderi*		v			Un	52
Ridged Water-milfoil	*Myriophyllum porcatum*	V	v	L		Un	2257
River Swamp Wallaby-grass	*Amphibromus fluitans*	V	k				3623
Silky Swainson-pea	*Swainsona sericea*		v	N		Un	4946
Silky Umbrella-grass	*Digitaria ammophila*		v			Un	1041
Slender Club-sedge	*Isolepis congrua*		v	L		Un	1773
Slender Darling-pea	*Swainsona murrayana*	V	e	L			3321
Slender Sunray	*Rhodanthe stricta*		e	L		Un	1651
Slender Water-milfoil	*Myrioplyllum gracile var. lineare*		e	N		Un	4517
Small Scurf-pea	*Cullen parvum*	E	e	L	31		2773
Tough Scurf-pea	*Cullen tenax*		e	L		Un	2776
Twiggy Sida	*Sida intricata*		v			Un	3143
Umbrella Wattle	*Acacia oswaldii*		v			Un	70
Violet Swainson-pea	*Swainsona adenophylla*		e	N		Un	3319
Weeping Myall	*Acacia pendula*		e	L	86	Un	73
Western Water-starwort	*Callitriche cyclocarpa*	V	v	N			569
Yarran Wattle	*Acacia omalophylla*		e	L			69
Yellow-tongue Daisy	*Brachyscome chrysoglossa*		v	L			3654

* Australian (denoted by capital letter) Status of Species: E = Endangered, V = Vulnerable (in order highest to lowest).
* Victorian (denoted by lower case) Status of Species: e = endangered, v = vulnerable, r = rare, k = poorly known, cr = critically endangered.
* FFG (*Flora Fauna Guarantee Act 1988*) taxon: L = listed, N = Nominated to be Listed (individual species only - not if part of listed communities) and the accompanying identification number.
* BNA (Bioregional Network Analysis) Assessment: Un = Unassessed. Ranking refers to the required response level for each taxon (determined through the occurrence of the species in the Bioregion, in different land tenures, occurrence ranking, risk ranking and priority level).
* Species Number: State identification number/code attributed to individual species.

APPENDIX 6 – THREATENED FAUNA

List of threatened fauna and their conservation status in the Barmah Landscape Zone (NRE 2002f). Table modified from Ahern *et al* 2003.

English Name	Latin Name	Australian Status*	Victorian Status*	FFG Listed*	FFG Action Statement	Recovery Plan	BNA*	Species Number*
Australasian Bittern	*Botaurus poiciloptilus*		e				Un	197
Australasian Shoveler	*Anas rhynchotis*		v				Un	212
Baillon's Crake	*Porzana pusilla*		v				Un	50
Barking Owl	*Ninox connivens*		e	L	116		Un	246
Black Falcon	*Falco subniger*		v				Un	238
Blue-billed Duck	*Oxyura australis*		e	L	174		Un	216
Bluenose (Trout) Cod	*Maccullochella macquariensis*	E	cr	L	38	Y	Un	4093
Brolga	*Grus rubicunda*		v	L	119			177
Brown Treecreeper	*Climacteris picumnus*		k					555
Brush-tailed Phascogale	*Phascogale tapoatafa*		v	L	79		Un	1017
Bush Stone-curlew	*Burhinus grallarius*		e	L	78			174
Carpet Python	*Morelia spilota metcalfei*		e	I	175			2969
Diamond Firetail	*Stagonopleura guttata*		v	L			Un	652
Freckled Duck	*Stictonetta naevosa*		e	L	105			214
Freshwater Catfish	*Tandanus tandanus*		e	L				4050
Giant Bullfrog	*Limnodynastes interioris*		cr	L				3060
Golden Perch	*Macquaria ambigua*		v					4095
Great Egret	*Ardea alba*		v	L	120			187
Grey Goshawk	*Accipiter novaehollandiae*		v				Un	220
Grey-crowned Babbler	*Pomatostomus temporalis*		e	L	34			443
Ground Cuckoo-shrike	*Coracina maxima*		v	L			Un	423
Hardhead	*Aythya australis*		v				Un	215
Intermediate Egret	*Ardea intermedia*		cr	L	120			186
Lewin's Rail	*Rallus pectoralis*		v	L			Un	45
Little Bittern	*Ixobrychus minutus*		e					195
Little Egret	*Egretta garzetta*		e		120			185
Macquarie Perch	*Macquaria australasica*	E	e	L			Un	4096
Major Mitchell's Cockatoo	*Cacatua leadbeateri*		v	L	87		Un	270
Masked Owl	*Tyto novaehollandiae*		e	L	124		Un	250
Murray Cod	*Maccullochella peelii peelii*		e	L				4094
Musk Duck	*Biziura lobata*		v				Un	217
Painted Honeyeater	*Grantiella picta*		v	L			Un	598
Painted Snipe	*Rostratula benghalensis*		c				Un	170
Powerful Owl	*Ninox strenua*		v	L	92		Un	248
Regent Honeyeater	*Xanthomyza phrygia*	E	cr	L	41	Y	Un	603
River Blackfish	*Gadopsis marmoratus*		c				Un	4127
Royal Spoonbill	*Platalea regia*		v					181
Silver Perch	*Bidyanus bidyanus*		cr	L				4099
Speckled Warbler	*Chthonicola sagittata*		v				Un	504
Squirrel Glider	*Petaurus norfolcensis*		e	L	166			1137
Superb Parrot	*Polytelis swainsonii*	V	e	L	33			277
Swift Parrot	*Lathamus discolor*	E	e	L	169	Y	Un	309
Tree Goanna	*Varanus varius*		v				Un	2283
Growling Grass Frog	*Litoria raniformis*	V	e				Un	3207
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		v	L	60			226

* Refer to Appendix 5 for table definitions/explanation of terms.

APPENDIX 7 – SITE PRIORITISATION METHOD

To determine the conservation significance and the need for ground-truthing (surveying) sites were prioritised according to the following table (GBCMA *in prep.*). If ground-truthing was required and no survey was completed (e.g. more than 100 sites required survey), the minimum priority status was applied. *LCM refers to the Landscape Context Model.

Status of EVC	Potential habitat within known dispersal range of threatened taxon or focal species, or within priority areas as identified by LCM*	EVC Patch Size	Ground-truthing required to confirm priority rank on basis of vegetation condition	Priority Status: Very High, High, Medium or Low
Endangered	Y	<5ha	Ground-truthing needed	VH or H
E	N	<5ha	Ground-truthing needed	VH or H
E	Y	5-10ha	Ground-truthing needed	VH or H
E	N	5-10ha	Ground-truthing needed	VH or H
E	Y	11-40ha		VH
E	N	11-40ha		VH
E	Y	>40ha		VH
E	N	>40ha		VH
Vulnerable	Y	<5ha	Ground-truthing needed	M, H or VH
V	N	<5ha	Ground-truthing needed	M or H or VH
V	Y	5-10ha	Ground-truthing needed	M, H or VH
V	N	5-10ha	Ground-truthing needed	M or H or VH
V	Y	11-40ha		VH
V	N	11-40ha	Ground-truthing needed	H or VH
V	Y	>40ha		VH
V	N	>40ha		VH
Rare	Y	<5ha	Ground-truthing needed	M, H or VH
R	N	<5ha	Ground-truthing needed	M or H or VH
R	Y	5-10ha	Ground-truthing needed	M, H or VH
R	N	5-10ha	Ground-truthing needed	M or H or VH
R	Y	11-40ha		VH
R	N	11-40ha	Ground-truthing needed	H or VH
R	Y	>40ha		VH
R	N	>40ha		VH
Depleted	Y	<5ha	Ground-truthing needed	M or H
D	N	<5ha	Ground-truthing needed	L or M
D	Y	5-10ha	Ground-truthing needed	M or H
D	N	5-10ha	Ground-truthing needed	L, M or H
D	Y	11-40ha		H
D	N	11-40ha	Ground-truthing needed	M or H
D	Y	>40ha		VH
D	N	>40ha		VH
Least Concern	Y	<5ha		M
LC	N	<5ha		L
LC	Y	5-10ha		M
LC	N	5-10ha	Ground-truthing needed	L or M
LC	Y	11-40ha	Ground-truthing needed	M or H
LC	N	11-40ha	Ground-truthing needed	L or M
LC	Y	>40ha	Ground-truthing needed	H or VH
LC	N	>40ha	Ground-truthing needed	H or VH

APPENDIX 8 – VEGETATION QUALITY ANALYSIS (VQA) ASSESSMENT FORM

There are four survey forms for vegetation types in the Barmah Landscape Zone (e.g. grassland, wetland, plains grassy forests or woodlands and riverine forests or woodlands). The example below is the plains grassy forests or woodlands sheet (refer to DSE 2004 for further information). Information and other factors (e.g. threatening processes) were also recorded at each of the surveyed sites. For further information on obtaining assessment information/scores refer to Appendix 12.

ASSESSMENT OF HABITAT QUALITY – Self-assessment method

Site score sheet 12. Plains Grassy FORESTS or WOODLANDS

Component & Benchmark	Observations	Quality Range		Score
LARGE TREES Defined as trunk diameter or circumference at breast height. Apply to both WOODLANDS and FORESTS: **Diameter** (Circumference) 80 cm (250 cm)	**Number of large trees /ha (100m x 100m)**	*no large trees*	0	
		up to 7 LARGE TREES /ha in WOODLANDS 12 LARGE TREES /ha in FORESTS	1	
		more than 7 LARGE TREES /ha in WOODLANDS 12 LARGE TREES /ha in FORESTS	2	
CANOPY COVER Defined as the tallest stratum of native trees greater than 5m tall. Apply as: Plains Grassy WOODLANDS 10% benchmark Plains Grassy FORESTS 30% benchmark	% canopy cover **% cover/benchmark x 100**	*less than* 25% CANOPY COVER	0	
		between 25 – 50% CANOPY COVER	0.5	
		more than 50% CANOPY COVER	1	
UNDERSTOREY **(B)** Tick appropriate boxes for PRESENCE of native vegetation (i.e. different life forms) Tree >5m / Large herb >1m / Grass or grasslike <1m / Other / Shrub 1-5m / Small herb <1m / Fern / Small shrub <1m / Grass or grasslike >1m / Moss or lichen	**(A) % cover of native species**	*minimal* COVER *less than* 10%	0	
		low COVER *between* 10% – 25%	2	
		reduced COVER *between* 25% - 75% AND *less than* 4 boxes ticked for WOODLANDS *less than* 5 boxes ticked for FORESTS	3	
		OR 4 or *more* boxes for ticked WOODLANDS 5 or *more* boxes ticked for FORESTS	4	
		adequate COVER *more than* 75% AND *less than* 4 boxes for ticked WOODLANDS *less than* 5 boxes ticked for FORESTS	4	
		OR 4 or *more* boxes for ticked WOODLANDS 5 or *more* boxes ticked for FORESTS	5	
WEEDINESS	**% weed cover**	50% *or more* WEED COVER	0	
		between 25% - 50% WEED COVER	1	
		between 5% - 25% WEED COVER	2	
		less than 5% WEED COVER	3	
RECRUITMENT A woody species is considered to be recruiting when the number of immature plants (i.e. not flowering or fruiting) of an individual woody species is at least 10% of the total population of that species	(A) Number of *woody species* present (B) Number of *woody species* recruiting **% recruitment = B/A x100**	*less than* 30% woody species RECRUITING	0	
		between 30% -70% woody species RECRUITING	1	
		70% *or more* woody species RECRUITING	2	
ORGANIC LITTER Defined as small branches (less than 10cm diameter), twigs, leaves and other fallen or dead organic matter	**% cover of organic litter**	*less than* 5% ORGANIC LITTER for WOODLANDS 10% ORGANIC LITTER for FORESTS	0	
		more than 5% ORGANIC LITTER for WOODLANDS 10% ORGANIC LITTER for FORESTS	1	
LOGS Defined by length of stumps, fallen trees or branches at least 10 cm diameter (30 cm circumference)	Length of logs greater than 10 cm dia in 50m x50m (i.e. 0.25 ha) **Logs (m) x 4 (i.e. m/ha)**	*no logs*	0	
		less than 25m LOGS/ha	0.5	
		more than 25m LOGS/ha	1	
SIZE Defined by the size of the area being assessed **AND** any adjoining native vegetation		*less than* 2 ha	0	
		between 2 – 10 ha	1	
		more than 10 ha	2	
NEIGHBOURHOOD Defined by the % area covered by native vegetation within 1 km of the site being assessed		*less than* 10% area covered	0	
		between 10% - 50% area covered	1	
		more than 50% area covered	2	
CORE AREA Defined by the distance of the site being assessed from a block of native vegetation greater than 50ha		*1 km or more* from 50 ha block of native vegetation	0	
		less than 1 km from 50 ha block of native vegetation	1	

Department of Sustainability and Environment
ENVIRONMENTAL MANAGEMENT IN AGRICULTURE
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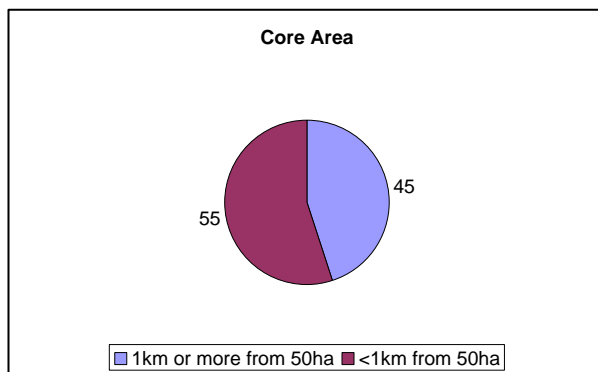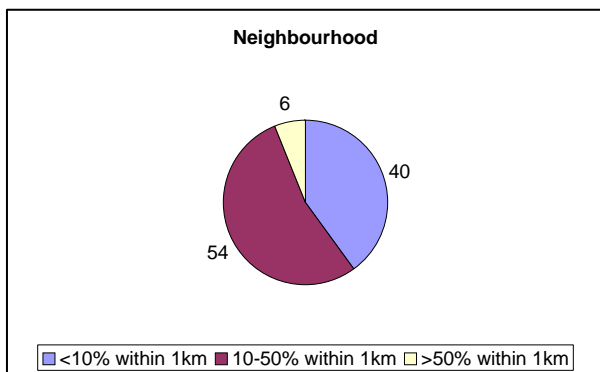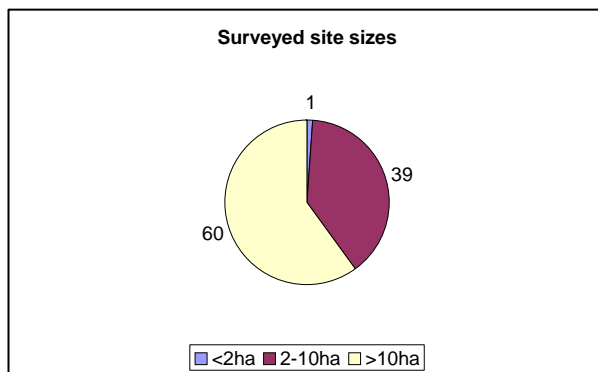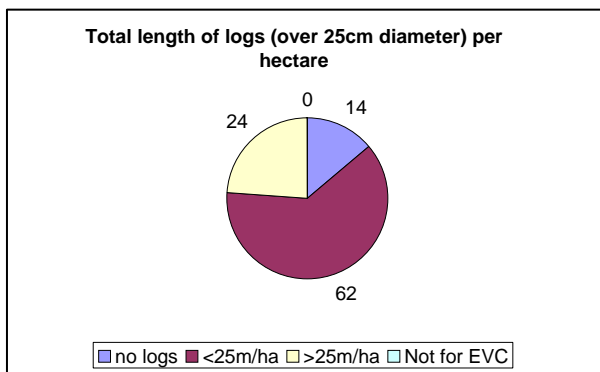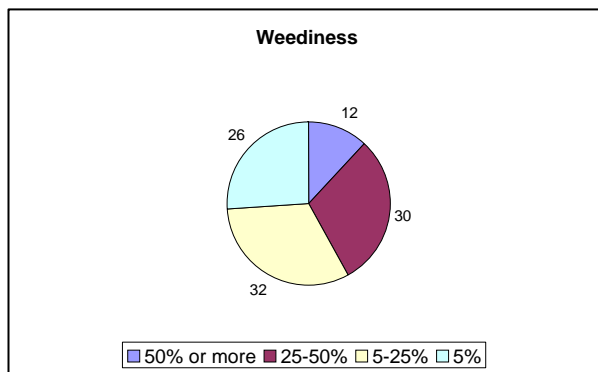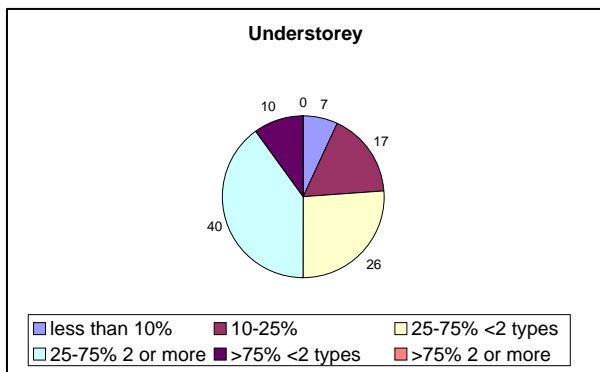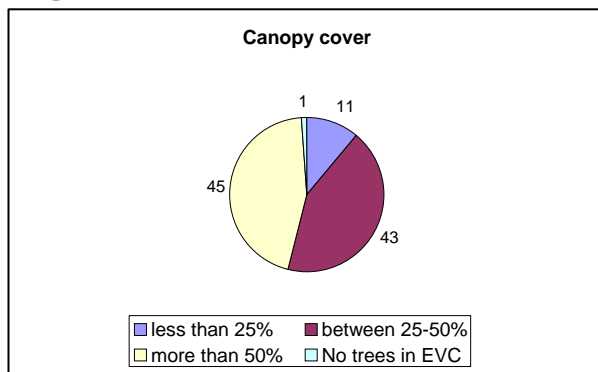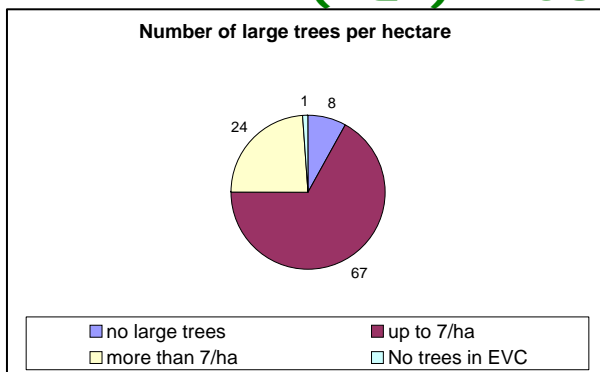
Assessment of Habitat Quality (total)

APPENDIX 9 – LANDSCAPE CONTEXT MODEL (LCM)

The LCM mapping is also contained on the BAP CD* (Version 1, January 2008) or on the GBCMA website (www.gbcma.vic.gov.au). This mapping can be used in conjunction with the BAP mapping and this Conservation Plan.
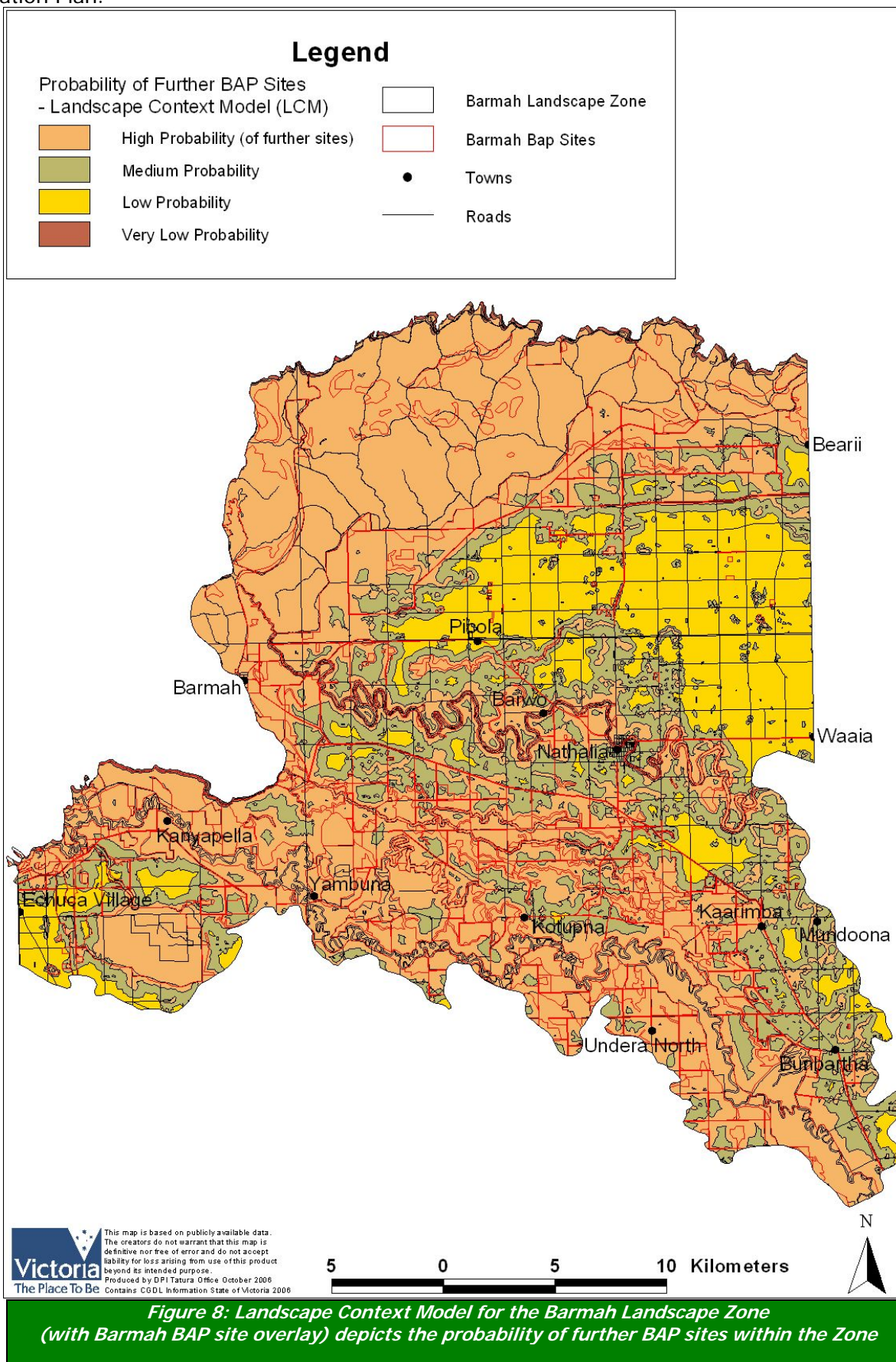
Figure 8: Landscape Context Model for the Barmah Landscape Zone
(with Barmah BAP site overlay) depicts the probability of further BAP sites within the Zone

* To obtain copies of the BAP CD (Version 1, January 2008), or for further information on BAP, please contact bap@gbcma.vic.gov.au OR the Biodiversity Action Planning Officer, Department of Sustainability and Environment (DSE) Benalla at Ph: (03) 57 611 611

APPENDIX 10 – VEGETATION QUALITY ASSESSMENT (VQA) RESULTS

Number of large trees per hectare

- no large trees
- up to 7/ha
- more than 7/ha
- No trees in EVC

Canopy cover

- less than 25%
- between 25-50%
- more than 50%
- No trees in EVC

Understorey

- less than 10%
- 10-25%
- 25-75% <2 types
- 25-75% 2 or more
- >75% <2 types
- >75% 2 or more

Weediness

- 50% or more
- 25-50%
- 5-25%
- 5%

Recruitment

- <30%
- 30-70%
- 70% or more
- Not for EVC

Percent cover of organic litter

- <5%
- >5%

Total length of logs (over 25cm diameter) per hectare

- no logs
- <25m/ha
- >25m/ha
- Not for EVC

Surveyed site sizes

- <2ha
- 2-10ha
- >10ha

Neighbourhood

- <10% within 1km
- 10-50% within 1km
- >50% within 1km

Core Area

- 1km or more from 50ha
- <1km from 50ha

APPENDIX 11 – BIRD LIST

This list includes birds surveyed during the 100 site (20 minute) surveys. It is not intended to represent the entire bird population in the Barmah Landscape Zone. For further information on obtaining data on birds surveyed at each site refer to Appendix 12.

English* Name	Latin Name
Australian Hobby	*Falco longipennis*
Australian Raven	*Corvus coronoides*
Barn Owl	*Tyto alba*
Black-chinned Honeyeater	*Melithreptus gularis*
Brown Falcon	*Falco berigora*
Brown Thornbill	*Acanthiza pusilla*
Brown Treecreeper	*Climacteris picumnus*
Buff-rumped Thornbill	*Acanthiza reguloides*
Crested Pigeon	*Geophaps lophotes*
Dusky Woodswallow	*Artamus cyanopterus*
Eastern Rosella	*Platycercus eximius*
Flame Robin	*Petroica phoenicea*
Galah	*Cacatua roseicapilla*
Golden Whistler	*Pachycephala pectoralis*
Grey Fantail	*Rhipidura fuliginosa*
Grey Shrike-thrush	*Colluricincla harmonica*
Grey Teal	*Anas gracilis*
Grey-crowned Babbler	*Pomatostomus temporalis*
Laughing Kookaburra	*Dacelo novaeguineae*
Little Raven	*Corvus mellori*
Magpie	*Gymnorhina tibicen*
Magpie Lark	*Grallina cyanoleuca*
Mountain Duck	*Tadorna tadornoides*
Pacific Heron	*Ardea pacifica*
Pelican	*Pelecanus conspicillatus*
Pied Butcherbird	*Cracticus nigrogularis*
Pied Currawong	*Strepera graculina*
Purple Swamphen	*Porphyrio porphyrio*
Raven spp.	*Corvus spp.*
Red-capped Robin	*Petroica goodenovii*
Red-rumped Parrot	*Psephotus haematonotus*
Restless Flycatcher	*Myiagra inquieta*
Royal Spoonbill	*Platelea regia*
Rufous Whistler	*Pachycephala rufiventris*
Silvereye	*Zosterops lateralis*
Singing Bushlark	*Mirafra javanica*
Spotted Pardalote	*Pardalotus punctatus*
Straw-necked Ibis	*Threskiornis molucca*
Striated Pardalote	*Pardalotus striatus*
Striated Thornbill	*Acanthiza lineata*
Sulphur-crested Cockatoo	*Cacatua galerita*
Superb Fairy-wren	*Malurus cyaneus*
Thornbill spp.	*Acanthiza spp.*
Triller spp.	*Lalage spp.*
Wedge-tailed Eagle	*Aquila audax*
White-faced Heron	*Egretta novaehollandiae*
White (Sacred) Ibis	*Threskiornis molucca*

English* Name	Latin Name
White-plumed Honeyeater	*Lichenostomus penicilatus*
White-throated Treecreeper	*Cormobates leucophaeus*
White-winged Chough	*Cocorax melanorhamphos*
Willie Wagtail	*Rhipidura leucophrys*
Wood Duck	*Chenonetta jubata*
Yellow-billed Spoonbill	*Platelea flavipes*
Yellow Rosella	*Platycercus elegans flaveolus*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Yellow Thornbill	*Acanthiza nana*

* In Alphabetical Order of English (Common) Name

APPENDIX 12 – PRIORITY SITE INFORMATION (MAPPING):

Mapping and accompanying information for each of the priority BAP sites is contained on the BAP CD* (Version 1, January 2008) or on the GBCMA website (www.gbcma.vic.gov.au). This mapping data is designed to be used in conjunction with this Conservation Plan to assist users to obtain further information on priority sites.

HOW TO OBTAIN INFORMATION FROM THE BAP CD:

1. Locate the available mapping data by clicking on the 'BAP Mapping' hyperlink#.
2. Click on the hyperlink relating to the Zone of interest under 'BAP Mapping' and the 'Available Maps Subheading' (e.g. 'Barmah').
3. This will lead to a map identifying priority BAP sites within the chosen Zone.
4. On this map, locate the area/site of interest by clicking on the area.
5. Zoom in or out to the areas/sites of interest, using the North, South, East, West arrows.
6. Click on a BAP site to view the Attribute Table information for that site.
7. Refer to the list of birds surveyed at each site (where available).
8. An explanation of the data provided in the Attribute Table is provided in the 'Attribute Table Definition' document under the 'BAP Mapping' subheading.
9. For further information to assist with the identification of opportunities to link the BAP sites, refer to 'BAP Mapping', 'Landscape Context Model Maps' and choose the relevant Zone name hyperlink (e.g. 'Barmah').
10. To access the data via the Geographical Information System (GIS) (where available) select 'BAP Mapping', 'GIS data' then either 'BAP GIS layer' or 'LCM GIS layer'.

 # Note: Mapping data for each Landscape Zone can also be located by clicking on the 'BAP Zones' hyperlink and choosing the Landscape Zone of interest from the map of the Goulburn Broken Catchment.

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* To obtain copies of the BAP CD (Version 1, January 2008), or for further information on BAP, please contact bap@gbcma.vic.gov.au OR the Biodiversity Action Planning Officer, Department of Sustainability and Environment (DSE) Benalla at Ph: (03) 57 611 611