

**PRIORITIES FOR NATURE CONSERVATION
RESERVATION AND MANAGEMENT IN THE
EASTERN NORTHERN PLAINS OF VICTORIA**

Doug Robinson 1998

Goulburn Valley Environment Group Inc.

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A report prepared under the National Estates Grant Program of the Australian
Heritage Commission

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SUMMARY

Background

The need for a comprehensive, adequate and representative (CAR) reserve system to conserve Australia's biodiversity is now formally recognised at the National, State and local level, with formal agreement by the Commonwealth, Territories and States that at least 15% of the pre-European extent of different vegetation communities should be reserved (JANIS 1997).

But how is it possible to establish a CAR reserve system in a landscape such as the eastern Northern Plains of Victoria, when 94% of all tree cover has been removed, 99% of the tree cover of woodland communities has disappeared and only 0.03% of the former woodland estate (Robinson & Mann 1996) is still intact? More fundamentally, how is it possible to establish a CAR reserve system within the one million hectares of the eastern Northern Plains when 95% of the land is freehold and little opportunity exists to increase the Crown land estate? Finally, how is it possible to establish a CAR reserve system in the eastern Northern Plains when much of the Crown land estate, and indeed the conservation reserve estate, is used for purposes other than nature conservation such as forestry, quarrying and grazing?

As part of a long-term objective to ensure the protection of biodiversity in the Goulburn Valley, the Goulburn Valley Environment Group applied to the Australian Heritage Commission for funding to address these issues by prioritising the conservation values of all Crown land remnants in the eastern Northern Plains. Specifically, the study aimed to:

1. evaluate the existing reservation status of Broad Vegetation Types, vegetation communities and threatened species on Crown land in the eastern Northern Plains,
2. evaluate the existing conservation status (i.e. the existing management) of every vegetation type, vegetation community and threatened species on Crown land,
3. prioritise all Crown land sites within the eastern Northern Plains in terms of their habitat conservation value and conservation threat,
4. identify additional sites on public or private land which should be added to the conservation reserve estate in order to meet JANIS (1997) criteria for a CAR reserve system, and
5. identify sites worthy of nomination to the Register of the National Estate.

Current conservation status of vegetation communities and threatened species

Not surprisingly, in a landscape in which only 6% tree cover remains, the study found that, firstly, every Broad Vegetation Type (including the Riverine woodlands) was inadequately reserved under the JANIS criteria for ecosystem reservation in Australia (Table 1). Secondly, more than three quarters of the 22 vegetation communities found in the area were, likewise, inadequately reserved (Table 2). Thirdly, the area of land that was actually managed for conservation within the study area was very small, because of threatening activities, notably stock-grazing or logging, being allowed to persist in many conservation reserves. Thus, only 1.5% of the remaining extent of Riverine Red Gum Forest, 2% of Creekline Grassy Woodland, 3% of Yellow Box-White Cypress-pine Woodland and 4% of Riparian Red Gum Forest was secure from these major threats (Table 2).

When the existing reservation and protection status of threatened species in the region was measured, it was found that only 15% of the 144 threatened species are adequately reserved and that 25% of all threatened species do not occur in any reserve (Table 3). Species most at risk comprise those restricted to roadsides, railway lines and private land (Table 4).

Application of reserve selection criteria to public land sites

Five criteria were used to prioritise the relative conservation values of the 318 public land sites:

- adequate representation of different vegetation communities
- adequate representation of diverse sites
- adequate representation of all threatened species
- adequate representation of large remnants across the geographic range of the study area, and
- adequate representation of high-quality sites.

Using these criteria, it was clear that the additional reservation and/or protection of relatively few public land sites in the eastern northern Plains would significantly increase the reservation status of most vegetation communities (Tables 5, 6, 7), increase the formal protection of native vegetation remnants in most land of the 30 land systems, and increase protection for many of the threatened species.

Thus, the proper management of all of Barmah Forest for conservation would provide significant representation of 50% of all vegetation communities, 49% of all threatened species and 40% of all endangered species (5.1.1). The establishment and conservation management of the proposed Broken, Boosey and Nine Mile Creeks State Park would provide significant representation of 50% of all vegetation communities, 27% of all threatened species and 24% of endangered species. More significantly, it would provide significant representation of four vegetation communities, five land systems and 19 threatened species not recorded in the proposed Barmah Forest National Park, and would provide representation of seven species not recorded anywhere else in the region (5.1.3). Finally, reservation of the 19 most significant sites for threatened wildlife (section 4.3) would increase the reservation status of 86 (59%) threatened species and provide formal protection for 25 species presently not reserved at all.

Recommendations

On the basis of these reserve-selection criteria, changes in reservation status or management are recommended for 33 Crown land sites in the eastern Northern Plains. In addition, significant gaps are identified in the reserve estate, even with the inclusion of these proposed new reserves, and important remnants on roadsides and private land are identified to help fill those gaps. On the basis of those two sets of sites, the report identifies 28 sites worthy of nomination to the Register of the National Estate. Finally, it is acknowledged that surveys such as these depend heavily on existing levels of knowledge and suggestions are made for areas where further survey work is required.

The sites proposed for changes in reservation or protection status are:

Barmah and Tocumwal forests

National Park

Ovens River	National Park
Broken, Boosey, Nine Mile Creeks system	State Park
Echuca Regional Park and Goulburn River	State Park
Three Chain Road, Tungamah	part of Boosey State Park
Reef Hills Regional Park	State Park
O'Dea Road, Wyuna	Conservation Reserve
Strathmerton-Mywee Railway line	Conservation Reserve
Nathalia-Picola Railway line	Conservation Reserve
Boorhaman Railway line	Conservation Reserve
Dookie Bushland Reserve	Conservation Reserve
Glenrowan Railway Reserve	Conservation Reserve
Yarrowonga State Forest, Bruces Bend	Conservation Reserve
Deep Creek	Conservation Reserve
Seven Creeks	Conservation Reserve
Stony Creek and Honeysuckle Creek	Conservation Reserve
Castle Creek, Creightons Creek, Pranjip Ck	Conservation Reserve
Black Dog Creek	Conservation Reserve
Nine Mile Creek, Waggarandall	Conservation Reserve
Boxwood Reserve	Conservation Reserve

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1 INTRODUCTION

The need for a comprehensive, adequate and representative (CAR) reserve system to conserve Australia's biodiversity is now formally recognised at the National, State and local level, with formal agreement by the Commonwealth, Territories and States that at least 15% of the pre-European extent of different vegetation communities should be reserved (JANIS 1997).

But how is it possible to establish a CAR reserve system in a landscape such as the eastern Northern Plains of Victoria, when 94% of all tree cover has been removed, 99% of the tree cover of woodland communities has disappeared and only 0.03% of the former woodland estate (Robinson & Mann 1996) is still intact? More fundamentally, how is it possible to establish a CAR reserve system within the one million hectares of the eastern Northern Plains when 95% of the land is freehold and little opportunity exists to increase the Crown land estate? Finally, how is it possible to establish a CAR reserve system in the eastern Northern Plains when much of the Crown land estate, and indeed the conservation reserve estate, is used for purposes other than nature conservation such as forestry, quarrying and grazing?

In Victoria, the first attempt at addressing such issues was done by the Land Conservation Council. This government body undertook a series of studies of public land use throughout the State between 1970 and 1997 and recommended appropriate future uses for all public land. These land-use studies were some of the first in Australia to include ecological considerations in land-use decisions and led to some significant increases in the area of land managed for conservation (LCC 1988). But ironically, these same studies tended to under-value the significance of small Crown land reserves for conservation, such that little public land in depleted ecosystems was specifically recommended to be managed for conservation (LCC 1985, 1988). The legislative requirement of the *Land Conservation Act* (1970) to 'provide for the balanced use of land in Victoria' further diminished the effective size and value of the proposed conservation estate by permitting grazing and/or timber harvesting to continue in many of the designated conservation reserves; for example in Barmah State Park, most regional parks, most wildlife reserves, most streamside reserves and even some flora reserves (e.g. LCC 1985).

Recently, a series of reviews of the conservation status of different vegetation communities in Victoria and other parts of temperate Australia have highlighted the endangered status of native grasslands, grassy woodlands and box-ironbark forests as a consequence of past clearing for agriculture, mining and timber, and of ongoing threats (e.g. Frood & Calder 1987; LCC 1988; McDougall & Kirkpatrick 1993; Robinson 1994; Thackway & Cresswell 1995; Robinson & Traill 1996; Sherwin 1996). All have recommended that substantial new areas of these threatened vegetation types should be added to the conservation reserve estate.

As a result of these reviews and other, more detailed studies (e.g. Webster 1988; Webster & Menkhorst 1992; Robinson 1991; Bennett *et al.* 1994; Lunt 1995; Muir *et al.* 1995; Ross 1995; Davidson 1996; Robinson & Mann 1996; Robinson *et al.* in press), land management agencies in Victoria have formally acknowledged the need for greater protection of grassy woodlands, box-ironbark forests and native grasslands (e.g. DCE 1992a; Crown 1997; GBCLPB 1997, DNRE in prep.). Most significantly, in 1996, the Victorian Government authorised the Land Conservation Council and its replacement body, the Environment Conservation Council, to 'carry out a special investigation of box-ironbark forests and woodlands in northern Victoria' (ECC 1997). As previously, the study was required to make

recommendations on the balanced use of public lands in the Box-Ironbark Forest and Woodland Area of Northern Victoria. In addition, the ECC was specifically directed by its Minister that ‘ *in making recommendations...the Council should have regard to the Nationally Agreed Criteria for the establishment of a comprehensive, adequate and representative reserve system....*’ (ECC 1997).

Priorities for reservation within the box-ironbark forest part of the ECC’s study area have already been largely identified by the many studies conducted in the region over the last ten years (e.g. Webster & Menkhorst 1992; Robinson & Rowley 1994; Muir *et al.* 1995; Berwick 1996; Davidson 1996; Sherwin 1996; Soderquist & Rowley 1996). However, priorities for reservation out on the plains have not been as well documented. Accordingly, as part of a long-term objective to ensure the protection of biodiversity in the Goulburn Valley, the Goulburn Valley Environment Group Inc. applied to the Australian Heritage Commission for funding to survey and prioritise all blocks of Crown land in the eastern Northern Plains.

Specifically, the study aimed to:

1. evaluate the existing reservation status of Broad Vegetation Types, vegetation communities and threatened species on Crown land in the eastern northern Plains,
2. evaluate the existing conservation status (i.e. the existing management) of every vegetation type, vegetation community and threatened species on Crown land,
3. prioritise all Crown land sites within the eastern Northern Plains in terms of their habitat conservation value and conservation threat,
4. identify additional sites on public or private land which should be added to the conservation reserve estate in order to meet JANIS (1997) criteria for a CAR reserve system, and
5. identify sites worthy of nomination to the Register of the National Estate.

2 METHODS

2.1 STUDY AREA

The study area consisted of the eastern part of the Northern Plains. It was bounded in the north by the Murray River; in the east by Indigo Creek and the Hume Freeway; in the south by the Goulburn River south of Nagambie, the northern edges of Rushworth State Forest and the Rushworth-Elmore Road; and in the west by Mt Camel Range and the Calivil Fault (Figure 1).

Within this 1.14 million hectare region, the larger patches of box-ironbark forest (Chiltern, Killawarras, Rushworth, Reef Hills Regional Park) and inland slopes woodland (Warby Range State Park, Chesney Hills) were excluded, as they contained different ecosystems from the ones of principal interest to this study (grassy woodlands, riverine forests) and their natural values had already been assessed (Muir *et al.* 1995; Davidson 1996; Sherwin 1996). Small patches of box-ironbark forest or inland slopes woodland at the edge of the study area were excluded from the study area for the same reasons. However, isolated patches of box-ironbark forest or inland slopes woodland that were separated from the larger patches by at least ten kilometres of alluvial plain (e.g. Dookie Hills, Waggarandall Hills, Katandra Hills) were included in the study area as they included distinctive elements of the grassy woodland ecosystem and they had biogeographic significance in their own right. With these caveats, the study area consisted of approximately 1.04 million hectares of land.

2.2 DATA SET

The principal classification units used for the study were the Crown land blocks described in the LCC's Final Recommendations reports for the Murray Valley, North Central and North-eastern Areas (LCC 1981, 1985, 1986). Some additional Crown land blocks not described by the LCC were also included. These comprised smaller parcels of Crown land identified from Parish Plans, roadsides or railway lines with known conservation value, and the Special Protection Zones shown in the draft Mid-Murray Forest Management Area Plan (DNRE in prep.). Finally, private land sites with known conservation value were included, although the latter group of sites was surveyed only cursorily.

Altogether, 365 sites were included in the study, 43 of which were discarded after inspection, either because they contained box-ironbark vegetation or else because they were totally modified and had no conservation value (e.g. some town land, some recreation reserves). Analysis was restricted, thereafter, to the remaining 318 Crown land sites (Appendix 1) and some private land sites.

The area of every site was determined from existing reports, the Crown Lands database of Lands Victoria, large scale maps or aerial photographs. The land system unit of every site was ascertained by overlaying Rowan's (1990) land system maps over the LCC maps for each study area. Where a given site included more than one land system, each land system unit was treated as a separate site and the area of each was re-calculated using the above techniques. This method was particularly relevant to creeklines with Crown land frontage, since the longer creeks often spanned several land systems and subdivision of the creeks into land system units created potentially more practical management units.

2.3 FIELD ASSESSMENTS

For every site sampled, information was collected on:

- area
- site width
- site management (especially fencing and signage)
- vegetation types, their condition and their distribution
- age-class structure of the canopy vegetation
- composition and abundance of understorey
- dominant species of native and introduced groundcover plants
- plant and animal species of special interest
- native plant species richness
- special natural features (e.g. restricted soil types, billabongs, natural water flows)
- abundance of weeds
- earthworks and soil disturbance
- grazing by domestic stock
- site-specific threats, and
- site-specific values (see Appendix 2 for definitions of the variables measured).

Additional information on the attributes of sites was derived from DNRE's Biomaps of threatened plant and animal species' distributions, DNRE's Flora Information System, the Parks Victoria database for its reserves, the Lands Victoria database for licenced land, previous surveys (e.g. LCC 1983 , 1985; Beauglehole 1985; McDougall *et al.* 1993; Foreman 1995; Muir *et al.* 1995; Clark 1996; Muir 1996; Robinson & Mann 1996; Cook 1997, Raven 1997), DNRE staff and local naturalists.

Using these data, sites were classed into three categories on the basis of whether or not the sites were intended to be managed primarily for conservation, and their tenure:

1. Conservation reserves on public land: comprises all of the land now managed by Parks Victoria (State Parks, Regional Parks, Wildlife Reserves, Bushland Reserves, Flora and Fauna Reserves, Streamside Reserves, some other reserves); proposed Special Protection Zones in the Mid-Murray Forest Management Area (DNRE in prep.); the Dookie Bushland Reserve; several road reserves and one rail reserve.
2. Other public land: notably State Forest, Stone Reserves, Historic Reserves, unreserved Crown land blocks, water frontages, recreation reserves, agricultural reserves, road reserves and rail reserves.
3. Private land.

In addition, conservation reserves were divided into two sub-categories:

1. those which were being actively managed for conservation (i.e. they were protected from threatening processes such as grazing or timber harvesting) - hereafter called Protected Reserves;
2. and those which were not being managed for conservation and which, therefore, did not contribute to the conservation estate - hereafter called Unprotected Reserves.

The classification of sites as ‘protected’ or not was based on field inspections and grazing licence records provided by Lands Victoria.

2.4 VEGETATION COMMUNITY DESCRIPTIONS

The vegetation communities recognised in the field were chiefly derived from those vegetation types previously described for the region by Frood (1983), Margules & Partners (1990), DCE 1992b, Foreman (1995), Muir *et al.* (1995) Robinson & Mann (1996), ECC (1997) and Berwick & Conway (in prep.). They were as follows:

1 Riverine River Red Gum Forest is a vegetation community restricted to the regularly inundated parts of the Murray River and Goulburn River floodplains. The vegetation consists of an overstorey of River Red Gum *Eucalyptus camaldulensis* and a ground layer dominated by species such as Warrego Grass *Paspalidium jubiflorum*, River Bluebell *Wahlenbergia fluminalis*, River Buttercup *Ranunculus inundatus*, Common Sneezeweed *Centipeda cunninghamii* and Terete-culm Sedge *Carex tereticaulis*.

2 Dry Red Gum Forest/Woodland is a vegetation community characterised as growing on heavy soils in less frequently inundated sites than the Riverine Red Gum or Wetland communities (Foreman 1995). It typically occurs as a narrow fringe of vegetation along the bank of some creeks or at the ecotone between Riverine or Riparian River Red Gum Forest and box woodland. Common groundcover plants growing beneath the Red Gum overstorey are Terete-culm Sedge, rushes *Juncus* spp, Common Spike-rush *Eleocharis acuta*, Small Spike-rush and wallaby grass *Rytidosperma* spp.

3 Riparian Red Gum Forest is a vegetation community found on coarse sediments along the margins of the permanent streams. The vegetation consists of an overstorey of River Red Gum, sometimes interspersed with Yellow Box *Eucalyptus melliodora* or Grey Box *E. microcarpa*, an understorey of Silver Wattle *Acacia dealbata* and a ground layer of Tussock Grass *Poa labillardierei* and Terete-culm Sedge. In higher rainfall zones, the understorey also includes River Bottlebrush *Callistemon sieberi*, Rough-barked Honey-myrtle *Melaleuca parvistaminea* and River Tea-tree *Leptospermum obovatum*.

4 Creepline Grassy Woodland was defined by Muir *et al.* (1995) as a vegetation type growing along shallow or ephemeral drainage lines on the lower slopes of the box-ironbark ecosystem. It typically occurs on sandy or gravelly sites. The overstorey consists of River Red Gum, sometimes interspersed with Yellow Box, Grey Box or White Box *Eucalyptus albens*. The understorey includes a range of shrubs such as Silver Wattle, Black Wattle *A. mearnsii*, Varnish Wattle *A. verniciflua*, Lightwood *A. implexa*, Gold-dust Wattle *A. acinacea*, Golden Wattle *A. pycnantha*, Rough-barked Honey-myrtle and Sweet Bursaria *Bursaria spinosa*. The ground layer characteristically includes Tussock Grass, Weeping Grass *Microlaena stipoides*, Kangaroo Grass *Themeda triandra*, Common Reed *Phragmites australis* and Terete-culm Sedge.

5 Damp Grey Box Open Forest/Woodland represents a transitional community between the River Red Gum and drier box woodland communities. It occurs on heavy soils in low-lying sites along creeklines across the eastern Northern Plains. Common groundcover plants are Forde Poa *Poa fordeana*, Joyweeds *Alternanthera* spp., Raspworts *Haloragis* spp., Small

Spike-rush *Eleocharis pusilla* and Native Pennyroyal *Mentha satureoides*. Tangled Lignum *Muehlenbeckia florulenta* is often moderately common in this community and some dryland species of shrubs such as Weeping Pittosporum *Pittosporum phylliraeoides*, Sweet Bursaria, Spreading Eutaxia *Eutaxia diffusa* and Gold-dust wattle also begin to appear.

6 Black Box Woodland is near the eastern limits of its range in the eastern Northern Plains and only occurs in the lowest rainfall portions of the study area. By contrast with most other vegetation communities present in the eastern Northern Plains, Black Box *Eucalyptus largiflorens* Woodland is characteristic of semi-arid rather than temperate environments. Its groundcover vegetation consequently includes a high proportion of chenopods such as Nodding Saltbush *Einadia nutans*, Creeping Saltbush *Atriplex semibaccata*, Frosted Goosefoot *Chenopodium desertorum microphyllum* and Black Bluebush *Maireana decalvans*, rather than grasses or sedges.

7 West Riverine Grey Box Woodland is a grassy woodland community dominated by Grey Box that typically occurs at sites with an average annual rainfall of less than 400 mm (ECC 1997). It is distinguished from Central Riverine Grey Box Woodland by the dominance of chenopods in the ground layer; notably Nodding Saltbush, Creeping Saltbush, Frosted Goosefoot, Ruby Saltbush *Enchylaena tomentosa* and Wingless Bluebush *Maireana enchylaenoides*. Characteristic understorey plants include Gold-dust Wattle, Golden Wattle, Hakea Wattle *Acacia hakeoides*, Waterbush *Myoporum montanum* and Weeping Pittosporum.

8 Central Riverine Grey Box Woodland is the characteristic Grey Box community of the higher rainfall (> 450 mm) regions in the eastern Northern Plains. It differs from West Riverine Grey Box Woodland by the scarcity of chenopods and by the increasing presence of plant species typical of more temperate environments as rainfall increases (e.g. Kangaroo Grass, Stinking Pennywort *Hydrocotyle laxiflora*, Bulbine Lily *Bulbine bulbosa*, Common Cranesbill *Geranium retrorsum*, Austral Bear's Ear *Cymbonotus pressianus*). The overstorey often includes Yellow Box at sites with lighter soils. Buloke *Allocasuarina luehmannii* may also be present.

9 Yellow Box-White Cypress-pine Woodland is a community restricted to sheets of sandy soils from prior stream deposits which have been weathered to low relief (Berwick & Conway in prep.). Because of clearing of nearly the entire vegetation community for cropping, few intact examples of this vegetation type still exist. At the few intact sites left, the understorey vegetation includes Desert Cassia *Senna artemisioides*, Mallee Wattle *Acacia montana*, Sweet Bursaria, Sugarwood *Myoporum platycarpum*, Hooked Needlewood *Hakea tephrosperma*, Berrigan *Eremophila longifolia* and Wedge-leaf Hopbush *Dodonaea viscosa*. Characteristic groundcover plants include Sweet-scented Mat-rush *Lomandra effusa*, Annual New Holland daisy *Vittadinia cervicalis*, Sweet Hound's-tongue *Cynoglossum suaveolens*, Variable Glycine *Glycine tabacina*, and various native grasses (*Stipa* spp., *Panicum* spp.) .

10 Sand Ridge Woodland is a community identified by Berwick & Conway (in prep.) that occurs on source-bordering dunes composed of deep sandy soil. The overstorey typically consists of Yellow Box, Lightwood or White Cypress-pine. Sites close to riverine environments may contain River Red Gum. The understorey includes Common Fringe Myrtle *Calytrix tetragona*, Grey Mulga *Acacia brachybotrya*, Wallowa *Acacia calamifolia*, Sweet Bursaria, Berrigan, Desert Cassia and Wedge-leaf Hopbush. At the few intact sites discovered, the groundcover characteristically includes Panic-grasses *Digitaria* spp, Wire-

grasses *Aristida* spp., Niggerheads *Enneapogon nigricans* and Panics *Panicum* spp. Distinctive groundcover plants include Twining Glycine *Glycine clandestina*, Small-leaf Clematis *Clematis microphylla*, Woolly Mat-rush *Lomandra leucocephala* and Tufted Sedge *Carex gaudichaudii* (Robinson & Mann 1996).

11 Eastern Wet Grassland is a community found in the eastern part of the study area on a range of soil types, but typically on self-mulching clays. It is restricted to wetter sites. The groundcover typically comprises Plains Spear-grass *Stipa aristiglumis*, Rigid Panic *Homopholis proluta*, Silky Browntop *Eulalia aurea*, Common Spike-rush, herbs such as Blue Devil *Eryngium ovinum*, Drumsticks *Pycnosaurus globosus*, Broughtons Pea *Swainsona procumbens*, Native Flax *Linum marginale*, Common Woodruff *Asperula conferta* and Lemon Beauty-heads *Calocephalus citreus*, and various lilies (Foreman 1995).

12 Northern Plains Grassland is a grassland community restricted to particular soil types in the northwestern part of the study area. The ground layer is dominated by Bristly Wallaby-grass *Rytidosperma setacea*, Spider Grass *Enteropogon acicularis*, Rigid Panic and Spurred Spear-grass *Stipa gibbosa*. Characteristic herbs and forbs include Drumsticks, Blushing Bindweed *Convolvulus erubescens*, Scaly Buttons *Leptorhynchos squamatus*, Lamb-tails *Ptilotus exaltatus*, Broughton's Pea and Cut-leaf Daisy *Calotis anthemoides*. Chenopods are an important component of the flora and include Dwarf Bluebush, *Maireana humillima*, Wingless Bluebush and Black Bluebush.

13 Alluvial Terraces Herb-rich Woodland is a community found on the lower slopes, drainage lines and old alluvial plains of gently undulating landscapes (Muir *et al.* 1995). In higher rainfall parts of the study area (> 600 mm), this community is a dominant element of the plains. In lower rainfall areas it is most common next to the larger streams. The vegetation consists of an overstorey of Yellow Box, sometimes interspersed with Grey Box, White Box, River Red Gum, Blakely's Red Gum *Eucalyptus blakelyi* or Yellow Gum *E. leucoxylo*. The understorey typically includes Varnish Wattle, Lightwood, Golden Wattle and Gold-dust Wattle. The ground layer is often herb-rich and may include a high abundance of lilies at temperate sites. In more arid areas, spear-grasses *Stipa* spp. are typically abundant.

14 Low Rises Grassy Woodland is used here to describe the various woodland types found on the more fertile, hilly sites in the study area. It includes the Eastern Low Rises Grassy Woodland EVC recognised by the ECC (1997) and typically consists of woodland vegetation on sites with high soil fertility (e.g. Boxwood Reserve on basaltic soils) or high water availability (e.g. granitic outwash sites). The vegetation contains elements of Plains Grassy Woodland and Box-Ironbark Forest (Muir *et al.* 1995) and is best distinguished by the presence of White Box or Yellow Box.

15 Granitic Hills Woodland is a community complex belonging to the Broad Vegetation Type 'Inland Slopes Woodland'. Most of this BVT was explicitly excluded from the study area but small examples were recorded in reserves at the edge of the plains and the hills. The community occurs on granitic soils and is dominated by Blakely's Red Gum. At the one site containing this vegetation type, a spring supported distinctive species such as Golden Spray *Viminaria juncea*.

16 Yellow Gum-Grey Box Woodland is a community occurring on the edges of the box-ironbark hills and the riverine plains. It most closely resembles Muir *et al.*'s (1995) sub-

community 4.1 Box-ironbark Forest (Northern goldfields). The overstorey is dominated by Yellow Gum and Grey Box and sometimes Buloke. The understorey typically includes Golden Wattle, Gold-dust Wattle, Mallee Wattle and Drooping Cassinia *Cassinia arcuata*. Characteristic groundcover plants include Shiny Everlasting *Bracteantha viscosa*, *Hibbertia* spp., Wattle Mat-rush *Lomandra filiformis* and Black-anthered Flax-lily *Dianella revoluta*.

17 Box-Ironbark Forest (Northeastern foothills). Most of this community was specifically excluded from the study area but small examples were located north of Violet Town, near Killawarra State Forest and north of Chiltern. The community is characterised by an overstorey of Grey Box and Red Box *Eucalyptus polyanthemos*, an understorey of Golden Wattle, Gold-dust Wattle, Bent-leaf Wattle *A. flexifolia*, Spreading Wattle *A. genistifolia*, Gorse Bitter-pea *Daviesia ulicifolia* and Slender Rice-flower *Pimelea liniifolia*. The ground layer typically includes Silvertop Wallaby-grass *Chionochloa pallida*, Common Wheat-grass *Elymus scaber* and Wallaby-grasses *Rytidosperma* spp.

18. Box-ironbark-Green Mallee Woodland is a sub-community of Box-ironbark Forest (northeastern foothills) which only occurs in the low hills north of Violet Town (Muir *et al.* 1995). The sub-community includes an outlier of Green Mallee *Eucalyptus viridis*, under which is found Saloop *Einadia hastata*, Elegant Spear-grass *Stipa elegantissima* and Coarse Lagenifera *Lagenifera huegelii*.

19 Freshwater Meadow is classified as a temporary wetland that holds water for less than four months of the year and is less than 30 cm deep (DCE 1992b).

20 Shallow Freshwater Marsh is a temporary wetland that usually dries out by mid-summer and fills with the onset of winter rains. Shallow freshwater marshes are deeper than freshwater meadows but generally less than half a metre (DCE 1992b).

21 Deep Freshwater Marsh comprises wetlands which are usually between one and two metres deep and only dry out occasionally (DCE 1992b).

22 Permanent Open Freshwater comprises wetlands that hold water permanently, and which are usually deeper than one metre (DCE 1992b).

Because the past and present distribution of native vegetation has not yet been mapped across the study area at a community scale, these different communities were additionally coalesced into broader vegetation categories known as Broad Vegetation Types (BVTs) for some of the reserve-selection analyses, as the pre-1750 extent and present extent of BVTs has been mapped across the State.

The BVTs recognised in the study area and their component communities were:

- 1 Riverine Grassy Woodland (communities 1-3, 19-22)
- 2 Plains Grassy Woodland (communities 5-12)
- 3 Herb-rich Woodland (communities 4, 13, 14)
- 4 Box-ironbark Forest (communities 15-18).

2.5 ASSESSMENT OF CONSERVATION VALUES OF SITES

Overall ratings of conservation value and threats were given for every site. Rating procedures broadly followed those developed for Parks Victoria (NPS 1995) to ensure that the information collected was compatible with that organisation's, since Parks Victoria was the main potential manager of land identified as having conservation value in the study area.

Conservation rankings were defined as follows, with sites being ranked according to which set of conservation-ranking criteria their values most closely resembled:

6. Excellent:

- known populations of any endangered species
- three or more threatened species of plants or animals
- five or more regionally significant species of plants or animals
- large area - more than 500 m wide
- three or more vegetation communities present
- more than 50 species of native plants present
- intact example of any vegetation community with predominantly old-growth habitat, regeneration, shrubs and a predominantly native groundcover layer (> 75% native)
- high potential for restoration (e.g. no soil disturbance).
- contains one or more intact examples of vegetation communities not represented elsewhere in the reserve system

5. High

- no endangered species but one or more vulnerable or rare species
- five or more regionally significant species of plants or animals
- moderately large area - at least 100 m wide
- three or more vegetation communities present
- more than 40 species of native plants
- basic elements of environment intact - mostly old-growth habitat, mostly native ground layer (>75%), some shrubs and regeneration
- contains one or more intact examples of vegetation communities not well represented elsewhere in the reserve system
- potential for restoration high (e.g. little soil disturbance).

4. Moderate-High

- one or more rare or threatened species but no endangered or vulnerable species
- two or more regionally significant species
- predominantly native ground layer (>50%)
- predominantly old-growth woodland
- contains some shrubs or regeneration
- site at least 100 m wide
- site connected in the landscape
- contains one or more intact examples of vegetation communities not represented elsewhere in the reserve system
- high potential for restoration (e.g. little soil disturbance)
- site width variable.

3. Moderate

- if threatened species present, only in the categories 'rare' or 'depleted' (see Gullan *et al.*, 1990)
- not necessarily any regionally significant species
- site less than 100 m wide
- contains one or more examples of vegetation communities represented elsewhere in the reserve system
- basic elements of environment present but modified by persistent grazing and human use
- ground cover predominantly native(> 50%)
- predominantly old-growth habitat but sometimes including regrowth
- site with little, if any, shrub cover or regeneration
- site not necessarily well connected in landscape
- moderate potential for restoration (e.g. little soil disturbance or weed invasion)

2. Moderate-Low

- no threatened species or regionally significant species
- tree cover intact but not the habitat (i.e. mostly regrowth rather than old-growth habitat)
- some native species but ground cover predominantly weedy
- some to much soil disturbance at site

1. Low

- site highly modified by tree clearing and/or cultivation and disturbance
- site < 25m wide

Threat rankings were defined as follows:

5. Severe

- site actively deteriorating as a consequence of threatening processes (e.g. tree clearing, extensive soil disturbance, weed invasion, etc.).

4. Moderate-severe.

- site currently intact but extensive modification and use by stock and/or humans occurring

3. Moderate

- basic elements of site intact
- some human use, some-much weed/pest levels
- some modification of site by earthworks and grazing occurring.

2. Low

- site intact and securely protected
- some weed or pest problems, or occasional grazing by stock

1. Very Low

- site securely protected
- no grazing, no weed invasion or soil disturbance

2.6 SITE SELECTION PROCEDURES FOR INCLUSION IN THE RESERVE ESTATE

The criteria used for reserve selection in the eastern Northern Plains were based on the JANIS determined principles and criteria for the establishment of a comprehensive, adequate and representative reserve (CAR) system for forests in Australia (JANIS 1997). Under these principles, a reserve system must:

- include the full range of vegetation communities across the landscape (**comprehensiveness**);
- ensure the maintenance of ecological viability and integrity of populations, species and communities through reservation of adequately sized areas of land and replication of reserves across the range (**adequacy**); and
- reasonably reflect the biological diversity of the vegetation communities being reserved (**representativeness**).

Given these principles, the JANIS criteria for the conservation of biodiversity are as follows:

1 As a general criterion, protect 15% of the pre-1750 distribution of each ecosystem in the CAR reserve system.

2 Where ecosystems are recognised as vulnerable, at least 60% of their remaining extent should be reserved. Vulnerable ecosystems comprise those which are:

- approaching a reduction in area of 70% within the bioregion and which remain subject to threatening processes; or
- not depleted but are subject to continuing and significant threatening processes which may reduce their extent.

3 All remaining occurrences of rare and endangered ecosystems should be reserved or protected by other means as far as is practicable.

4 Reserved areas should be replicated across the geographic range of the ecosystem to decrease the likelihood that chance destructive events will cause the ecosystem to decline.

5 The reserve system should seek to maximise the area of high quality habitat for all known elements of biodiversity wherever practicable, but with particular reference to:

- the special needs of threatened species
- special groups of organisms (e.g. species with complex habitat requirements)
- areas of high species diversity, natural refugia and centres of endemism, and
- species whose distributions and habitat requirements are not well correlated with any particular ecosystem.

6 Reserves should be large enough to sustain the viability, quality and integrity of populations.

7 To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each ecosystem.

8 In fragmented landscapes, ensure the protection of remnants that contribute to sampling the full range of regional biodiversity.

Adapting these, and other established reserve-selection techniques (e.g. Kirkpatrick 1983; Pressey & Nicholls 1989; Bedward *et al.* 1992; Nicholls & Margules 1993; Pressey *et al.* 1993; Pressey *et al.* 1994), the following criteria and selection rules were established for reserve prioritisation in the eastern Northern Plains.

Criterion 1: To ensure comprehensiveness, adequately represent all vegetation types within the study area.

- **Rule 1:** Reserve at least 15% of the pre-1750 extent of non-depleted (i.e. > 70% remaining) broad vegetation types.
- **Rule 2:** Reserve, and manage for conservation, at least 50% of the remaining public land extent of depleted broad vegetation types (30-70% remaining of pre-1750 extent).
- **Rule 3:** Reserve, and manage for conservation, at least 90% of the remaining public land extent of endangered broad vegetation types (< 30% of pre-1750 extent remaining) (see Parigi 1998, DNRE in prep.).
- **Rule 4:** Reserve, and manage for conservation, at least 50% of the remaining public land extent of depleted vegetation communities and 90% of the remaining public land extent of endangered communities.

Criterion 2: To ensure adequacy, representativeness and efficiency (see Bedward *et al.* 1992; Pressey *et al.* 1993), adequately reserve diverse sites across the study area.

- **Rule 5:** Select sites that are as diverse as possible
- **Rule 6:** Where there is a choice, select larger sites or sites which are rated highly for other reasons.

Criterion 3: To ensure adequacy, adequately reserve all threatened species.

- **Rule 7:** Ensure the representation of all threatened species of plants and animals in at least five protected reserves.
- **Rule 8:** Where there is a choice, select sites with larger populations or sites which are rated highly for other reasons.

Criterion 4: To ensure comprehensiveness and adequacy, reserve sites that are as large as possible across the geographic range of each ecosystem.

- **Rule 9:** Select sites that are as large as possible in each vegetation community and land system unit to achieve, ideally, the reservation of at least one 500 ha block of native vegetation in every land system unit. Where that is not possible, select as large a reserve as possible in every land system unit.
- **Rule 10:** Select sites throughout the geographic range of each vegetation community, as defined by their presence in different land systems.

Criterion 5: To ensure adequacy and representativeness, adequately represent all high-quality sites in the study area.

- **Rule 11:** Reserve all sites with conservation values in the classes 4-6 (see 2.5).
- **Rule 12:** Where possible, select sites with high species diversity or community diversity, old growth stands and intact understorey layers and ground layers.

2.7 RESERVE CLASSIFICATIONS

Classifications for proposed reserves were taken from the LCC (1994). Under these definitions, a National Park is an extensive area of public land of national significance because of its outstanding natural features and diverse land types, set aside primarily to provide public enjoyment, education and inspiration in natural environments.

A State Park is an area of public land, containing one or more land types, set aside primarily to provide public enjoyment, education and inspiration in natural environments.

A Conservation Reserve is an area of public land set aside to conserve and protect species, communities or habitats of indigenous animals and plants.

2.8 SELECTION OF SITES FOR NOMINATION TO THE REGISTER OF THE NATIONAL ESTATE

Nearly all sections classified as having Excellent or High conservation values are considered to merit nomination to the Register of the National Estate. To ensure compatibility with the AHC's own criteria for nomination (AHC 1990), the proposed sites to be nominated were reviewed with regard to the criteria specifically set out by Ross (1995) for the nomination of grassy woodland or grassland sites in Victoria to the AHC's Register of the National Estate. These criteria are summarised in Appendix 3.

3 CURRENT CONSERVATION STATUS OF NATIVE VEGETATION AND THREATENED WILDLIFE IN THE EASTERN NORTHERN PLAINS

3.1 EXISTING STATUS OF BROAD VEGETATION TYPES

Ninety-four percent of the native vegetation which once covered the eastern northern Plains has been eliminated in the past 150 years and the majority of the remaining vegetation now occurs within the tiny public land estate (ECC 1997). However, that remnant vegetation on public land is not representative of the former landscape. Historically, some 80% of the vegetation in the eastern Northern Plains consisted of box woodlands and 11% consisted of riverine woodlands of River Red Gum (Table 1). Now, 86% of all remaining vegetation on public land comprises riverine woodland and only 12% consists of box woodlands. Concurrently, the proportion of box-ironbark forest in the study area has decreased from 7% to 1%. In the last 150 years, therefore, there has been a massive loss of more than 840,000 hectares of box woodland vegetation from within the one million hectare study area, while less substantial but nonetheless significant losses of 60,000 hectares of riverine woodland and 60,000 hectares of box-ironbark forest have also occurred.

As a result of this extensive loss of native vegetation, three of the four broad vegetation types (BVTs) found in the study area should be classified as 'endangered' according to the JANIS criteria, warranting the reservation and conservation of at least 90% of their remaining extent (Table 1). The fourth BVT, Riverine Grassy Woodland, still retains approximately 49% of its pre-1750 tree cover but is so extensively modified by timber harvesting and grazing (Table 1) that it could reasonably be classified as a vulnerable ecosystem according to JANIS Criterion Two. On that basis, a minimum of at least 50% of the remaining extent of Riverine Grassy Woodland should be reserved.

3.2 EXISTING RESERVATION STATUS OF BROAD VEGETATION TYPES AND VEGETATION COMMUNITIES

Applying the reserve selection rules under Criterion 1 (see 2.7), not one of the BVTs or vegetation communities found in the eastern Northern Plains is adequately reserved.

For the relatively widespread Riverine Grassy Woodland BVT, 19% of its pre-1750 extent is currently reserved but less than 50% of its present extent is in reserves.

For each of the three endangered BVTs, 2.5%, or less, of their pre-1750 extent is currently reserved. For the once dominant Plains Grassy Woodland BVT, only 0.4% of its pre-1750 extent is reserved (Table 1). There is no chance, moreover, of reserving sufficient land in the study area to meet the 15% reservation target for any of these BVTs, as all have been too extensively cleared (column 3, Table 1). Applying just selection rule 3 and trying to reserve at least 90% of the present extent of these endangered BVTs, only Box-ironbark Forest is adequately reserved. Less

Table 1. Past and present extent of Broad Vegetation Types in the study area and their current reservation and protection status.

Current area protected indicates the subset of conservation reserves which are being managed for conservation (see 2.3). Figures in brackets in the first two columns indicate the relative proportion of each BVT at that time.

Broad Vegetation Type	Pre-1750 area		Area remaining on public land		Proportion of pre-1750 remaining	Area of remaining reserved	Proportion of pre-1750 reserved	Proportion of remaining reserved	Proportion of pre-1750 protected	Proportion of remaining protected
	Ha		Ha		%	Ha	%	%	%	%
Plains Grassy Woodland	800,795	(76.8%)	5,718	(8.3%)	0.7	2,976	0.4	51.7	0.2	30.1
Riverine Grassy Woodland	120,268	(11.5%)	59,566	(86.2%)	49.5	22,830	19.0	38.4	5.9	12.0
Box-ironbark Forest	72,721	(7.0%)	898	(1.3%)	1.2	881	1.2	98.1	1.2	94.2
Herb-rich Woodland	48,846	(4.7%)	2,880	(4.2%)	5.9	1,203	2.5	42.1	2.0	34.6
Totals	1,042,630	(100%)	69,062	(100%)	6.6	27,890	2.7	40.5	1.0	15.6

than 60% of the remaining extent of Plains Grassy Woodland and Herb-rich Woodland BVTs is presently reserved (Table 1).

The current reservation status of vegetation communities is equally poor. Of the 22 vegetation communities identified in the study area, only 10 have more than 50% of their remaining public land area reserved, even though every one is classified as depleted or endangered on the basis of the conservation status of their parent BVTs. Moreover, only one of the 10 endangered box woodland communities is adequately reserved (Table 2), on the basis of the 90% reservation target set for endangered vegetation types (Rule 4, 2.7). Particularly poorly reserved communities comprise Creekline Grassy Woodland, West Riverine Grey Box Woodland, Sand Ridge Woodland, Riverine Red Gum Forest, Dry Red Gum Forest, Riparian Red Gum Forest and Northern Plains Grassland (Table 2).

Additional sub-communities may not be represented in the reserve system at all. For example, the riverine plains grassland community R1.3 occurs only in the Corop area, includes two nationally threatened species of plants, but is evidently confined to just a few roads (McDougall *et al.* 1993). No Crown land reserves containing this sub-community were found during the study.

3.3 EXISTING PROTECTION STATUS OF BROAD VEGETATION TYPES AND VEGETATION COMMUNITIES

Despite the massive loss of native vegetation from the eastern Northern Plains, much of the conservation reserve estate is still not managed for conservation. Thus, the area of Riverine Grassy Woodland BVT that is managed for conservation amounts to just 6% of its pre-1750 extent and 12% of its present-day public land extent (Table 1). The remainder of the Riverine Grassy Woodland BVT is persistently grazed by stock (e.g. Barmah State Park, Echuca Regional Park, Lower Ovens Regional Park, Tocumwal Regional Park, Yarrawonga Regional Park, Cobram Regional Park, Goulburn State Forest, Lower Ovens Flora Reserve, Ovens River State Forest) logged, or both (e.g. Barmah State Park).

As a result of those degrading activities, the protection status of the vegetation communities associated with the Riverine Grassy Woodland BVT is very poor, particularly for those communities restricted to red gum forests along the major rivers. Of the 18,930 hectares of Riverine Red Gum Forest found in the study area, for instance, only 287 hectares (1.5%) is securely protected from major threats. Similarly, only 482 hectares (4.3%) of the 11,163 hectare estate of Riparian Red Gum Forest is managed as a protected reserve (Table 2): the remainder is either grazed and/or logged.

By contrast with the very poor protection status of the Riverine Grassy Woodland BVT, the protection status of the other BVTs is comparatively better, albeit still very low for the Plains Grassy Woodland and Herb-rich Woodland BVTs (Table 1).

Table 2. Current reservation and protection status of native vegetation communities on public land in the eastern Northern Plains.

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Vegetation community	Total area on public land Ha	Area reserved Ha	Proportion reserved %	Area protected Ha	Proportion protected %
Riverine Red Gum Forest	18,930.1	5,414.0	28.6	287.0	1.5
Riparian Red Gum Forest	11,320.4	3,835.4	33.9	481.8	4.3
Dry Red Gum Woodland	15,379.7	5,049.7	32.8	1,994.4	13.0
Creekline Grassy Woodland	1,253.2	63.8	5.1	25.0	2.0
Damp Grey Box Woodland	1,316.2	585.4	44.5	422.4	32.1
Black Box Woodland	829.2	595.7	71.8	374.8	45.2
West Riverine Box Woodland	818.1	312.6	38.2	69.9	8.5
Central Riverine Box Woodland	1,875.0	853.8	45.5	520.3	27.7
White Cypress-pine Woodland	293.8	227.0	77.3	10.0	3.4
Sand Ridge Woodland	89.0	23.0	25.9	5.0	5.6
Eastern Wet Grassland	445.8	339.4	76.1	319.4	71.6
Northern Plains Grassland	52.9	21.4	40.5	21.4	40.5
Herb-rich Woodland	1,250.6	788.9	63.1	595.4	47.6
Low Rises Grassy Woodland	394.5	376.5	95.4	367.0	93.0
Granitic Hills Woodland	13.0	13.0	100	13.0	100
Yellow Gum-Grey Box Woodland	368.0	368.0	100	356.0	96.7
Box-ironbark/Green Mallee	64.0	56.0	87.5	56.0	87.5
Box-ironbark Forest	453.1	444.0	98.0	434.0	95.8
Freshwater Meadow	137.3	137.3	100	137.3	100
Shallow Freshwater Marsh	7,820.3	3,824.0	48.9	2,219.0	28.4
Deep Freshwater Marsh	4,298.0	3,064.0	71.3	1,376.0	32.0
Permanent Open Water	1,681.0	1,506.0	89.6	850.0	50.6

Furthermore, as the breakdown of protection status for different vegetation communities indicates, (Table 2) many of the communities associated with the Plains Grassy Woodland and Herb-rich Woodland BVTs are very poorly protected. In particular, Creekline Grassy Woodland, West Riverine Grey Box Woodland, Central Riverine Grey Box Woodland, Yellow Box-White Cypress-pine Woodland, Sand Ridge Woodland and Damp Grey Box Woodland are all very poorly protected communities in conservation reserves (Table 2), mostly because of operating threats from grazing and weed invasion (e.g. Robinson & Mann 1996, 1998). The only vegetation communities with high levels of protection on public land are the relatively scarce Freshwater Meadows, Granitic Hills Woodland, Yellow Gum-Grey Box Woodland, Box-ironbark Forest, Box-ironbark-Green Mallee Woodland and Low Rises Grassy Woodland (Table 2).

3.4 EXISTING RESERVATION STATUS OF THREATENED WILDLIFE

Of the 144 species of threatened wildlife recorded from the study area, only 22 (15%) are adequately represented in reserves according to selection rule 7 (see 2.7), which requires representation of all threatened species in at least five conservation reserves. The inclusion of records from other public land sites increases the number of adequately reserved species to 39 (27%) but still leaves three quarters of all threatened taxa inadequately conserved (Table 3). These are, notably, those species with the majority of their distributions on roadsides or private land (Table 4, Appendix 4).

Examining just the reservation status of endangered species, only two (8%) of the 25 species are adequately represented in conservation reserves and eight (32%) are not represented at all (Table 3, Appendix 4). For the 42 vulnerable species found in the study area, five (12%) are adequately represented in conservation reserves and 12 (29%) are not represented at all. Altogether, one quarter of all threatened species are currently unreserved (Table 3).

Table 3. Reservation status of threatened species in the eastern Northern Plains

Threatened species categories	No. species	Recorded 5+ times in conservation reserves		Not recorded in any reserves		Recorded 5+ times in all reserves	
		No.	%	No.	%	No.	%
Endangered	25	2	8.0	8	32.0	4	16.0
Vulnerable	42	5	11.9	12	28.6	9	21.4
Rare	52	10	19.2	13	25.0	18	34.6
Depleted/Suspected	17	3	17.6	3	17.6	6	35.3
Colonial breeders	8	2	25.0	0	0	2	25.0
Total	144	22	15.3	36	25.0	38	27.1

Table 4. Major distributions of threatened species by land tenure.

Note that only species with $\geq 50\%$ of their distribution in one of the land tenures are included. "Public land" here excludes road and railway reserves.

Threatened species groups	No. species	Conservation Reserves	Other public land	Road and rail reserves	Private land
Terrestrial vertebrates	33	16	5	2	10
Fish	10	3	6	0	1
Plants	87	30	18	32	7
Total	130	49	29	34	18

4 APPLICATION OF RESERVE SELECTION CRITERIA TO PUBLIC LAND SITES IN THE EASTERN NORTHERN PLAINS

As highlighted in Section 3, most vegetation communities and Broad Vegetation Types (BVTs) found in the eastern northern Plains are now so depleted that it is impossible to meet the JANIS criterion of 15% reservation of their pre-1750 extent, even if one protects and manages every public land and private land remnant for nature conservation (Table 1; Crown 1997).

In one sense then, application of reserve selection criteria to these remnants is unnecessary, as every site clearly has significance for nature conservation (e.g, see Pressey *et al.* 1995, p. 31); a point acknowledged by the State Biodiversity Strategy (Crown 1997) and the Goulburn Broken Catchment Strategy (GBCLPB 1997, p. 30).

For practical purposes, however, the remnants differ greatly in quality. This section of the report consequently seeks to identify those sites which should be priorities for protection within the study area, using the reserve selection criteria and rules outlined in Section 2.7.

4.1 CRITERION 1: ADEQUATE REPRESENTATION OF BVTs AND VEGETATION COMMUNITIES

Applying the reserve-selection rules under this criterion (see 2.7) to BVTs and vegetation communities in the eastern Northern Plains, it is clear that every BVT and vegetation community is inadequately conserved (3.1, 3.2, 3.3). Nevertheless, there still remain significant opportunities to increase the conservation status of all BVTs and vegetation communities in the eastern Northern Plains by increased reservation or changed management of public land, and by the incorporation of private land sites into the conservation reserve system.

In particular, sufficient remains of the depleted Riverine Grassy Woodland BVT to enable a reserve system to be established for that BVT which meets the proposed reservation targets of reservation of at least 15% of its pre-1750 extent (Rule 1) and reservation of at least 50% of this depleted BVT's remaining extent (Rule 2). At present, nearly 23,000 hectares of the 30,000 hectare reservation target is already reserved but only 7,145 hectares (24% of conservation reserve target) is actually managed for conservation (Table 1). It is recommended accordingly that grazing and timber harvesting be removed from the 23,000 hectares already in reserves to achieve the first goal of reservation and conservation of at least 15% of the BVT's pre-1750 extent. It is further recommended that an additional area of at least 7000 hectares be added to the reserve system to achieve the second goal of reservation and conservation of at least 50% of the BVT's remaining extent.

As Table 5 shows, the most useful sites for addition to the reserve system in terms of size, Riverine Grassy Woodland BVT representation and associated community representation are:

- Barmah State Forest
- Goulburn State Forest
- State Forest along the Murray between Tocumwal and Yarrawonga
- State Forest along the Murray between Ulupna and Tocumwal, and
- Ovens State Forest and water frontage along the Ovens upstream to Wangaratta.

For each of the other three BVTs it is impossible to meet the initial reservation target of 15% (Table 1). Significantly, however, the Plains Grassy Woodland BVT and Herb-rich Woodland BVT do not even meet the secondary reservation target (Rule 3) of reservation of at least 90% of their remaining extent (Table 1) and only four vegetation communities (Box-ironbark Forest, Granitic Hills Woodland, Yellow Gum-Grey Box Woodland, Low Rises Grassy Woodland) have more than 90% of their remaining extent managed for conservation (Rule 4), even though all of them are classed as endangered (Table 2).

Significant, additional representations of some of these communities (e.g. Central Riverine Grey Box Woodland, Herb-rich Woodland, Black Box Woodland) would occur as part of the proposal for increased reservation of the Riverine Grassy Woodland BVT (Table 5), as many of the largest box woodland remnants are found in the various State Forests, notably along the Goulburn River, north of the Goulburn, Barmah, Munroes and along the Murray between Ulupna and Tocumwal (Table 5).

Other key sites for reservation to improve the representation of the various woodland communities and BVTs are:

- Public water frontages (Broken, Boosey and Nine Mile Creeks system, Deep Creek, Sevens Creek, Black Dog Creek, Pranjip Creek, Honeysuckle Creek, Castle Creek and Stony Creek).
- Railway lines (Nathalia-Picola, Boorhaman, Strathmerton-Mywee)
- Roadsides (Three Chain Road at Tungamah, O’Dea Road, Corop roadsides)
- Township reserves (Wangaratta common, Numurkah Rifle Range, Wilby Reserve), and
- Unclassified Crown land reserves (U32, U33) (Table 5).

4.2 CRITERION 2: REPRESENTATION OF DIVERSE SITES

Of the 318 sampled sites on Crown land, 44 contain four or more vegetation communities (Table 6). Less than half (41%) of these are conservation reserves and only 18% of them are managed as protected reserves (Table 6). The most diverse sites occur along the major river and creek systems in the study area - the Murray, Goulburn and Ovens Rivers and the Broken, Boosey and Nine Mile Creeks. The most diverse, non-riverine sites are the Numurkah-Picola Railway line west of Nathalia and Reedy Lake Wildlife Reserve.

At many of these sites, however, the different vegetation communities occupy very small areas. Accordingly, a more realistic estimate of the community diversity of different sites is obtained by examining the number of communities for which a site contains significant representation (defined as being one of the twenty largest remnants of a given community within the study area) (Rule 5). Using those data (Table 5), 31 Crown land sites contain significant representation of three or more vegetation communities (Table 7). Of these sites, 52% are classed as conservation reserves but only 26% are managed as protected reserves (Table 7).

Again, the most diverse sites occur along the major river and creek systems, with Barmah State Park, Goulburn State Forest and State Forest along the Murray between Tocumwal and Yarrawonga containing the highest number of different communities. Because of their

position in the landscape, however, these riverine sites do not contain any representation of the vegetation communities associated with the low hills found in the study area (e.g. Creekline Grassy Woodland, Box-Ironbark Forest, Yellow Gum-Grey Box Woodland, Low Rises Grassy Woodland) and contain very poor representation of the two grassland communities (Table 5). Key sites to increase the reservation status of these latter communities and which maximise diversity are:

- The Broken, Boosey, Nine Mile Creeks system
- Seven Creeks
- Pranjip Creek
- Honeysuckle Creek
- Creightons Creek
- Indigo Creek
- Nathalia-Picola Railway line, and
- Dookie-Katamatite Railway line (Tables 5, 7).

4.3 CRITERION 3: ADEQUATE REPRESENTATION OF THREATENED SPECIES

Two sites stand out because of their significance for threatened wildlife in the eastern Northern Plains - Barmah State Park and Barmah State Forest (Table 8). Just on its own, Barmah State Park contains nearly one third of all threatened species known from the study area and it and the State Forest combined, contain 50% of all threatened species. Furthermore, the Barmah Forest sites collectively support 11 threatened species not recorded from anywhere else in the region and 40% of all endangered species.

Additional sites of significance for all species of threatened wildlife include:

- the Goulburn River State Forest and Special Protection Zone
- Broken, Boosey and Nine Mile Creeks system, particularly between Barmah and Waaia and Waaia and Katamatite
- Reef Hills Regional Park
- Lower Ovens Regional Park and Ovens State Forest
- Murray River east of Tocumwal
- Drumanure Streamside Reserve
- Three Chain Road at Tungamah, and
- Katamatite Bushland Reserve (Table 8).

Consideration of just the number of threatened plant species (Table 9) still underlines the importance of Barmah State Park and Barmah State Forest but also highlights the conservation significance of the Broken, Boosey and Nine Mile Creeks system and several small sites such as Katamatite Bushland Reserve, Three Chain Road at Tungamah, roadsides near Corop, a private land grassland near Katamatite, and railway lines near Mywee, Picola and Boorhaman.

Of those sites rich in all threatened wildlife, 59% are currently reserved but only 38% are managed as protected reserves. Of sites rich in threatened plants, 43% are reserved and 27% are managed as protected reserves.

Reservation and protection of the 19 currently unreserved, species-rich sites shown in Tables 8 and 9 would increase the reservation status of 86 (60%) of the threatened species of wildlife found in the study area, including 25 not yet reserved at all. It would provide sufficient representation in reserves for an additional 15 species.

For endangered and vulnerable species, reservation of these 19 sites would increase the reservation status of 58% (39) of species, provide reservation for ten species not reserved at all, provide sufficient (5+) representation in reserves for six (9%) additional species and reserve every known site for another 45% (30) of species.

Conversely, however, reservation of just those 19 sites would leave 27 endangered and vulnerable species inadequately reserved. Further, the provision of sufficient representation for those 27 species would require 50 additional sites, mostly on roadsides or private land; once more emphasising the importance every remnant has for nature conservation in this mostly cleared region.

4.4 CRITERION 4: RESERVATION OF LARGE REMNANTS IN EVERY LAND SYSTEM

Twenty-seven land systems with remnant vegetation are represented on public land in the study area. An additional three land systems occur in the study area, all of them on the hills around Katandra, Colbinabbin and Stanhope, but are not represented at all on public land (Table 10).

Of the 27 land systems represented on public land, 21 do not contain a single public land site larger than 500 hectares and 12 contain a total area of less than 500 hectares of public land (Table 10). Given these constraints, consolidated reserves of larger than 500 hectares (Rule 9) will need to be obtained by incorporating adjoining remnants from other land systems or from private land. Where that is not possible, the largest consolidated reserve possible should be selected in every land system (Rule 9). Options for reserves of at least 100 ha for every land system are shown in Table 11.

4.5 CRITERION 5: ADEQUATE REPRESENTATION AND PROTECTION OF HIGH QUALITY SITES

Of the 318 Crown land sites surveyed in the study, 140 (44%) are considered to have high conservation significance (categories 4-6, see 2.5) (Table 12). Ninety-eight (70%) of these are already reserved and 71 (51%) are managed as protected reserves (Table 12).

Although many of the high value sites have been identified by other criteria, it is noteworthy that the highest number of 'very high' value sites occurs along roadsides and rail reserves (Table 13). It is also worth noting that many of the relatively small or narrow public land blocks found along stream frontages or in Bushland Reserves have at least moderate conservation value (Table 13; Appendix 5), often because of intact ground layers or stands of old growth trees (Robinson & Mann 1996). These sites are consequently a high priority for addition to the reserve estate.

Table 6 Crown land sites ranked by the number of vegetation communities found at each site. In the reservation and protection columns, 1 = Yes, 0 = No.

Site	No. of communities	Reservation status	Protection status
Barmah State Park	9	1	0
Goulburn River State Forest	8	0	0
Murray River, Tocumwal-Yarrawonga	7	0	0
Broken/Boosey Creek, Waaia-Katamatite	7	0	0
Echuca Regional Park	6	1	0
Cobram Regional Park	6	1	0
Yarrawonga Regional Park	6	1	0
Murray River, Ulupna-Tocumwal	6	0	0
Broken Creek, Barmah edge-Waaia	6	0	0
Special Protection Zone 105/10, Barmah	6	1	0
Lower Ovens Regional Park	5	1	0
Loch Garry Wildlife Reserve	5	1	0
Murray River Reserve, south of Barmah	5	1	0
Barmah State Forest	5	0	0
Ovens State Forest	5	0	0
Munroes State Forest	5	0	0
Broken Creek, Boosey Junction-Katam.	5	0	0
Nine Mile Creek, Wattville	5	0	0
Nathalia-Picola Railway line	5	0	0
Special Protection Zone 103/01, Goulburn	5	1	0
Reedy Lake Wildlife Reserve	5	1	1
Drumanure Streamside Reserve	5	1	1
Tocumwal Regional Park	4	1	0
State Forest, north of the Goulburn	4	0	0
Murray River, east of the Ovens	4	0	0
Goulburn outliers at Kotupna	4	0	0
Chinaman Creek, Peechelba	4	0	0
Nine Mile Creek, junction-Wunghnu	4	0	0
Boosey creek, Katamatite-Boosey	4	0	0
Broken Creek, Tungamah-H44	4	0	0
Boosey Creek, Boosey-Lake Rowan	4	0	0
Broken Creek, Devenish West	4	0	0
Honeysuckle Creek	4	0	0
Stony Creek	4	0	0
Lake Moodemere	4	0	0
Dookie College Agricultural land	4	0	0
Uncommitted land, Tungamah	4	0	0
Gemmills Swamp Wildlife Reserve	4	1	1
Moodie Swamp Wildlife Reserve	4	1	1
Tungamah Swamps Wildlife Reserve	4	0	0
Rowan Swamp Wildlife Reserve	4	1	1
Katamatite Bushland Reserve	4	1	1
Bushland Reserve H44	4	1	1

Table 7 Crown land sites ranked by the number of significant representations of different vegetation communities. Significant representation was defined as being one of the twenty largest examples of a particular vegetation community (see Table 5).

Site	No. of communities	Reservation status	Protection status
Barmah State Park	8	1	0
Goulburn River State Forest	8	0	0
Murray River, Tocumwal-Yarrawonga	7	0	0
Broken/Boosey Creek, Waaia-Katamatite	6	0	0
Murray River, Ulupna-Tocumwal	6	0	0
Barmah State Forest	5	0	0
Echuca Regional Park	5	1	0
Broken Creek, Barmah edge-Waaia	5	0	0
Special Protection Zone 105/10, Barmah	5	1	0
Special Protection Zone 103/01, Goulburn	5	1	0
Cobram Regional Park	4	1	0
Yarrawonga Regional Park	4	1	0
Lower Ovens Regional Park	4	1	0
Loch Garry Wildlife Reserve	4	1	0
Ovens State Forest	4	0	0
Munroes State Forest	4	0	0
Nathalia-Picola Railway line	4	0	0
Reedy Lake Wildlife Reserve	4	1	1
Drumanure Streamside Reserve	4	1	1
Murray River, east of the Ovens	4	0	0
Moodie Swamp Wildlife Reserve	4	1	1
State Forest, north of the Goulburn	3	0	0
Goulburn outliers at Kotupna	3	0	0
Boosey Creek, Boosey-Lake Rowan	3	0	0
Tungamah Swamps Wildlife Reserve	3	0	0
Rowan Swamp Wildlife Reserve	3	1	1
Broken Creek, Boosey Junction-Katam.	3	0	0
Reef Hills Regional Park	3	1	1
Reedy Swamp Wildlife Reserve	3	1	1
Nine Mile Creek, junction-Wunghnu	3	0	0
Streamside Reserve K10	3	1	1

Table 8. Significant Crown land and private land sites as ranked by the number of threatened species of wildlife

The table shows the top ten percent of sites. Numbers in brackets in the threatened species column indicate the numbers of threatened terrestrial animals, fish and plants respectively.

Site	Area (ha)	Reserved status	Protected status	No. of threatened species	No. of endangered species	No. of unique species
Barmah State Park	7,900	1	0	44 (22, 6, 16)	7	5
Barmah State Forest	19,947	0	0	34 (14, 5, 15)	5	6
Special Protection Zone, Goulburn	1,992	1	0	21 (10, 8, 3)	0	0
Broken Creek, Barmah edge-Waiaia	625	0	0	19 (4, 4, 11)	2	1
Goulburn State Forest	3,226	0	0	18 (8, 3, 7)	1	0
Three Chain road, Tungamah	20	0	0	14 (2, 0, 12)	1	0
Murray River, Tocumwal-Yarra.	3,300	0	0	13 (2, 8, 3)	1	0
Drumanure Streamside Reserve	476	1	1	12 (2, 0, 10)	1	0
Lower Ovens Regional Park	1,430	1	0	11 (5, 2, 4)	1	0
Reef Hills Regional Park	2,040	1	1	11 (8, 0, 3)	2	1
Ovens State Forest	2,440	0	0	11 (7, 3, 1)	0	0
Broken/Boosey Creek, Waiaia-Kata	337	0	0	11 (1, 0, 10)	1	1
Katamatite Bushland Reserve	17	1	1	11 (0, 0, 11)	2	2
Private block, Katamatite	8	0	0	11 (2, 0, 9)	1	0
Loch Garry Wildlife Reserve	687	1	0	9 (3, 4, 2)	1	0
Reedy Lake Wildlife Reserve	1,400	1	1	9 (6, 2, 1)	1	0
Rowan Swamp Wildlife Reserve	430	1	1	9 (3, 0, 6)	1	1
Boosey Creek, Katamatite-Boosey	112	0	0	9 (0, 1, 8)	1	0
Dookie Bushland Reserve	270	1	1	9 (0, 4, 5)	1	1
Corop roadsides	10	0	0	8 (0, 0, 8)	2	3
Wunghnu Bushland Reserve	33	1	1	8 (0, 0, 8)	0	0
Broken Creek frontage, Barmah	55	0	0	8 (1, 2, 5)	1	2
Mywee Railway Line	20	0	0	8 (0, 0, 8)	2	1
SPZ 105/09 Barmah S.F	74	1	0	7 (0, 0, 7)	1	0
Boosey Creek, Boosey-lake Rowan	322	0	0	7 (1, 0, 6)	0	0
Boorhaman Railway line	15	1	1	7 (0, 0, 7)	1	1
Nathalia-Picola Railway line	31	0	0	7 (0, 0, 7)	2	0
Lake Moodemere	262	0	0	7 (3, 0, 4)	0	0
Special Protection Zone 105/02, Barm.	106	1	0	6 (2, 0, 4)	3	1
Gaynors Swamp	422	1	1	6 (5, 0, 1)	0	1
Reedy Swamp Wildlife Reserve	224	1	1	6 (4, 1, 1)	0	0
Moodie Swamp Wildlife Reserve	198	1	1	6 (3, 0, 3)	0	0
Tungamah Swamp Wildlife Reserve	146	1	1	6 (3, 0, 3)	0	0
Dowdle Swamp Wildlife Reserve	291	1	1	6 (5, 0, 1)	0	0
Tocumwal Regional Park	310	1	0	6 (0, 0, 6)	0	1

Table 9. Significant Crown land and private land sites as ranked by the number of threatened species of plants

Site	Area (ha)	Reserved status	Protected status	No. of threatened species	No. of endangered species	No. of unique species
Barmah State Park	7,900	1	0	15	7	5
Barmah State Forest	19,947	0	0	15	5	6
Three Chain road, Tungamah	20	0	0	12	1	0
Broken Creek, Barmah edge-Waaia	625	0	0	11	2	1
Katamatite Bushland Reserve	17	1	1	11	2	2
Drumanure Streamside Reserve	476	1	1	10	1	0
Broken/Boosey Creek, Waaia-Kata	337	0	0	10	1	1
Private block, Katamatite	8	0	0	9	1	0
Corop roadsides	10	0	0	8	2	3
Boosey Creek, Katamatite-Boosey	112	0	0	8	1	0
Wunghnu Bushland Reserve	33	1	1	8	0	0
Mywee Railway Line	20	0	0	8	2	1
SPZ 105/09, Barmah S.F.	74	1	0	7	1	0
Boorhaman Railway line	15	1	1	7	1	1
Nathalia-Picola Railway line	31	0	0	7	2	0
Goulburn State Forest	3,226	0	0	7	1	0
Rowan Swamp Wildlife Reserve	430	1	1	6	1	1
Boosey Creek, Boosey-Lake Rowan	322	0	0	6	0	0
Dookie Bushland Reserve	270	1	1	5	1	1
Broken Creek frontage, Barmah	55	0	0	5	1	2
Glenrowan Rail Reserve	6	1	1	5	1	1
Tocumwal Regional Park	310	1	0	5	0	1
Numurka Railway line-Waaia	10	0	0	5	0	0
Mt Major Agricultural land	300	0	0	5	0	0
O'Dea Rd, Wyuna	5	1	1	5	3	0
Numurkah Rifle Range	8	0	0	5	0	0
SPZ 105/02, Barmah S.F.	106	1	0	4	2	1
Lower Ovens Regional Park	1,430	1	0	4	1	0
Dookie Railway line, Yabba North	25	0	0	4	0	0
Lake Moodemere	262	0	0	4	0	0

Table 10. Land system representation on public land. Land systems are classified according to Rowan (1990). The capital letter in each land system code denotes the Landform (F - Present Floodplain, P - Plain above flood level, G - gentle to moderate hills, L -Lunette); the small letters denote lithology (f - fine, unconsolidated deposits, c - coarse, unconsolidated deposits, g - granitic, s - sedimentary, v - volcanic); The first number indicate climatic zones (2 - 200-300 mm rainfall, 3 - 300-400 mm, 4 - 400-500 mm, 5 - 500-600 mm, 6 - 600-700 m, 7 - > 700 mm). Note that the asterisked land systems are those in which not all of the land system was included in the study area and additional Crown land sites occur outside the study area boundary.

Land system	Area	Number of Crown land sites	Crown land area	No. of sites \geq 500 ha
Ffc4	49,650	32	43,586	10
Ffc5*	19,050	10	6,418	3
FLf4	18,250	5	1,250	1
FLfc4	13,200	6	4,029	2
Gg5	13,025	1	2	0
Gs45	4,375	3	250	0
Gs51*	178,925	34	636	0
Gs61*	62,824	2	15	0
Gvs5	10,150	5	368	0
Pf41	136,850	24	1,870	0
Pf42	225,400	14	471	0
Pf43	25,325	2	24	0
Pf44	37,000	5	54	0
Pf46	17,850	14	1,007	0
Pf51	34,150	17	1,401	0
Pf52	123,300	11	372	0
Pf53	252,325	52	1,743	0
Pf54	10,550	9	805	0
Pf55	10,200	8	1,833	1
Pf61	161,050	19	956	0
Pf62	15,350	8	131	0
Pf63	91,250	2	224	0
Pf64	8,450	6	252	0
Pf65	41,525	1	2	0
Pf71	17,175	2	710	1
Pfc4	318,600	23	1,505	1
Pfc5	16,500	3	95	0
Gs41	29,850	0	0	0
Gv4	2,200	0	0	0
Gvs4	1,050	0	0	0

Table 11. Options for consolidated reserves of 500 hectares or more in every land system. Note that where no option exists for a consolidated reserve larger than 500 ha, the largest reserve option for that land system is described instead.

Land system	Site	Area
Ffc4	Barmah State Forest	19,947
	Barmah State Park	7,900
	Murray, Tocumwal-Yarrawonga	3,300
	Goulburn State Forest	3,226
	Special Protection Zone 103/01, Goulburn	1,992
	Murray, Ulupna-Tocumwal	900
	Goulburn outliers, Kotupna	695
	Loch Garry Wildlife Reserve	687
	Cobram Regional Park	594
	Barmah Regional Park	580
FFc4/Flfc4	Echuca Regional Park	520
Ffc5	Ovens State Forest	2,440
	Murray, east of the Ovens	2,000
	Lower Ovens Regional Park	1,440
Flf4	Wallenjoe Swamp Wildlife Reserve	500
Flfc4	Kanyapella Wildlife Reserve	2,581
	State Forest north of Goulburn, Murray R. reserve	1,109
	Echuca Regional Park	520
Gs45	Runnymede Flora Reserve, roadside links to north, south, links eastwards to Cornella Creek.	300+
Gs51/Ffc4	Billabong, Irishman, Chinaman Creeks and links to Ovens and Killawarra State Forest	500+
	Dookie Bushland Reserve, Dookie College land, links south to Broken River	500+
Gvs5	Dookie College land, Mt Major, and links to Dookie Bushland Reserve	300+
	Boxwood Historic Reserve, adjacent private land	100+
Pf41/Pf43	Drumanure Streamside Reserve and adjacent parts of Nine Mile, Broken Creeks system, Bushland Reserves H27, H 32, H40, H26, H43, Wildlife Reserve C19	
	Streamside Reserve K13	1,388
Pf41	Dowdle Swamp Wildlife Reserve	291
Pf42/Ffc4	Reedy Swamp Wildlife Reserve, Goulburn State Forest	5,000+
Pf42/Pf53/Pf54	Broken River, Shepparton-Caseys Weir	400+
Pf42/Pf41	Broken Creek Streamside Reserve K10 and upstream	500+
Pf43	Broken Creek, located within the Pf41 reserve (see above)	1,388
Pf44/Pf51/Pf53	Broken Creek, se. of Katamatite to Bushland Reserve H45, Moodie Swamp Wildlife Reserve	417

Pf46	Deep Creek, Sheepwash Creek, Skeleton Creek, K7, K8	500+
Pf46/Pfc4	Goulburn outlier Kaarimba, Goulburn State Forest	5,000+
Pf51	Boosey Creek, Tungamah-Lake Rowan, Tungamah Swamp, Rowan Swamp Wildlife Reserve, Crown land U33, Bushland Reserve H46, Streamside Reserve K27	1,047
Pf52/Pf61/Pf54	Seven Creeks Streamside Reserve & Frontage	427
	Pranjip Creek	185
	Castle Creek	178
Pf53/Pfc5	Black Dog Creek Streamside Reserves & frontage	210
Pf53/Pf54/Pf42	Broken River, Shepparton-Caseys Weir	400+
Pf53/Pf61	Honeysuckle Creek, Stony Creek, Riggs Creek	402
Pf53/Gs51	Billabong Creek, linking to Ovens River and Killawarra	500+
Pf54	Goulburn River, west of Arcadia, Streamside Reserve K50, Recreation Reserve, Murchison	650+
Pf54/Pf61/Pf52	Seven Creeks Streamside Reserve & Frontage	427
Pf55	Reedy Lake Wildlife Reserve	1,400
	Doctors Swamp Wildlife Reserve, links east to Goulburn and south and west to Rushworth	300+
	Black Swamp Wildlife Reserve, creek links to Black Dog Creek	200+
Pf61/Pf52/Pf54	Seven Creeks Streamside Reserve & Frontage	427
Pf61/Pf53	Honeysuckle Creek, Stony Creek, Riggs Creek	402
Pf61/Pf52	Pranjip Creek	185
	Castle Creek	178
Pf62/Pf53	Broken River, east and west of Caseys Weir	400+
Pf63	Ovens River frontage, upstream of State Forest	200+
Pf64	Jubilee Swamp, connected creeklines on Stony Creek, Woolpress Creek, private land	350+
Pf71	Reef Hills Regional Park	2,040
Pfc4	Broken Creek, Barmah-Waaiia	650+
	State Forest, Murray River, s. of Barmah	388
	Sheepwash, Ulupna Creeks, Mywee	215
Pfc5/Pf53	Black Dog Creek Streamside Reserves & frontage	210

Table 12. Conservation ranking of Crown land sites by land tenure and land management.

Conservation Ranking	Total Sites Number	Reserved		Protected	
		No.	%	No.	%
6. Very High	20	15	75)	13	65
5. High	43	34	79	27	63
4. Moderate-High	77	49	64	31	40
3. Moderate	83	43	52	22	27
2. Moderate-Low	70	35	50	9	13
1. Low	25	13	52	0	0
Total	318	189	59	102	32

Table 13. Conservation ranking of Crown land sites by public land use classification.

Public land use classification	No. sites	6. Very high	5. High	4. Mod. to high	3. Mod.	2. Mod. to low	1. Low
		No. sites	No. sites	No. sites	No. sites	No. sites	No. sites
State or Regional Park	8	2	2	2	2	-	-
Reference Area	2	-	-	-	2	-	-
Wildlife Reserve	23	4	8	7	4	-	-
Flora or Fauna Reserve	4	-	4	-	-	-	-
Bushland Reserve	101	4	10	27	26	22	12
Streamside Reserve	31	-	4	8	6	12	1
Special Protection Zone	11	1	5	4	1	-	-
State Forest or Murray Reserve	15	2	2	5	4	1	1
Public Water Frontage Reserve	62	-	4	15	23	19	1
Historic Reserve	1	-	-	-	-	-	-
Uncommitted Crown land	21	-	-	1	3	7	10
Agricultural land	3	1	-	-	-	2	-
Town land or Rec. Reserve	13	1	-	4	4	4	-
Stone Reserve	4	-	1	-	1	2	-
Road or Rail Reserve	18	5	2	3	7	1	-

5 RECOMMENDATIONS

5.1 KEY CONSERVATION SITES IN THE EASTERN NORTHERN PLAINS

On the basis of the preceding criteria, the following Crown land sites (Figure 2) are considered key sites for nature conservation in the eastern northern Plains. Descriptions of their values and recommendations for their future management are given below.

Three important caveats should be noted. Firstly, because so little remains of every vegetation type, it is implicit that all remnants of native vegetation in the eastern Riverina are important for nature conservation at a regional, district or local scale, and that all should be managed with regard to nature conservation (GBCLPB 1997; Raven 1997).

Secondly, not every individual site with conservation value is described here. The intention, instead, is to identify the most important priorities for reservation or changed management in the study area. The overall values of all sites assessed during the study are given in Appendix 5. More detailed inventories of Crown land sites will be provided in a separate report to Parks Victoria (unpubl. data).

Thirdly, the report does not recommend specific management actions for any of the proposed reserves. It is widely acknowledged that habitat clearance, grazing by stock, altered water regimes, rising water tables, earthworks (including cultivation), weed invasion and timber harvesting are the major threats to the natural environment in the study area (e.g. Koehn & O'Connor 1990; Koehn 1993; Bennett *et al.* 1994; Robinson 1994; Robinson & Mann 1996; Robinson & Traill 1996; Crown 1997; GBCLPB 1997; ECC 1997; Robinson & Mann 1998). It is simply recommended that these threatening processes be removed or abated at all of the existing and proposed reserves.

5.1.1 Barmah and Tocumwal Forests

Recommendation

National Park

Definition

Comprises Barmah State Park, Barmah State Forest, creek frontage along the Broken Creek, Special Protection Zones 105/01-105/10, Barmah Regional Park, Tocumwal Regional Park west of Tocumwal, the Murray River Reserve, both Reference Areas, State Forest between Ulupna Island and Tocumwal Regional Park and Ulupna Creek frontage (31,090 ha).

Values

- Part of the largest River Red Gum forest in the world.
- A highly significant system of forests, wetlands and riverine environments which is listed on the Register of the National Estate and the International RAMSAR list of significant wetlands.
- The largest and the most diverse remnant of native vegetation found in the eastern Northern Plains (Tables 6, 7).
- In addition to extensive areas of Riverine Red Gum Forest, Dry Red Gum Woodland, Riparian Red Gum Forest, Shallow Freshwater Marsh and Deep Freshwater Marsh (Table 5) contains some of the largest remnants of Black Box Woodland, West Riverine Grey Box Woodland, Damp Grey Box Woodland, Yellow Box-White Cypress-pine Woodland and Sand-ridge Woodland in the study area (Table 5).
- Contains 50% of all threatened species of wildlife found in the region, 40% of all endangered species and 11 species of threatened wildlife not found elsewhere (Section 4.3).
- The threatened species comprise 36 species of native plants, 27 species of terrestrial animal and nine species of fish. They include 17 species found only in the State Forest or Special Protection Zones (SPZs) of the State Forest, two found only in the Broken Creek public frontage and three found only in the section to the east of Ulupna Island.
- Supports at least four species of plants not known from anywhere else in the State (Silky Heads *Cymbopogon obtectus*, Fat Spectacles *Menkea crassa*, Upright Sunray *Rhodanthe stricta*, Violet Swainson-pea *Swainsona adenophylla*).
- One of four major breeding grounds in Australia for the nationally vulnerable Superb Parrot (Webster & Ahern 1992).
- An important breeding site for several species of restricted, colonially breeding waterbirds (e.g. Little Egret, Intermediate Egret, Great Egret, Nankeen Night-heron) and other waterbirds, especially ibis (Chesterfield *et al.* 1984).
- The largest remnant of native vegetation in the land system Ffc4 (Table 11).
- Contains significant remnants of native vegetation in land system Pfc4, along Ulupna Creek.

5.1.2 Ovens River forest

Recommendation

National Park (also incorporating Warby Range State Park and Killawarra State Forest).

Definition

Lower Ovens Regional Park, Ovens State Forest, Ovens River public frontage upstream to Wangaratta, Ovens Flora Reserve, and public frontage along Chinaman, Irishman and Billabong Creeks connecting to Killawarra State Forest (4386 ha).

Values

- The third largest and third widest remnant of native vegetation in the region. In conjunction with the Warby Range and Killawarra State Forest, represents the second largest remnant of native vegetation in the region.
- A mostly unregulated river.
- One of eighteen Heritage Rivers identified in the State and protected under the *Heritage Rivers Act (1992)*.
- A river system considered to be of State significance on the basis of its red gum forests, wetlands and riverine values (LCC 1991, NRE 1997).
- A regional corridor of Statewide significance (Bennett *et al.* 1991, p. 37; DCE 1992c) that connects environments in five separate bioregions (Victorian Alps, Highlands-Northern Fall, Central Victorian Uplands, Northern Inland Slopes and Riverina) (Crown 1997).
- Is closely linked to Warby Range State Park and Killawarra State Forest, providing seasonal or distinctive habitat for birds such as honeyeaters, Powerful Owl and Barking Owl.
- Contains examples of nine vegetation communities: Riparian Red Gum Forest, Dry Red Gum Woodland, Creekline Grassy Woodland, Central Riverine Grey Box Woodland, Herb-rich Woodland, Box-ironbark Forest, Shallow Freshwater Marsh, Deep Freshwater Marsh, Permanent Open Freshwater.
- Contains significant representation of seven vegetation communities (Table 5), including two (Creekline Grassy Woodland, Box-ironbark Forest) not represented at all in the above nominated reserve, and a third (Permanent Open Freshwater) which is barely represented (Table 5).
- Provides habitat for 24 species (16%) of threatened wildlife, including four species not found in Barmah Forest (Powerful Owl, Regent Honeyeater, Swamp Crayfish, Painted Honeyeater).
- Is a very important breeding ground for the vulnerable Murray Cod
- Contains some of the largest remnants of native vegetation in four land systems (Ffc5, Gs51, Pf53, Pf63) not represented in the Barmah Forest/Tocumwal Forest reserve proposed above (Table 11).

5.1.3 Broken, Boosey, Nine Mile Creeks system

Recommendation

State Park

Definition

Goulburn Valley Environment Group Inc. has previously outlined a proposed State Park along this creeks system (Robinson & Mann 1996). In light of more recent information, that proposal is extended here to include all of the public land along the Broken Creek between James Bridge and Nathalia and the public land upstream of Streamside Reserve K10 to the Broken Creek/Nine Mile Creek junction. In addition, it is recommended that some significant private land sites along the creeks (e.g. Ward 1998) be incorporated into the reserve estate, either through purchase or covenant.

The proposed Park thus comprises all of the public land frontage indicated in Fig. 17 of Robinson & Mann (1996), plus the additional public land indicated above, Wildlife Reserves C19, C26, C27, C28, Streamside Reserves K9, K10, K12, K13, K27, Bushland Reserves H19a, H26, H27, H32, H40, H43, H44, H45, H46, Uncommitted Crown land block U33, Narioka Recreation Reserve and the Numurkah Rifle Range (3020 ha).

Values

- Comprises the single largest remnant of the Plains Grassy Woodland BVT in the eastern Northern Plains (Robinson & Mann 1996).
- Contains examples of 13 vegetation communities, including significant representations of 11 of these (Table 5).
- Contains significant representations of four vegetation communities not represented significantly in the above nominated reserves (Freshwater Meadow, Eastern Wet Grassland, Northern Plains Grassland, Central Riverine Grey Box Woodland)
- Contains significant remnants of native vegetation in land systems Pf41, Pf42, Pf43, Pf44, Pf51 and Pfc4 (Table 11), five of which are not represented in the above nominated reserves.
- Contains 27% of all species of threatened wildlife found in the region, including 24 species of native plants, 12 species of terrestrial animal and four species of fish.
- Contains seven threatened species not recorded from elsewhere in the region (*Red-chested Button-quail*, *Panicum laevinode*, *Panicum queenslandicum*, *Atriplex spinibractea*, *Swainsona behriana*, *Acacia notabilis*, *Sida fibulifera*).
- Contains two species not recorded from anywhere else in the State (*Atriplex spinibractea*, *Panicum queenslandicum*).
- Contains 19 threatened species not recorded from any of the reserves proposed above.

As well, the system:

- Is of historical significance as one of the few surviving remnants of the Northern Plains landscape as it once was.
- Contains some of the only surviving examples of Northern Plains Grassland.
- Links many of the larger conservation reserves in the region.
- Is ecologically distinguishable from most other Victorian creeks and rivers because of its riparian Grey Box vegetation.
- Is relatively intact, albeit simplified, because of an 1874 prescription prohibiting timber cutting and cultivation on public frontages.
- Supports a significantly higher proportion of old-growth woodland than most other remnants in the eastern Northern Plains as a consequence of the 1874 prescription (Robinson & Mann 1996).

5.1.4 Lower Goulburn River forests

Recommendation

State Park

Definition

Includes the Goulburn Heritage River downstream of Shepparton (NRE 1997), the Goulburn State Forest Special Protection Zones downstream of Shepparton, most of Goulburn State Forest downstream of Shepparton (excluding Kotupna and Kaarimba outliers), Echuca Regional Park, Loch Garry Wildlife Reserve, Reedy Swamp Wildlife Reserve, Gemmills Swamp Wildlife Reserve, and Streamside Reserves K5 and K6 (7,300 ha).

Values

- The second most extensive remnant of native vegetation in the region
- One of 18 Heritage Rivers identified in the State and protected under *the Heritage Rivers Act (1992)*.
- A system recognised to be of State significance on the basis of its River Red Gum forests, wetlands and wildlife (NRE 1997).
- A critical regional corridor for wildlife movement (Bennett *et al.* 1991, p. 37; DCE 1992c) which connects four bioregions (Victorian Highlands-Northern Fall, Central Victorian Uplands, Goldfields and Riverina) (Crown 1997).
- Includes examples of 13 vegetation communities: Riverine Red Gum Forest, Riparian Red Gum Forest, Dry Red Gum Woodland, Black Box Woodland, Damp Grey Box Woodland, West Riverine Grey Box Woodland, Central Riverine Grey Box Woodland, Herb-rich Woodland, Sand-ridge Woodland, Yellow Box-White Cypress-pine Woodland, Permanent Open Freshwater, Shallow Freshwater Marsh, Deep Freshwater Marsh.
- Contains significant representation of 12 vegetation communities (Table 5).
- Contains one of the largest and best box woodland remnants in the study area, at Wyuna River Reserve.
- Contains 24% of all threatened species of wildlife found in the region, including 11 species of plants, 16 species of terrestrial mammal and eight species of fish
- Includes some of the most important sites for threatened wildlife in the region (Table 8).
- Includes representation of three threatened species not known from the above nominated reserves (Darter, *Juncus psammophilus* and *Aristida jerichoensis*).
- Contains some of the largest remnants of native vegetation in land systems Ffc4, FLfc4 and Pf42 (Table 11).
- Contains one land system (Flfc4) not represented in the above nominated reserves (Table 11).

5.1.5 Three Chain Road, Tungamah

Recommendation

Incorporate into the Broken Creek, Nine Mile Creek, Boosey Creek State Park

Definition

The road reserves from Tungamah Swamps Wildlife Reserve south to Pelleubla Road, Kreck Road east to the Yarrowonga Road and west to Bushland Reserve H44 (20 ha). Ideally, private land located between Three Chain Road and the Boosey Creek frontage (see Ward 1998) and to the north of Kreck Road should also be incorporated into the reserve, either by purchase, covenant or other landholder agreement.

Values

- A very significant example of Eastern Wet Grassland (Tables 5, 8, 9), with 12 known species of threatened plants and two species of threatened animal (Brolga, Grey-crowned Babbler, *Eleocharis pallens*, *Stipa gibbosa*, *Tripogon loliiformis*, *Panicum laevinode*, *Eryngium paludosum*, *Ixiolaena* spp., *Minuria integerrima*, *Haloragis glauca*, *Prasophyllum campestre*, *Allocasuarina luehmannii*, *Triglochin dubium*, *Templetonia stenophylla*).
- Contains three species of threatened plants not recorded from any of the above reserves and two species (*Eryngium paludosum*, *Triglochin dubium*) not recorded from any reserve in the study area (Appendix 4).
- Contains one threatened species (*Panicum laevinode*) otherwise known in the region from only one site along the Boosey Creek and only known from one other site in the State.
- Contains significant populations of regionally rare species such as Golden Billy-buttons *Pycnosaurus chrysanthes* (see Robinson & Mann 1996).
- Provides breeding habitat for Brolgas.

5.1.6 Corop Lakes

Recommendation

State Park

Definition

Wallenjoe Swamp, Two Tree Swamp, Gaynors Swamp and Mansfield Swamp Wildlife Reserves (C10, C11, C12, C13); and high quality roadsides on Winter Road, Deviation Road, Wallenjoe Road and Gilmour Road (1270 ha). In addition, conservation management of nearby swamps on private land (e.g. Little Wallenjoe Swamp, Horseshoe Lake, One Tree Swamp) should be sought through purchase, covenant or landholder agreements (total area).

Values

- A distinctive area of floodplain red gum woodland, wetlands and grasslands which includes the only known remnants of the Northern Plains Grassland community R1.3 (McDougall *et al.* 1993).

- Contains the only significant remnants of native vegetation in land system FLf4 (Table 11).
- Contains significant representations of three vegetation communities: Shallow Freshwater Marsh, Deep Freshwater Marsh, Northern Plains Grassland (Table 5)
- A known breeding ground for at least 22 species of waterbird, including the threatened Brolga, Great Egret and Royal Spoonbill.
- Contains 14% (20) of all threatened species found in the study area.
- Includes known sites for two nationally endangered species of plants (*Senecio behrianus*, *Swainsona plagiotropis*).
- Contains four threatened species not recorded from any of the above nominated reserves or from any other existing reserves in the study area (*Swainsona plagiotropis*, *Senecio behrianus*, *Muehlenbeckia horrida*, *Melaleuca halmatorum*). Note that the first three of these occur only on roadsides in the proposed Park.
- Contains the only examples of remnant vegetation in land system FLf4, a land system not found in the above, nominated reserves.

5.1.7 Reef Hills Regional Park

Recommendation

State Park

Definition

Reef Hills Regional Park (2040 ha).

Values

- Includes significant representations of three vegetation communities (Box-ironbark Forest, Herb-rich Woodland, Shallow Freshwater Marsh (Table 5).
- Contains the only large remnant of Herb-rich Woodland with an intact ground layer and understorey in the study area.
- Provides the only significant representation of land system Pf71 in the region (Table 11).
- Is a known site for four, nationally threatened species (Square-tailed Kite, Regent Honeyeater, Swift Parrot, *Glycine latrobeana*).
- Provides habitat for 11 threatened species (Regent Honeyeater, Painted Honeyeater, Swift Parrot, Turquoise Parrot, Square-tailed Kite, Powerful Owl, Squirrel Glider, Tuan, Buloke, *Diuris punctata*, *Glycine latrobeana*).
- Provides habitat for three threatened species not recorded in the above nominated reserves (Square-tailed Kite, *Diuris punctata*, *Glycine latrobeana*), and is a key site for four species recorded only rarely, if at all, in the above reserves (Swift Parrot, Turquoise Parrot, Regent Honeyeater, Painted Honeyeater).

5.1.8 O’Dea Road, Wyuna

Recommendation

Conservation Reserve

Definition

Both sides of O’Dea Road, Wyuna from the Murray Valley Highway to Day Road, Wyuna (15 ha).

Values

- A site of national significance (McDougall *et al.* 1993) as an intact example of the endangered Northern Plains Grassland community.
- Contains three nationally threatened species of plants (*Swainsona murrayana*, *Sclerolaena napiformis*, *Myriophyllum porcatum*) and an additional two species listed as threatened in Victoria (*Stipa gibbosa*, *Maireana excavata*).
- Contains three threatened species of plants, including two endangered species (*Swainsona murrayana*, *Sclerolaena napiformis*), not represented in any of the above, nominated reserves.

5.1.9 Strathmerton-Mywee Railway reserve

Recommendation

Conservation Reserve

Definition

The Strathmerton-Mywee Railway reserve and adjoining road reserve from Strathmerton to Mywee. In addition, private land located north of the gun club should be managed for conservation through purchase or covenant (20 ha).

Values

- Represents one of the very few examples of sand-ridge woodland found in the region which still supports remnant native vegetation (Table 5). As a result, contains a very distinctive and unusual flora, dominated by *Aristida* spp., *Panicum* spp., *Digitaria* spp. and *Enneapogon nigricans*.
- Is the only known site in Victoria for a recently described species of grass, *Aristida personata* (N. Walsh, National Herbarium, *pers. comm.*).
- Provides habitat for eight threatened species of plant (*Aristida personata*, *Digitaria ammophila*, *Digitaria coenicola*, *Panicum decompositum*, *Maireana aphylla*, *Maireana microphylla*, *Psoralea parva*, *Minuria integerrima*), one of which is nationally endangered (*Psoralea parva*) and all of which are inadequately reserved (Appendix 4).
- Contains two species not represented in the above nominated reserves: *Aristida personata*, *Digitaria coenicola*.

5.1.10 Boorhaman Railway reserve

Recommendation

Conservation Reserve

Definition

Boorhaman Rail Reserve and road reserve east and west of Boorhaman (15 ha).

Values

- A significant remnant of the endangered Eastern Wet Grassland community (Table 2) and of land system Pfc5 (see 5.2); a land system not represented in any of the above nominated reserves.
- One of only two known sites in Victoria for the endangered *Diuris dendrobioides* (Muir 1996).
- Contains seven threatened species of plants (*Diuris dendrobioides*, *Diuris punctata*, *Prasophyllum campestre*, *Stipa setacea*, *Stipa gibbosa*, *Isolepis wakefieldiana*, *Cymbonotus lawsonianus*).
- Contains six threatened species under-represented in the current reserves (Appendix 4).

5.1.11 Nathalia-Picola Railway reserve between Broken Creek and Picola

Recommendation

Conservation Reserve

Definition

The disused railway reserve between Nathalia and Picola, and including the unused road reserve at Murray Road, Picola (35 ha).

Values

- Contains significant remnants (Table 7) of four endangered communities (Northern Plains Grassland, Sand-ridge Woodland, Yellow Box-White Cypress-pine Woodland, West Riverine Grey Box Woodland) (Table 5).
- Contains populations of seven threatened species of plants (*Tragus australianus*, *Swainsona sericea*, *Swainsona murrayana*, *Maireana humillima*, *Eryngium paludosum*, *Eleocharis pallens*, *Ptilotus erubescens*), two of which are endangered and three of which are vulnerable (Appendix 4).
- Contains three threatened species not found in any existing reserve (Appendix 4) and two threatened species not found in the above nominated reserves (*Swainsona sericea*, *Ptilotus erubescens*).
- Is an important site for regionally rare species associated with these vegetation communities, e.g. *Acacia brachybotrya*, *Erodium crinitum*, *Maireana pentagona* (see Robinson & Mann 1996, Table 14).

5.1.12 Dookie Bushland Reserve

Recommendation

Conservation Reserve

Definition

Bushland Reserve at Dookie Agricultural College (270 ha).

Values

- A very significant remnant of Box-ironbark Forest and Low Rises Grassy Woodland vegetation (Table 5) that is listed on the Interim Register of the National Estate (ECC 1997) for its outstanding natural values.
- A significant outlier of Box-ironbark vegetation on the riverine plains (Sherwin 1996).
- One of the largest remnants of land system Gs51 in the study area (Table 11).
- A known site for at least nine threatened species (Squirrel Glider, Swift Parrot, Woodland Blind Snake, Bandy Bandy, White Cypress-pine, *Brachyscome gracilis*, *Templetonia stenophylla*, *Cryptandra amara longiflora*, *Desmodium varians*).
- A known historical site for an additional five threatened species (Regent Honeyeater, Grey-crowned Babbler, Bush Stone-curlew, *Swainsona phacoides*, *Psoralea parva*) (Hamilton 1993).
- Contains two threatened species not known from the above nominated reserves (*Brachyscome gracilis*, *Cryptandra amara*) and a third for which Dookie is the only recent site (Bandy Bandy).
- A key site for Squirrel Glider and Swift Parrot in the study area and the only known site for *Cryptandra amara*.
- A very diverse site for reptiles and woodland birds (Hamilton 1993).

5.1.13 Reedy Lake Wildlife Reserve

Recommendation

Conservation Reserve

Definition

Wildlife Reserve C15 (1,400 ha).

Values

- A large and diverse site (Tables 6, 7), containing significant representations of four vegetation communities (Permanent Open Freshwater, Shallow Freshwater Marsh, Yellow Gum-Grey Box Woodland and Herb-rich Woodland) (Table 5).
- Comprises the largest remnant of native vegetation in land system Pf55 (Table 11), a land system not represented in the above nominated reserves.
- Contains the largest remnant of Yellow Gum-Grey Box Woodland in the study area (Table 5).
- Provides a link between the Riverina and Goldfields Bioregions (Crown 1997).
- provides a habitat link between the Rushworth Box-ironbark forests and the Goulburn River.

- Contains nine threatened species (Swift Parrot, Squirrel Glider, Brolga, Darter, Royal Spoonbill, White-bellied Sea-Eagle, River Blackfish, Flat-headed Galaxias, *Prasophyllum campestre*), including several species of restricted, colonially breeding bird.

5.1.14 Glenrowan Railway reserve

Recommendation

Conservation Reserve

Definition

The rail reserve and road reserve on each side of the Melbourne-Albury railway line, south of Glenrowan (6.4 ha).

Values

- A very diverse (> 90 native plant species) site which contains plant species characteristic of Plains Grassy Woodland, Herb-rich Woodland and Inland Slopes Woodland BVTs.
- The only known site in Victoria for the endangered plant *Swainsona recta*.
- Contains five threatened species (*Digitaria coenicola*, *Swainsona recta*, *Templetonia stenophylla*, *Isolepis congrua*, White Cypress-pine).
- Contains two threatened species not represented in any reserve (*Swainsona recta*, *Isolepis congrua*).
- Represents a very significant example of native vegetation in land system Pf64 (see 5.2).

5.1.15 Yarrawonga/Cobram State Forests, Bourkes Bend-Cemetery Bend

Recommendation

Conservation Reserve

Definition

Parts of Yarrawonga State Forest, Cobram State Forest and the Murray River Reserve between Bourkes Bend and Cemetery Bend (1300 ha).

Values

- Includes some of the best sections of the Murray River forest between Tocumwal and Yarrawonga in terms of tree size, understorey and groundcover.
- Includes significant representations of four vegetation communities (Riparian Red Gum Forest, Dry Red Gum Woodland, Shallow Freshwater Marsh, Deep Freshwater Marsh).
- Provides habitat for 11 threatened species (Superb Parrot, Broad-shelled Tortoise, Trout Cod, Murray Cod, Golden Perch, Silver Perch, River Blackfish, Mountain Galaxias, Unspeckled Hardyhead, *Amphibromus fluitans*, *Hypsela tridens*).
- Contains representation of seven inadequately reserved species (Appendix 4).

- Contains two species not recorded from Barmah Forest (Broad-shelled Tortoise, Mountain Galaxias), five threatened species not recorded from the Goulburn (Broad-shelled Tortoise, Trout Cod, Mountain Galaxias, Unspeckled Hardyhead, *Hypsela tridens*) and five species not recorded from the nominated reserve along the Ovens (Superb Parrot, Silver Perch, Unspeckled Hardyhead, Mountain Galaxias, *Hypsela tridens*).

5.1.16 Deep Creek and branches

Recommendation

Conservation Reserve

Definition

All public land frontage along Deep Creek, Skeleton Creek and Sheepwash Creeks from the Murray River east to Kaarimba, Streamside Reserves K7 and K8, and Bushland Reserves H20, H23, H24 (485 ha).

Values

- Contains significant representation of two endangered communities (West Riverine Grey Box Woodland, Eastern Wet Grassland) (Table 5).
- Comprises one of the largest remnants of native vegetation in land system Pf46 (Table 11) and the only remnant of grassy woodland vegetation within that system.
- Provides representation of a land system not included in the above, nominated reserves.
- Particularly at the lower end, provides outstanding examples of intact riparian vegetation along a creek system with natural flows.
- Is a known site for five threatened species (Grey-crowned Babbler, Squirrel Glider, Woodland Blind Snake, Barking Marsh Frog, *Digitaria ammophila*); the latter three of which are under-represented in the reserve system.

5.1.17 Runnymede Flora Reserve

Recommendation

Conservation Reserve

Definition

Runnymede Flora Reserve H9 and Stone Reserve R84 (242 ha).

Values

- Along with adjacent roadsides, the only remnant of native vegetation in land system GS45 (Table 11), and one of very few remnants in the Camel Range.
- Contains the largest remnant of Low Rises Grassy woodland in the study area (Table 5).
- A White Box dominated reserve with intact shrub layer and ground layer.
- Contains three threatened species (Swift Parrot, Woodland Blind Snake, *Stipa breviglumis*).

- The only public land site in the study area which supports *Stipa breviglumis*.

5.1.18 Seven Creeks, downstream from Miepoll

Recommendation

Conservation Reserve

Definition

Streamside Reserve K19 and public frontage from Miepoll to Kialla (253 ha).

Values

- The largest remnant of native vegetation in land systems Pf52 and Pf61 (Table 11).
- An important regional corridor for wildlife movement that connects four bioregions (Highlands-Northern Fall, Goldfields, Northern Inland Slopes, Victorian Riverina).
- Contains a very wide (generally > 100 m wide) public frontage.
- Contains significant representations of two vegetation communities: Creekline Grassy Woodland and Herb-rich Woodland (Table 5).
- Contains the largest representation of Creekline Grassy Woodland in the study area (Table 11).
- Supports five species of threatened wildlife (Barking Owl, Silver Perch, Golden Perch, Macquarie Perch, River Blackfish), including one species (Macquarie Perch) not represented in any existing reserve or any of the proposed reserves.

5.1.19 Dookie-Youanmite Railway reserve

Recommendation

Conservation Reserve

Definition

Disused railway line from just north of Dookie township to Youanmite (38 ha).

Values

- Contains representation of three land systems (Gvs5, Pf43, Pf51), including one (Gvs5) not represented in the above nominated reserves.
- Contains examples of the very rare Yellow Box-White Cypress Pine Woodland and Low Rises Grassy Woodland communities.
- Contains seven threatened species (*Allocasuarina luehmannii*, *Minuria integerimma*, *Callitris glaucophylla*, *Acacia decora*, *Rytidosperma richardsonii*, *Panicum decompositum*, *Maireana humillima*).
- Includes two vulnerable species not present in any of the above nominated reserves (*Rytidosperma richardsonii*, *Acacia decora*).
- Supports additional, regionally rare species of plants such as Golden Billy Buttons *Pycnosaurus chrysanthes* and Yam Daisy *Microseris scapigera*.

5.1.20 Mt Major Agricultural Reserve

Recommendation

Conservation Reserve

Definition

Remnants of native vegetation on parts of the agricultural public land reserve around Mt Major (c. 20 ha).

Values

- One of the only public land sites on the very poorly represented land system Gvs5 (Table 10).
- Part of the largest consolidated remnant of native vegetation in land system Gvs5 (Table 11).
- One of the only remnants of Low Rises Grassy Woodland in the study area (Table 5).
- Contains five threatened species (*Allocasuarina luehmannii*, *Callitris glaucophylla*, *Acacia decora*, *Cheilanthes lasiophylla*, *Brachyscome gracilis*), including one species not known from any other site (*Cheilanthes lasiophylla*).
- Contains two vulnerable species under-represented in the existing and proposed reserves (*Acacia decora*, *Brachyscome gracilis*).
- Provides habitat for several regionally rare species of woodland dependent bird such as Chestnut-rumped Thornbill and Southern Whiteface.

5.1.21 Black Swamp Wildlife Reserve

Recommendation

Conservation Reserve

Definition

Black Swamp Wildlife Reserve (C31) (126 ha).

Values

- The largest public land remnant of native vegetation in land system Pf55 in the northern part of the study area (see Table 11).
- Includes significant representation of one vegetation community: Shallow Freshwater Marsh (Table 5).
- A known site for four threatened species, including three species of restricted, colonially breeding waterbird (Nankeen Night-heron, Royal Spoonbill, Great Egret, Barking Owl).
- A known breeding site for 20 species of waterbird (A. Corrick, *in litt.*).
- A High value site (Appendix 5) on the basis of the density of mature trees, size, land system representation and importance for waterbirds.

5.1.22 Dowdle Swamp Wildlife Reserve

Recommendation

Conservation Reserve

Definition

Dowdle Swamp Wildlife Reserve (291 ha).

Values

The largest remnant of native vegetation in land system Pf41 in the eastern part of the study area.

One of the largest remnants of Deep Freshwater Marsh in the study area (Table 5).

A very important breeding site for waterbirds, including four restricted, colonially breeding species (Great Egret, Nankeen Night-heron, Darter).

Contains three other threatened species (Brolga, White-bellied Sea-Eagle, *Hydrilla verticillata*).

Provides breeding habitat for at least 16 species of waterbirds (A. Corrick *in litt.*)

5.1.23 Munroes State Forest

Recommendation

Conservation Reserve

Definition

Munroes State Forest, Undera (163 ha).

Values

- A distinctive part of the Goulburn River State Forest system that occurs on a different land system (Pf46) from most of the Goulburn forest and which is characterised by extensive patches of Grey Box woodland.
- A diverse site (Tables 6, 7) containing significant representations of four vegetation communities (Shallow Freshwater Marsh, Damp Grey Box Woodland, Central Riverine Grey Box Woodland, Eastern Wet Grassland).
- One of the largest box woodland remnants in the study area.
- Contains two threatened species (Bush Stone-curlew, *Eutaxia diffusa*).
- One of the largest remnants of native vegetation in land system Pf46 (Table 11)
- Ranked as being of High conservation value (Appendix 5).

5.1.24 Pranjip Creek and Creighton Creek district

Recommendation

Conservation reserves (although the public land sites are separated, they are close enough together and well enough connected by roadside vegetation to consider as one management unit).

Definition

Public frontage along Little Branjee Creek, public frontage on Creightons Creek next to Williams Road, public frontage along Pranjip Creek from northwest of Longwood to Wahrung, Bushland Reserves H66, H67 and H68 (c. 135 ha).

Values

- Contain the most intact and diverse examples of remnant vegetation in the district, including distinctive creekline vegetation communities not recorded from anywhere else in the study area (notably, riparian vegetation of *Melaleuca parvistaminea* abutting Grey Box woodland and Buloke *Allocasuarina luehmannii* stands intermingled with River Red Gum).
- Contain some of the largest remnants of native vegetation in land systems Pf52 and Pf61 (Table 11).
- Include significant representations of Creekline Grassy Woodland, Herb-rich Woodland and Central Riverine Grey Box Woodland (Table 5).
- Contains at least five threatened species (Squirrel Glider, Bush Stone-curlew, *Allocasuarina luehmannii*, *Eutaxia diffusa*, *Templetonia stenophylla*).
- Ranked as having Moderately High conservation value (Appendix 5).

5.1.25 Bushland Reserve H53

Recommendation

Conservation Reserve

Definition

Bushland Reserve H53 (LCC 1985) (33 ha).

Values

- One of the most intact remnants of Central Riverine Grey Box Woodland in the study area.
- Ranked as being of Very High conservation value (Appendix 5).
- Contains three threatened species (*Templetonia stenophylla*, *Stipa gibbosa*, *Stipa setacea*), the latter of which is under-represented in existing reserves (Appendix 4).
- Has very high plant species diversity (> 80 native species) and includes regionally rare species such as Purple Burr-daisy *Calotis cuneifolia*.

5.1.26 Black Dog Creek

Recommendation

Conservation Reserve

Definition

The public frontage along Black Dog Creek between Chiltern and the Murray River, Streamside Reserves K14, K28, K30 (255 ha).

Values

The single largest remnant of native vegetation in land systems Pf53 and Pfc5 (Table 11).

A very important regional corridor, connecting two Bioregions (Northern Inland Slopes, Victorian Riverina) and four BVTs (Riverine Grassy Woodland, Plains Grassy Woodland, Box-ironbark Forest, Inland Slopes Woodland).

Contains significant representation of Creekline Grassy Woodland, including some distinctive species not found in this community further south (e.g. Apple Box *Eucalyptus bridgesiana*).

Contains three threatened species (Barking Owl, Grey-crowned Babbler, Bush Stone-curlew).

Has an overall conservation ranking of 'Moderate' but includes some areas classed as 'Moderately High' (Appendix 5).

5.1.27 Bushland Reserve H74 and H75

Recommendation

Conservation Reserve

Definition

Bushland Reserve H74 and H75 (21 ha).

Values

- Includes significant representation of the poorly represented Box-ironbark-Green Mallee Woodland community (Table 5).
- Comprises a rare, intact example of the ecotone between box-ironbark and grassy woodland ecosystems.
- As a consequence, is species-rich (> 90 native plant species) and includes many regionally significant species.
- Supports six threatened species (Grey-crowned Babbler, Bush Stone-curlew, *Callitris glaucophylla*, *Allocasuarina luehmannii*, *Tempeltonia stenophylla*, *Myoporum montanum*).
- Has provided part of the territory for as many as three groups of Grey-crowned Babblers.
- Is central to the largest remaining population of the endangered Grey-crowned Babbler in the State.
- Is ranked as having High conservation value (Appendix 5).

5.1.28 Bushland Reserve H78

Recommendation

Conservation Reserve

Definition

Bushland Reserve H78 (12 ha).

Values

- Intact example of Herb-rich Woodland, with an understorey dominated by Kangaroo Grass *Themeda triandra*, native lilies and herbs.
- Species rich site (> 80 native plant species).
- Supports two threatened species (Squirrel Glider, *Templetonia stenophylla*).

5.1.29 Stony Creek and Honeysuckle Creek

Recomendation

Conservation Reserve

Definition

All of the public water frontage along Stony Creek and Honeysuckle Creek (349 ha).

Values

- Contains significant representation of two vegetation communities: Central Riverine Grey Box Woodland and Creekline Grassy Woodland (Table 5).
- Includes significant remnants of native vegetation in land systems Pf53 and Pf61 (Table 11).
- Contains one of the best developed examples of creekline grassy woodland in the study area, at Tamleugh West.
- Is known habitat for five threatened species (Grey-crowned Babbler, Squirrel Glider, Bush Stone-curlew, *Desmodium varians*, *Eutaxia diffusa*).
- Provides a major habitat link within the best remaining district for Grey-crowned Babblers in Victoria.
- Includes moderately wide (50-100 m) public frontage, particularly along Stony Creek.
- Has an overall conservation ranking of Moderately High (Stony) and Moderate (Honeysuckle).

5.1.30 Castle Creek

Recommendation

Conservation Reserve

Definition

All of the public frontage along Castle Creek from Siems Road, Euroa, to Summer Road, Miepoll, and Bushland Reserve H69 (180 ha).

Values

- The best, overall remnant of creekline vegetation in the district, on the basis of site width, area, land system representation and habitat quality.
- An important, potential habitat link for threatened species in the district, especially Squirrel Gliders, Tuans and Grey-crowned Babblers.
- Contains significant representation of Creekline Grassy Woodland (Table 5), an extremely poorly reserved and protected community (Table 2).

- Contains two threatened species (Grey-crowned Babbler, *Allocasuarina luehmannii*).
- Ranked overall as having Moderate Conservation Value but includes some Moderately High value sites (Appendix 5).

5.1.31 Doctors Swamp

Recommendation

Conservation Reserve

Definition

Doctors Swamp Wildlife Reserve C14 (LCC 1981) (263 ha).

Values

- The second largest public land remnant in land system Pf55 (Table 11).
- Contains significant representation of two vegetation communities: Shallow Freshwater Marsh, yellow Gum-Grey Box Woodland (Table 5).
- A known site for three threatened species (Brolga, Great Egret, Grey-crowned Babbler).
- The only reserve in Victoria with a resident population of several groups of Grey-crowned Babbler.

5.1.32 Boxwood Historic Reserve

Recommendation

Conservation Reserve

Definition

Boxwood Historic Reserve I2 (LCC 1985) (52 ha). Ideally, adjoining remnants on private land should also be managed for conservation, either under purchase, covenant or other landholder agreement.

Values

- Is the second largest remnant of native vegetation on the scantily represented land system Gvs5 (Tables 10, 11).
- Contains the second largest remnant of Low Rises Grassy Woodland in the study area (Table 5).
- Includes stands of Grey Box, Yellow Box, White Box and Blakely's Red Gum.
- Contains one threatened species (Buloke) and at least three regionally significant species (*Allocasuarina verticillata*, *Enneapogon nigricans*, *Dicantheum sericeum*).
- Adjoins a large (> 50 ha) woodland remnant on private land which contains understorey and one threatened species (*Templetonia stenophylla*).

5.1.33 Streamside Reserves K17 and K50, Goulburn River

Recommendation

Conservation Reserve

Definition

Streamside Reserves K17 (LCC 1985) and K50 (LCC 1981), Goulburn River at Arcadia (290 ha).

Values

- Contain the largest representation of land system Pf54 in the study area (Table 11).
- Contain significant representations of two vegetation communities: Riparian Red Gum Forest and Herb-rich Woodland (Table 5).
- Contain a distinctive sub-community of Riparian Red Gum Forest which includes River Tea-tree *Leptospermum obovatum* and River Bottlebrush *Callistemon sieberi*.
- Contain two threatened species (Squirrel Glider, Golden Perch).

5.2 SIGNIFICANT GAPS IN THE RESERVE ESTATE AND POSSIBLE SITES FOR CONSERVATION ON PRIVATE LAND OR ROADSIDES

Although every vegetation community in the eastern Riverina is inadequately conserved (Tables 1, 2), seven communities stand out for their very poor representation on public land or for their poor representation in intact condition on public land (e.g. Black Box). These are: Northern Plains Grassland, Eastern Wet Grassland, Yellow Box-White Cypress-pine Woodland, Sand-ridge Woodland, Black Box Woodland, Freshwater Meadows and Box-ironbark Forest-Green Mallee Woodland. In addition, there is no public land representation of land systems Gs41, Gv4 or Gvs4 and only minor representation of land systems Gg5, Gs45, Gvs5, Pf42, Pf43, Pf44, Pf52, Pf62, Pf63, Pf64, Pf65, Pf71 and Pfc5 (Table 10).

Although private land was not surveyed systematically during the survey, it is recommended that any private land sites with remnant native vegetation in any of these under-represented categories, should be a priority for addition to the reserve estate, either through purchase, covenant or other forms of landholder agreements.

Outstanding sites recorded on private land or roadsides are shown in Table 14.

Table 14. Significant private land and roadside sites recorded in the study area. Numbers in the Vegetation community column indicate the vegetation communities found at each site as numbered in Section 2.4. Numbers in brackets in the threatened species column indicate the number of threatened species of terrestrial animal, fish and plant respectively.

Site	Area (ha)	Land system	Veg. comm. numbers	No. of threatened species	No. of endangered species	No. of unreserved species	No. of unique species
Private block, Katamatite	8	Pfc4	12	11 (2, 0, 9)	1	4	1
Private blocks, Earlston	150	Gs51	14, 18	13 (8, 0, 5)	3	1	1
Private block, Lake Rowan	1	Pf53	9	1 (0, 0, 1)	1	1	0
Private block, Lake Rowan	10	Gg5	9	2 (0, 0, 2)	0	0	0
Private block, Tungamah	50	Pf53	8, 9	3 (1, 0, 2)	1	1	0
Private block, Lake Rowan	20	Pf53	8, 9	3 (0, 0, 3)	1	1	1
Private block, Brimin	96	Pfc5	9, 11	5 (2, 0, 3)	1	1	0
Private block, Brimin	20	Pfc5	9	2 (0, 0, 2)	0	0	0
Private block, Pranjip	11	Pf61	16	5 (3, 0, 2)	1	1	0
Private block, Picola	2	Pfc4	12, 19	2 (0, 0, 2)	0	0	0
Private block, Kaarimba	70	Pf41	2, 5, 7, 9	5 (1, 0, 4)	1	0	0
Private block, Yabba North	10	Pf51	9	4 (1, 0, 3)	1	1	0
Private block, Uptopotpon	10	Gs51	18	1(1, 0, 0)	0	0	0
Barmah-Nathalia Road	40	Pfc4	6, 7	10 (2, 0, 8)	1	2	0
Old Coach Road, Bearii-Mywee	20	Pfc4	2, 8, 9	4 (2, 0, 2)	1	0	0
Shepparton-Echuca Road, Wyuna	1	Pf42	12	1 (0, 0, 1)	1	0	0
Unnamed roadside, Thoona	1	Pf53	13	1 (0, 0, 1)	0	1	1
Barmah-Picola Road	40	Pfc4	6, 7	4 (2, 0, 2)	1	0	0
Stewarts Bridge Road, Barmah	40	Pfc4, Pf46	2, 6, 7	2 (1, 0, 1)	1	0	0
Angle Road, Molka	60	Pf52, Pf61	8, 16	6 (4, 0, 2)	1	0	0
Violet Town-Nalinga Road	150	Pf61, Gs51	8, 13, 18	5 (3, 0, 2)	1	0	0

5.3 RECOMMENDATIONS FOR NOMINATIONS TO THE REGISTER OF THE NATIONAL ESTATE

Of the sites listed above, the following are considered worthy of nomination to the Register of the National Estate under various criteria (Table 15).

Table 15 Sites worthy of nomination to the Register of the National Estate. For definitions of the various criteria, see Appendix 3.

Site	Criteria
Barmah Forest (already listed)	A1, A2, A3, B, C1
Echuca Regional Park and State Forest south of Yambuna	A2, A3, D1
Ovens River between Murray and Wangaratta	A2, A3, B, C1, D1
Goulburn River forest, downstream of Shepparton	A2, A3, B, D1
Parts of the Broken, Boosey, Nine Mile Creeks system	A1, A2, A3, B, C1, D1
Corop Lakes system	A2, A3, B, C1, D1
Reef Hills Regional Park	A2, B, D1
Dookie Bushland Reserve (already listed)	A2, A3, B, C1, D1
Three Chain Road, Tungamah	A2, A3, B, D1
O'Dea Road, Tongala	A2, A3, B, D1
Boorhaman Railway line	A2, A3, B, D1
Strathmerton-Mywee Railway line	A2, A3, B, C1, D1
Wunghnu Bushland Reserve H27	A1, A2, A3, B
Katamatite Bushland Reserve H40	A1, A2, A3, B, C1, D1
Tungamah Swamp Wildlife Reserve	A1, A2, A3, B, C1, d1
Rowan Swamp Wildlife Reserve	A1, A2, A3, B, C1, D1
Runnymede Flora Reserve	B1
Deep Creek public frontage	A2, D1
Reedy Lake Wildlife Reserve	A2, A3, B, D1
Black Swamp Wildlife Reserve C31	D1
Bushland Reserves H74, H75	A2, A3, B, D1
Bushland Reserve H53	A2, A3, B, D1
Glenrowan Rail reserve	A2, A3, B, D1
Private block, Katamatite	A2, A3, B, D1
Private block, Brimin	A2, B, D1
Private block, Pranjip	A2, B, D1
Private block, Lake Rowan	B
Private blocks, Earlston	A1, A2, A3, B, D1

5.4 RECOMMENDATIONS FOR FUTURE SURVEY

A caveat which applies to this whole study is that sites can only be judged on the basis of known information. From perusal of literatures sources, databases and the Biomaps, it is clear that the following areas warrant more detailed biological survey:

- The Lower Goulburn region, especially including Echuca Regional Park and the State Forest on the north side of the Goulburn.
- Kanyapella basin
- State Forests and Regional Parks along the Murray River, east of Ulupna Island.
- Munroes State Forest
- Deep Creek and its branches
- Railway lines, in particular the Benalla-Yarrawonga and Numurkah-Strathmerton lines
- the creek systems running northwest from the Strathbogies (e.g. Sevens, Stony, Honeysuckle, Creightons, Castle, Pranjip)
- Boxwood Historic Reserve and other remnants in that land system Gvs5, and
- most of the Wildlife Reserves.

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References

- AHC (1990). What do we want to pass on to future generations? An overview of criteria and assessment procedures for the Register of the National Estate. Australian Heritage Commission, Canberra.
- AHC (1994). Nomination to the Register of the National Estate. Barmah and Millewah Forests. Australian Heritage Commission, Canberra.
- Beaglehole, A.C. (1986). *The distribution and conservation of vascular plants in the Murray Valley study area, Victoria*. A.C. & H.M. Beaglehole, Portland.
- Bedward, M., Pressey, R.L. & Keith, D.A. (1992). A new approach for selecting fully representative reserve networks: addressing efficiency, reserve design and land suitability with an iterative analysis. *Biol. Conserv.* 62: 115-125.
- Bennett, A.F., Lumsden, L.F. & Nichols, A.O. (1994). Tree hollows as a resource for wildlife in remnant woodlands: spatial and temporal patterns across the northern plains of Victoria, Australia. *Pacific. Conserv. Biol.* 1: 222-235.
- Bennett, S., Brereton, R., Mansergh, I., Berwick, S., Sandiford, K. & Wellington, C. (1991). The potential effect of the enhanced greenhouse climate change on selected Victorian fauna. *ARI Tech. Rep. Ser. No. 123*. Dept of Conservation and Environment, Melbourne.
- Berwick, S. (1996). Survey for selected rare or threatened vascular plant species in the Box-Ironbark Region, Victoria. Unpublished report to ANCA. DNRE, Melbourne.
- Berwick, S. & Conway, M. (in prep.). Goulburn Broken catchment CMA region pre-1750 ecological vegetation class mapping project. Draft project report. DNRE, Benalla.
- Chesterfield, E.A., Macfarlane, M.A. & Loyn, R.H. (1984). Flora and fauna of Barmah State Forest in relation to management. Forests Commission of Vic., Research Branch Rep. 239.
- Clark, T. (1996). *Identification and protection of relict box woodlands in the eastern Victorian Riverina*. Dept of Natural Resources and Environment, North East Region.
- Cook, D. (1997). Roadside survey of native grasslands in Moira Shire. Unpublished report to ANCA. Goulburn Valley Environment Group, Shepparton.
- Crown (1997). *Victoria's Biodiversity: Directions in Management*. DNRE, Melbourne.
- Davidson, I. (1996). *The Box-Ironbark Remnants Project*. DNRE, Melbourne.
- DCE (1992a). *Draft Conservation Program for Native Grasslands and Grassy Woodlands in Victoria*. DCE, Melbourne.
- DCE (1992b). *An assessment of Victoria's wetlands*. DCE, Melbourne.
- DCE (1992c). *Flora and Fauna Guarantee Strategy: Conservation of Victoria's Biodiversity*. DCE, Melbourne.
- DNRE (in prep.). Proposed Forest Management Plan for the Mid-Murray Forest Management Area. DNRE, Melbourne.
- ECC (1997). *Box-Ironbark Forests and Woodlands Investigation. Resources and Issues Report*. Environment Conservation Council, Melbourne.
- Foreman, P. (1995). The composition, structure and distribution of remnant indigenous vegetation throughout Victoria's Northern Riverine Plains with particular emphasis on grasslands and grassy woodlands. Draft report, DCNR, Bendigo.
- Frankenberg, J. (1971). *Nature Conservation in Victoria. A Survey*. Victorian National Parks Association, Melbourne.
- Frood, D. (1983). *The vegetation of the Murray Valley Study Area*. Report to the Land Conservation Council of Victoria.
- Frood, D. & Calder, M. (1987). *Nature Conservation in Victoria. Study Report Vol. 1*. Victorian National Parks Association, Melbourne.
- GBCLPB (1997). *Catchment Strategy, Goulburn Broken Catchment*. Goulburn-Broken Catchment Land Protection Board, Shepparton.
- Hamilton, S. (1993). *Management Plan: Dookie Bushland Reserve*. Victorian College of Agriculture and Horticulture Ltd., Dookie.
- JANIS (1997). *Comprehensive, adequate and representative reserve system for forests in Australia*. Commonwealth of Australia 1997.
- Kirkpatrick, J.B. (1983). An iterative method for establishing priorities for the selection of nature reserves: an example from Tasmania. *Biol. Conserv.* 25: 127-134.
- Koehn, J.D. (1993). Fish need trees. *Vic. Nat.* 110: 255-257.
- Koehn, J.D. & O'Connor, W.G. (1990). Threats to Victorian native freshwater fish. *Vic. Nat.* 107: 5-12.
- LCC (1981). *Final Recommendations North Central Study Area*. Land Conservation Council, Melbourne

- LCC. (1983). *Report on the Murray Valley Area*. Land Conservation Council, Melbourne.
- LCC. (1985). *Final Recommendations Murray Valley Area*. Land Conservation Council, Melbourne.
- LCC (1986). *Final Recommendations North-eastern Area (Benalla-Upper Murray) Review*. Land Conservation Council, Melbourne.
- LCC. (1988). *Statewide Assessment of Public Land Use, Victoria*. Land Conservation Council, Melbourne.
- LCC (1991). *Rivers and Streams Special Investigation. Final Recommendations*. Land Conservation Council, Melbourne.
- LCC (1994). *Melbourne Area District Two Review. Final Recommendations*. Land Conservation Council, Melbourne.
- Lunt, I.D. (1995). European management of remnant grassy forests and woodlands in south-eastern Australia - past, present and future? *Vic. Nat.* 112: 239-249.
- Margules & Partners (1990). River Murray Riparian vegetation Study. Report to Murray Darling Basin Commission. Margules & Partners, P & J. Smith, DCFL, Melbourne.
- McDougall, K. & Kirkpatrick, J.B. (1983). (Eds) *Conservation of Lowland Native Grasslands in South-eastern Australia*. World Wide Fund for Nature, Sydney.
- McDougall, K., Barlow, T. & Appleby, M. (1993). Grassland communities and significant grassland sites: Western basalt plains, Lake Omeo, Murray Valley riverine plains & the Wimmera. Pp. 87-108 in *Conservation of Lowland Native Grasslands in South-eastern Australia* (eds. K. McDougall & J. Kirkpatrick). World Wide Fund for Nature, Sydney.
- Muir, A. (1996). Significant grassland and grassy woodland sites of the Victorian volcanic, coastal and riverine plains. Preliminary Report -Stage one - to ANCA. DNRE, Melbourne.
- Nicholls, A.O. & Margules, C.R. (1993). An upgraded reserve selection algorithm. *Biol. Conserv.* 64: 165-169.
- NPS. (1995). Conservation reserves audit database user manual. Parks and Reserves Branch, Dept of Conservation and Natural Resources, Melbourne.
- NRE (1997). Heritage Rivers and Natural Catchment Areas. Draft Management Plans, Volume 2 - North East Victoria. DNRE, Melbourne.
- Parigi, P. (1998). Cost-sharing arrangements for vegetation management. Report prepared for the Goulburn-Broken Catchment Management Authority. CMAS and DNRE, Melbourne.
- Pressey, R.L. & Nicholls, A.O. (1989). Application of a numerical algorithm to the selection of reserves in semi-arid New South Wales. *Biol. Conserv.* 50: 263-278.
- Pressey, R.L., Humphries, C.J., Margules, C.R., Vane-Wright, R.I. & Williams, P.H. (1993). beyond opportunism: key principles for systematic reserve selection. *TREE* 8: 124-128.
- Pressey, R.L., Johnson, I.R. & Wilson, P.D. (1994). Shades of irreplaceability: towards a measure of the contribution of sites to a reservation goal. *Biodiversity and Conservation* 3: 242-262.
- Pressey, R.L., Ferrier, S., Hutchinson, C.D., Sivertsen, D.P. & Manion, G. (1995). Planning for negotiation: using an interactive geographic information system to explore alternative protected area networks. Pp. 23-33 in *Nature Conservation 4: the Role of Networks* (eds D.A. Saunders, J.L. Craig & E.M. Matiske). Surrey Beatty & Sons, Sydney.
- Raven, L. (1997). *Local Government and Landcare Action Plan for Nature Conservation in the Goulburn-Broken Catchment*. Trust for Nature, Melbourne.
- Robinson, D. (1991). Threatened birds in Victoria: their distributions, ecology and future. *Vic. Nat.* 108: 67-77.
- Robinson, D. (1994). Research plan for threatened woodland birds of southeastern Australia. *ARI Tech. Report Ser. No. 133*. DCNR, Melbourne.
- Robinson, D. & Mann, S. (1996). Natural values of the public lands along the Broken, Boosey and Nine Mile Creeks system of Northeastern Victoria. Goulburn Valley Environment Group, Shepparton.
- Robinson, D. & Mann, S. (1998). Effects of grazing, fencing and licencing on the natural values of Crown land frontages in the Goulburn-Broken catchment. Unpublished report. Goulburn Valley Environment Group, Melbourne.
- Robinson, D. & Traill, B.J. (1996). *Conserving woodland birds in the wheat and sheep belts of southern Australia*. RAOU Conservation Statement No. 10. RAOU, Melbourne.
- Robinson, D., Davidson, I. & Tzaros, C. in press). Biology and conservation of the Grey-crowned Babbler in Victoria. *Flora and Fauna Tech. Rep. No. 148*.
- Robinson, J. & Rowley, L. (1994). *Drought refuge identification project for the Box-Ironbark ecosystem within the Campaspe, Goulburn and Loddon catchments*. Bendigo Field Naturalists Club, Bendigo.
- Ross, J. (1995). The lowland native grasslands and grassy woodlands of Victoria. Victorian National Parks Association, Melbourne.
- Rowan, J.N. (1990). *1:250,000 mapset, Land Systems of Victoria*. DCE and LCC, Melbourne.
- Sherwin, C. (1996). *The box and ironbark forests and woodlands of northern Victoria*. A report to the Victorian National Parks Association. VNPA, Melbourne.

- Soderquist, T. & Rowley, L. (1996). Mature tree sites in the Bendigo Forest Management Area. Unpublished report, DNRE, Bendigo.
- Thackway, R. & Cresswell, I.D. (1995). *An Interim Biogeographic Regionalisation for Australia*. ANCA, Canberra.
- Ward, P. (1998). Flora survey of grasslands and woodlands on private property in North-east Victoria. Trust for Nature, Melbourne.
- Webster, R. (1988). The Superb Parrot. A survey of breeding distribution and habitat requirements. Report to ANPWS, Canberra.
- Webster, R. & Ahern, L. (1992). Management for conservation of the Superb Parrot (*Polytelis swainsonii*) in New South Wales and Victoria. NSW National Parks and Wildlife Service and Dept of Conservation and Natural Resources.
- Webster, R. & Menkhorst, P.W. (1992). The regent honeyeater (*Xanthomyza phrygia*): population status and ecology in Victoria and New South Wales. *ARI Tech. Rep. Ser.* No. 126. DCNR, Melbourne.

Appendix 2 Attributes measured for every site.

1. Land system
2. Habitats present (e.g. wetlands, dryland, riparian)
3. Vegetation communities present and their condition
4. Site width (1= <30 m, 2 = 30-50, 3= 50-100; 5=100-200; 6=200-500; 7=500-1000; 8 = > 1000 m - number refers to average category)
5. Mature tree abundance: For trees > 1m diameter = 2 = much(>10/ha); 1= some(<10/ha); 0=none. For trees > 50 cm & < 100 cm: 2 = much (> 20/ha); 1 = some (< 20/ha); 0 = none.
6. Number of all dryland shrubs (excluding lignum): 4 = many (> 50% of site with some shrubs); 3 = moderate (20 - 50% of site or community); 2 = some (5 - 20% of site with shrubs); 1 = few(< 5% of site with shrubs or less than 5 shrubs in total); 0 = none.
7. Ground layer vegetation: 5 = All Native (> 90% native); 4 = Mostly native (71 - 90% native); 3 = Moderately native (56 - 70%); 2 = 50/50 native and weedy (45 - 55%); 1 = 55-90% weedy; 0 = > 90% weedy. Note that if there is a bare ground component, this calculation only refers to the plant cover columns.
8. Grass value: 1 = tall warm season perennials; 2 = short warm season perennials;; 3 = medium cool season perennials; 4 = combination of 1 or 2 and 4; 5 = combination of 5 and 1 or 2; 6 = combination of 5 and 4; 7 = volunteer short, warm season perennials; 8 = short cool-season perennials; 9 = *Juncus* spp. / *Carex inversa* / *Eleocharis pusilla*; 10 = other (e.g. wetlands).
9. Weediness of troublesome weeds: 2 = extensive weed invasion; 1 = patchy areas of weeds, 0 = none.
10. Earthworks summary: 2 = much; 1= some; 0 = none. Note that “2” has been given to all sites that have been cultivated.
11. Native plant species richness.
12. Presence of threatened species
13. Distinctive features (e.g. natural flows, unusual soil types, complex habitat structure).
14. Land use (grazing, timber harvesting, etc.)
15. Management (whether fenced or signed).

Appendix 3 National Estate criteria for Grasslands and Grassy Woodlands (Ross 1995).

A1: THRESHOLD CRITERION FOR GRASSLANDS AND GRASSY WOODLANDS IN VICTORIA

1. The place supports a biogeographically significant or disjunct plant sub-community
2. The place supports a viable population of a greatly disjunct species uncommon in the region
3. The place represents the limit of range of several taxa or a community, that demonstrates critical environmental limits within evolutionary processes.
4. The place is a refugia for species rare at State level.

A2: THRESHOLD CRITERION FOR GRASSLANDS AND GRASSY WOODLANDS

1. An intact or extensive stand or series of smaller stands of a native grassland or grassy woodland sub-community and distinctive faunal assemblage or the most intact and extensive stand occurring in a biological reserve in a particular biogeographic region.
2. An intact and extensive primary habitat link containing comparable habitat attributes to two connecting sites or a series of sites of high conservation significance.
3. Important breeding sites for fauna that is rare at the State level.
4. Areas designated as Critical Habitat under section 20 of the Flora and Fauna Guarantee Act for species dependent upon grassland and grassy woodland habitat or for grassland and grassy woodland communities.
5. Sites which contain relatively high microtopographic variation, a variety of habitat and which may provide refugial habitat.

A3: THRESHOLD CRITERION FOR GRASSLANDS AND GRASSY WOODLANDS

1. Places supporting unusual floral and/or faunal species richness based on regional norms.
2. Places supporting a relatively diverse range of vegetation types and/or faunal assemblages.

B: THRESHOLD CRITERION FOR GRASSLANDS AND GRASSY WOODLANDS

1. A population of a species or sub-species listed as endangered in Australia by ANZECC (1991), Briggs & Leigh (1988) or one of the largest or last known populations of a species or sub-species listed as vulnerable in Australia or endangered or vulnerable in Victoria by CNR (1993) or Gullan, Cheal & Walsh (1989).
2. Four or more species which are listed as endangered, vulnerable, rare, indeterminate or insufficiently known in Victoria.
3. An intact or extensive stand or series of smaller stands of a native grassland or grassy woodland sub-community and distinctive faunal assemblage or the most intact and extensive occurring in a biological reserve in a particular biogeographic region.
4. The only known, or one of the largest known, populations of an undescribed species
5. Rare or uncommon associations of vegetation types and/or faunal assemblages.

C1: THRESHOLD CRITERION FOR GRASSLANDS AND GRASSY WOODLANDS

1. The place is the recognised Type locality and a current locality for rare or otherwise significant taxa (State level).
2. The place is recognised or proposed under the *Reference Areas Act* (1978)(Victoria).
3. The place is used to produce significant research information, particularly in relation to monitoring of ecological processes.
4. The place is significant as a teaching or educational area by students of natural history.
5. The place has high potential for rehabilitation and management for public appreciation of grassland flora and fauna values. N.B. The status and outlook of the place must be considered in respect to this criterion.

D1: THRESHOLD CRITERION FOR GRASSLANDS AND GRASSY WOODLANDS

1. The place is representative of a particular vegetation type (defined according to floristics but also considering important structural variants) including the range of geology and soil types. [See type profiles]

2. The place is representative of an identifiable faunal assemblage.
3. The place demonstrates the typical natural development of the type and where disturbance to natural processes are minimal or where management of the site has been consistent and is a positive factor in the maintenance of biodiversity.
4. The place demonstrates a particularly significant variation within the type in relation to substrate, altitude, latitude and/or climate.

