Public land use planning using bioregions and other attributes : determining the study area of the VEAC river red gum forests investigation

AUTHOR(S)

James Fitzsimons

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PUBLIC LAND USE PLANNING USING BIOREGIONS AND OTHER ATTRIBUTES: DETERMINING THE STUDY AREA OF THE VEAC RIVER RED GUM FORESTS INVESTIGATION

JAMES A. FITZSIMONS[1,2,3]

[1]Land Stewardship & Biodiversity, Department of Sustainability and Environment, Level 2, 8 Nicholson Street, East Melbourne VIC 3002, Australia.
[2]Biogeographical Planning and Research Group, School of Life & Environmental Sciences, Deakin University, 221 Burwood Highway, Burwood VIC 3125, Australia.
[3]Current address: Victorian Environmental Assessment Council, Level 1, 8 Nicholson Street, East Melbourne VIC 3002, Australia. Email: james.fitzsimons@dse.vic.gov.au

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In order to plan for the best use of public land at a regional scale the determination of an appropriate regional boundary is important for ecological, resource use and recreational reasons. The study area for the Victorian Environmental Assessment Council's (VEAC) River Red Gum Forests Investigation incorporated bioregional boundaries, modelled pre-1750 vegetation distribution, recent public land use investigations, and the distribution of public land. This paper outlines how ecological attributes and past land use studies were used to inform the boundary for this major study of public land along the Murray River in northern Victoria.

Keywords: Land use planning, bioregions, Ecological Vegetation Classes, riverine forests, Riverina, Murray River

To more efficiently achieve conservation goals a systematic and landscape-scale approach to biodiversity conservation is required (Margules & Pressey 2000). In order to undertake effective and systematic conservation planning exercises, the delineation of appropriate regional boundaries in which to carry out such exercises is of particular importance. Ideally, these regions encompass the full range of ecological elements in the landscape which are the target of such assessments.

In Australia, conservation planning is often used as part of broader public land use planning exercises. A key feature of conservation planning is the establishment of a reserve system which samples biodiversity in a comprehensive, adequate and representative (CAR) manner. All Australian States and Territories have been working toward the development of a CAR system of protected areas since signing the international Convention on Biological Diversity (1992) and the *National Strategy for the Conservation of Australia's Biological Diversity* (Commonwealth of Australia 1996). This has been guided by nationally agreed criteria for the establishment of a comprehensive, representative and adequate (CAR) reserve system (JANIS 1997, NRMMC 2005).

This paper outlines how various ecological attributes were used in conjunction with the location of past land use studies to determine a study area which encompasses the riverine forests and related environments of northern Victoria.

THE RIVER RED GUM AND BLACK BOX FORESTS OF NORTHERN VICTORIA

The Murray River and associated inflowing rivers of northern Victoria and southern New South Wales are characterised by forests and woodlands dominated by River Red Gum *Eucalyptus camaldulensis* and Black Box *E. largiflorens*. These forests form an important ecological corridor in a largely cleared surrounding landscape and habitat in their own right for a suite of sedentary and migratory species (Loyn 1985; State of Victoria 1997; Bennett et al. 1998; Eardley 1999; Ballinger & Yen 2002; Koehn 2002; Loyn et al. 2002). The forests not only provide important habitat for a range of forest-adapted fauna, but also act as a pathway for extending the geographic range of a number of species, particularly avifauna (e.g. Tzaros 2001). The forests also provide an important area for recreational activities such as camping and for the use of natural resources such as timber. River Red Gum and Black Box also dominate large areas of floodplain wetlands and non-riverine

wetlands in northern Victoria and southern NSW. These include the large internationally important wetlands, Barmah Forest and Gunbower Forests in Victoria and the NSW Central Murray State Forests, which are inundated during Murray River flood events. These wetlands provide a number of important ecological functions in the Murray River system, including providing habitat for native fish and water birds, improving water quality (filtering nutrients and salt) and carbon cycling (Young 2001).

HISTORIC PUBLIC LAND USE PLANNING IN THE MURRAY RIVERINE FORESTS

Since 1971, the Victorian Environmental Assessment Council (VEAC) and its predecessors, the Land Conservation Council (LCC) and Environment Conservation Council (ECC), investigated the best use of public land in a systematic region-by-region approach across Victoria. The recommendations of the LCC, ECC and VEAC were presented to the government and are reflected in the distribution of parks and reserves, state forests and other public land we see in Victoria today.

Regional public land use planning investigations by the former LCC were carried out within administrative boundaries often based on Forest Commission regions and with local government borders. The ECC more recently studied public land use within more ecosystem-based study areas (i.e. Box-Ironbark Forests and Woodlands, and Marine, Coastal and Estuarine).

The riverine forests of the mid-Murray and associated rivers and much of the surrounding plains have not been subject to a public land use investigation for more than 20 years, the longest for any part of the State[1]. The Barmah and Gunbower forests, were last subject to a public land use investigation in 1985 (in the LCC Murray Valley Investigation; LCC 1985), while recommendations on the use of riverine forests north of Kerang to the South Australian border were made in 1989 (LCC 1989). Yet other smaller areas of the Riverina have not been investigated since the early-mid 1980s (LCC 1981; LCC 1986). Other special investigations assessed the values of these areas for river, stream and catchment values and wilderness values (LCC 1991a; LCC 1991b). More recently, the North East Regional Forest Agreement process considered public land upstream of the Ovens River (Commonwealth of Australia & State of Victoria 1999), while management planning in State Forests in the region has seen an increase in the area zoned for conservation (NRE 2002; DSE 2004).

THE RIVER RED GUM FORESTS INVESTIGATION

In 2002, the Australian Labor Party made an election commitment to provide a reference to the Victorian Environmental Assessment Council to investigate the creation of a chain of multiple use parks on public land along the Murray River from Yarrawonga to Swan Hill and a uniform management regime for the Murray with NSW (ALP 2002). In December 2004, the Victorian Government released draft terms of reference for a study of these ecosystems by VEAC for public comment. The proposed study area covered the forests on public land between Swan Hill and Yarrawonga, taking in the Barmah, Gunbower and lower Goulburn Forests (Fig. 1). This area encompassed approximately 80,500 ha of public land.

More than 2,000 submissions on the draft Terms of Reference were received from a wide range of stakeholders and interested parties. The majority of submissions on the draft Terms of Reference were in favour of including all major riverine red gum forests on public land[2] along the Murray River corridor from the Hume Weir to the South Australian border. After considering the submissions received, the government decided to expand the study area.

This interest in expanding the study area allowed the opportunity to establish a boundary using a more ecosystem-based approach. Considering a larger area of the target ecosystem also allows flexibility in the range of recommendations that may be developed. For example, by considering resource use and recreation across the entire ecosystem provides more room to balance competing demands for public land and potentially avoids shifting uses and conflicts to those parts of the ecosystem outside of the study

1 The rest of the State has been subject to at least one public land use investigation since that time, either through the LCC/ECC/VEAC process or the Regional Forest Agreement process.

2 Public land is defined under the *Victorian Environmental Assessment Council Act 2001* and includes Crown land and land vested in any public authority (with the exception of a municipal council and some land managed by water authorities).

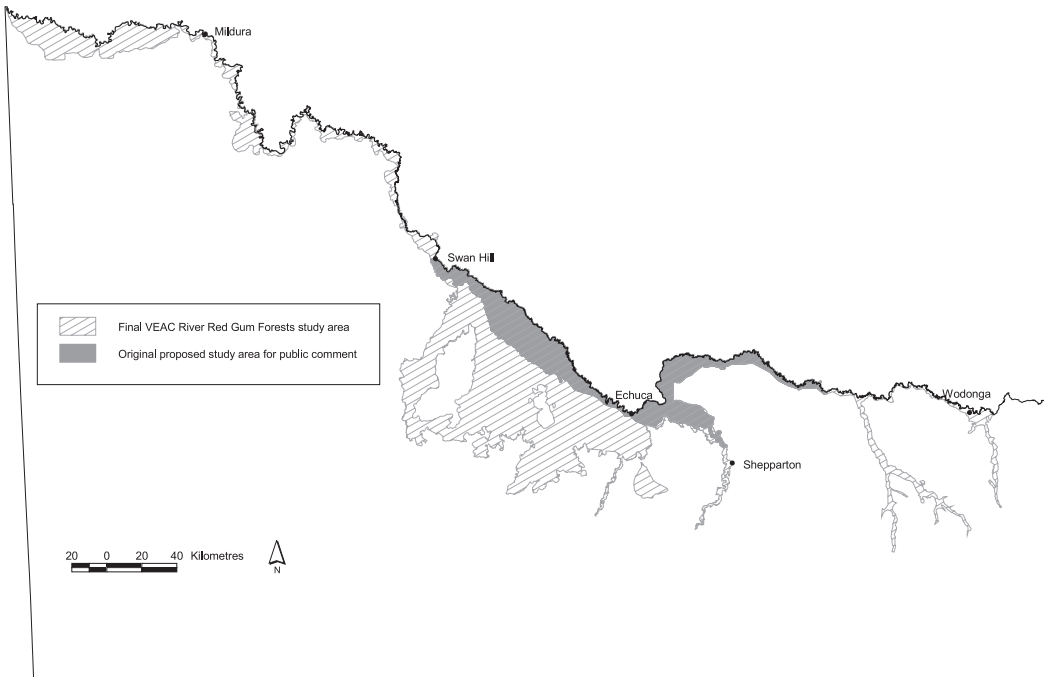

Fig. 1. Proposed and final study area boundaries for the VEAC River Red Gum Forests Investigation

area. Furthermore, it provides a sound basis for comparative assessments of Ecological Vegetation Class representation within the reserve system, internal consistency and distinct differences between areas in and outside of the study area.

As a result a number of options for expanding the study area were considered. Four main attributes for determining the final boundary were used: 1) Victorian bioregional boundaries (2002), 2) modelled occurrence of pre-1750 Ecological Vegetation Classes, 3) location of recent public land use studies, and 4) public land.

The means in which these attributes were incorporated into the final River Red Gum Forests Investigation study area boundary are outlined below. All datasets were sourced from the Department of Sustainability and Environment's Corporate Geospatial Data Library and analysed within ArcView GIS 3.3.

Bioregional boundaries

Bioregions are the broadscale mapping units for biodiversity planning in Victoria and capture the patterns and ecological characteristics in the landscape. Victorian Bioregions nest within the national categorisation for terrestrial environments, the Interim Biogeographic Regionalisation of Australia (IBRA) where they are known as 'subregions' (Thackway & Cresswell 1995; Environment Australia 2000). There they act as a framework for assessing representativeness in the reserve system.

The floodplain forests along the Murray fall within four main Victorian Bioregions — the Murray Fans, Murray Scroll Belt, Robinvale Plain and Victorian Riverina (Fig. 2). All Victorian bioregions fall within the national 'Riverina' IBRA bioregion. Three of these bioregions (subregions) also straddle the border with New South Wales and the Murray Scroll Belt continues into the Riverland country of South Australia.

Within Victoria, the Murray Fans bioregion, which occurs between the junction of the Ovens and Murray Rivers in the east and Narrung in the west incorporates the Barmah, Gunbower, lower Goulburn and Nyah forests. The Robinvale Plain bioregion is situated between Narrung and Mildura takes in part of the Hattah-Kulkyne National Park, while the Murray Scroll Belt to the west of Mildura and includes Wallpolla and Lindsay Islands. The Victorian Riverina bioregion borders the Murray between the Ovens and Kiewa Rivers and incorporates much of

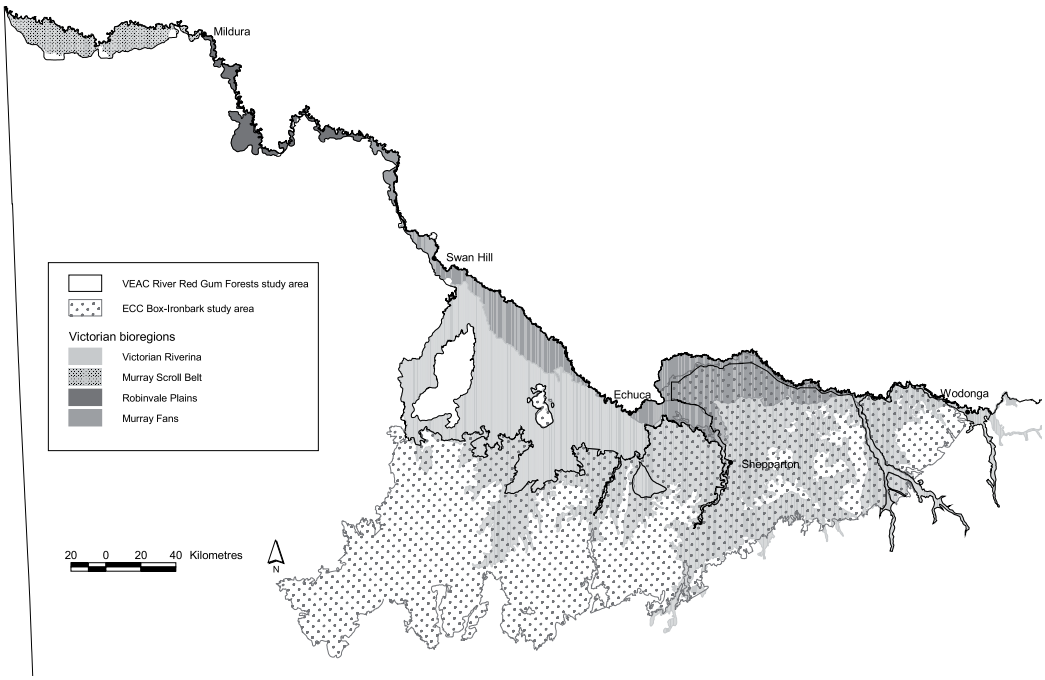

Fig. 2. Location of Victorian bioregions and the ECC Box-Ironbark study area in relation to the VEAC River Red Gum Forests study area.

the Northern Plains south of the Murray Fans bioregion.

The Robinvale Plain and Murray Scroll Belt bioregions incorporate almost all of the pre-1750 extent of the Riverine Grassy Forests and Woodland along the Murray River downstream of Swan Hill (see below).

Modelled occurrence of pre-1750 Ecological Vegetation Classes

Ecological Vegetation Classes (EVCs) are a type of native vegetation classification described through a combination of floristics, life forms and ecological characteristics, and through an inferred fidelity to particular environmental attributes. Since the mid-1990's, it has been the principal unit for vegetation circumscription and mapping for land-use planning and management in Victoria (Woodgate et al. 1996; Parkes et al. 2003).

Modelling of the predicted pre-1750 distribution of EVCs allows for comparisons of past and current extents and thus determination of levels of depletion prior to European settlement. Based on this, priority setting for those EVCs most in need of increased protection can occur. In the north west of Victoria, pre-1750 EVC modelling used soils, climate, terrain and flooding regime combined with current and historical records to spatially model vegetation distribution prior to clearing (see White et al. 2003).

'EVC groupings', which incorporate a number of related EVCs, were used to illustrate the distribution of vegetation in northern Victoria. Of particular interest was the pre-1750 distribution of the 'Riverine Grassy Woodlands or Forests' and 'Wetlands' EVC groups as these classifications incorporated the River Red Gum and Black Box forests and woodlands and associated floodplain wetlands. Also of interest was the distribution of the 'Plains Grasslands and Chenopod Shrublands' EVC group as Northern Plains Grasslands are one of the most threatened ecological communities in Victoria (see Table 1 for constituent EVCs within each of these groups and Fig. 3 for distribution).

The Riverine Grassy Woodlands or Forests occurred mainly within the Murray Scroll Belt, Robinvale Plain and Murray Fans bioregions, but also along the Kiewa, Ovens, Goulburn, Loddon and Avoca Rivers. Plains Grasslands occurred mainly in

Riverine Grassy Woodlands or Forests	Wetlands	Plains Grasslands and Chenopod Shrublands
Creekline Grassy Woodland	Billabong Wetland	Alluvial Plains Semi-arid Grassland
Drainage-line Complex	Billabong Wetland/Red Gum Wetland Mosaic	Chenopod Grassland
Floodplain Riparian Woodland	Cane Grass Wetland	Low Chenopod Shrubland
Floodway Pond Herbland/Riverine Swamp Forest Complex	Disused Floodway Shrubby Herbland	Plains Grassland
Grassy Riverine Forest	Floodplain Grassy Wetland	Plains Savannah
Grassy Riverine Forest/Floodway Pond Herbland Complex	Floodway Pond Herbland	
Grassy Riverine Forest/Riverine Swamp Forest Complex	Freshwater Lake Mosaic	
Intermittent Swampy Woodland	Lake Bed Herbland	
Lignum Shrubland	Lignum Wetland	
Lignum Swampy Woodland	Moira Plain Wetland	
Lignum Swampy Woodland/Lake Bed Herbland Mosaic	Plains Grassy Wetland	
Lignum Swampy Woodland/Plains Grassland Mosaic	Red Gum Wetland	
Riverine Chenopod Woodland	Red Gum Wetland/Plains Grassy Wetland Mosaic	
Riverine Chenopod Woodland/Lignum Wetland Mosaic	Reed Swamp	
Riverine Chenopod Woodland/Plains Grassland Mosaic	Shallow Freshwater Marsh	
Riverine Grassy Woodland	Spike-sedge Wetland	
Riverine Grassy Woodland/Plains Woodland Complex	Tall Marsh	
Riverine Grassy Woodland/Plains Woodland/Gilgai Wetland Complex	Wetland Formation	
Riverine Grassy Woodland/Plains Woodland/Riverine Chenopod Woodland Complex		
Riverine Grassy Woodland/Riverine Chenopod Woodland/Wetland Mosaic		
Riverine Grassy Woodland/Sedgy Riverine Forest/Wetland Formation Mosaic		
Riverine Swamp Forest		
Riverine Swampy Woodland		
Riverine Swampy Woodland/Lignum Wetland Mosaic		
Sedgy Riverine Forest		
Sedgy Riverine Forest/Riverine Swamp Forest Complex		

NB: EVC Groupings have been established by DSE for more convenient illustration and management of statewide vegetation data. Smaller occurrences of a number of other Ecological Vegetation Classes also fall within the study area. It is worth noting that more recent vegetation mapping of the Barmah forest by Frood (2005) has identified EVCs at a finer scale than past mapping for Barmah Forest (see also VEAC 2006).

Table 1. EVC Groupings (and constituent EVCs) within the expanded River Red Gum Forests Investigation study area.

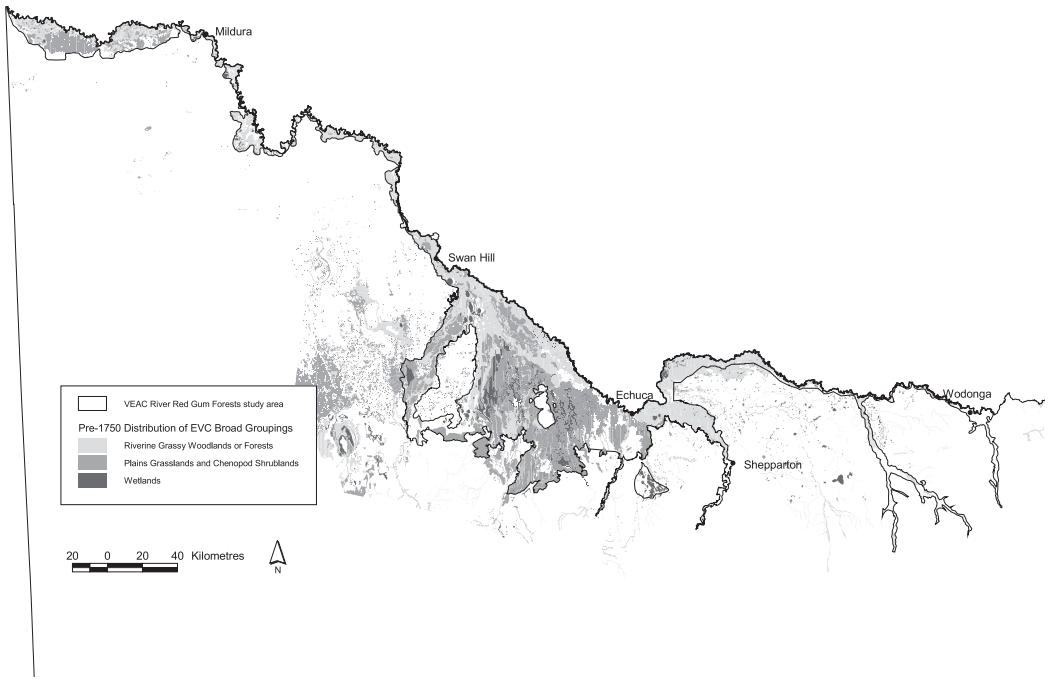

Fig. 3. Pre-1750 distribution of Riverine Grassy Woodlands or Forests, Plains Grasslands and Chenopod Shrublands, and Wetlands EVC broad groupings in and surrounding the VEAC River Red Gum Forests study area

the Victorian Riverina bioregion and particularly around the Patho Plains. Wetlands were scattered throughout the region, with larger occurrences near the Loddon River, Corop Lakes, Kerang Lakes and Barmah Forest. In designing the study area a 100 m buffer was applied to the 'Riverine Grassy Forests or Woodlands' EVC group to ensure the riverine corridors were represented as consolidated units.

Location of recent public land use investigations

The Environment Conservation Council's Box-Ironbark Forests and Woodlands Investigation included the box-ironbark forests and woodlands on the inland hills and on the elevated terraces of the Northern Plains but did not include the native grasslands on the elevated terraces or River Red Gum or Black Box forests and woodlands on the lower elevation floodplains (ECC 1997, see Fig. 2). Specifically, the Box-Ironbark study area was based on a combination of the modelled pre-1750 distribution of Broad Vegetation Types (a coarser vegetation classification than EVCs) which were allocated to land systems in the area, and modelled pre-1750 EVCs where available (see ECC 1997, particularly Maps D and E from that report). This resulted in some areas within the broad Box-Ironbark study area being excluded (e.g. the Corop Lakes area and the Ovens, King, and parts of the Goulburn and Campaspe Rivers).

As the Box-Ironbark investigation was only recently completed after extensive public consultation (ECC 2001), and with terms of reference similar to the River Red Gum Forests Investigation, reinvestigating the relatively small areas of riverine EVCs was not considered desirable. Exceptions to this were where small parts of larger riverine forest blocks were included in the Box-Ironbark study area due to the coarse nature of that mapping (e.g. Barmah Forest near the Barmah township).

Public land

The River Red Gum Forests Investigation only considers public land within the study area. Consequently it was important to ensure that all key blocks of public land likely to contain suitable vegetation were included in the study area. Where the ecological boundaries of the study area have intersected mainly

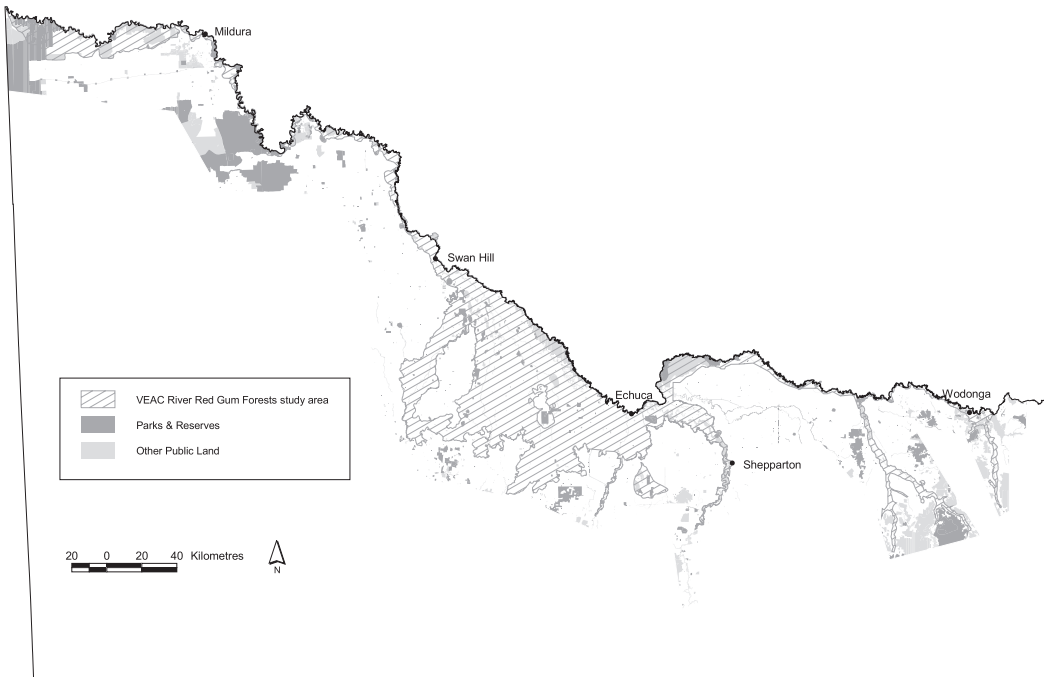

Fig. 4. Distribution of existing public land (including parks and reserves) in and surrounding the VEAC River Red Gum Forests study area

small parcels of public land, the boundary has been adjusted to incorporate the entire public land parcel (see Fig. 4). This will ensure a consistent and integrated assessment of those public land parcels.

DETAILS OF THE EXPANDED RIVER RED GUM FORESTS INVESTIGATION STUDY AREA

The decision to expand the study area to include all riverine forests along the Murray River and its tributaries provides a unique opportunity to consider the protection of endangered ecosystems occurring on public land in the surrounding plains. The Victorian Riverina is considered to be a high priority bioregion for increased conservation assessment and action (State of Victoria 1997; Environment Australia 2000). Due to the relatively small amount of public land remaining in this bioregion and the high conservation value it potentially represents, incorporation of this bioregion into the larger study area was considered desirable.

Based on the ecological and landform attributes, the location of recent public land use investigations and distribution of public land described above, the expanded River Red Gum Forests investigation study area was designed to broadly encompass the following: all the Murray Scroll Belt and Robinvale Plain bioregions, and the sections of the Murray Fans and Victorian Riverina bioregions not covered by the ECC Box-Ironbark investigation, with slightly widened corridors around parts of the Ovens, Goulburn and Campaspe Rivers. While only public land within the study area is considered in the investigation, all vegetation types occurring on that public land will be investigated (i.e. not just those vegetation types discussed above).

Specifically, the boundary is defined as the following:

Northern boundary

- Follows the Murray River from South Australian border to the western edge of Lake Hume. Mapping of the Murray River has been undertaken at different spatial and temporal scales for different purposes in the past. Nonetheless, the northern boundary of the study area will always be the high water mark on the Victorian side of the Murray River west of Lake Hume.

EVC Group	Area on public land (ha)	
	Proposed Terms of Reference	**Final Terms of Reference**
Riverine Grassy Woodlands or Forests	58,960	137,430
Plains Grasslands and Chenopod Shrublands	40	16,680
Wetlands	2,770	12,640
Plains Woodlands or Forests	2,590	23,660
Mallee	–	6,780
Riparian Forests or Woodlands	150	6,730
Salt-tolerant and/or succulent Shrublands	–	1,470
Dry Forests	–	70
Lower Slopes or Hills Woodlands	–	60

Rounded to nearest 10 ha. Note: does not include EVCs on recent land purchases.

Table 2. Area of extant EVC Groups occurring on public land in the proposed and final study areas.

Southern boundary (from east to west):

- South of Lake Hume, *Victorian Riverina* bioregional boundary along the Kiewa River.
- West of Wodonga to Ovens River: Riverine area not covered by the ECC Box-Ironbark Investigation.
- Ovens (and King) River corridors follows the ECC Box-Ironbark boundary and then *Victorian Riverina* bioregional boundary in the upper reaches. Slight buffering of pre-1750 EVCs and alignment to roads has occurred in some areas.
- The area of the *Murray Fans* bioregion not included in the ECC Box-Ironbark boundary (from Bundalong to east of Barmah township), with minor adjustments to follow roads.
- The Goulburn River corridor to below the Nagambie Weir.
- The Murray Fans from near Undera to below Kanyapella Basin.
- The area of the *Victorian Riverina* bioregion not included in the ECC Box-Ironbark boundary (between Kanyapella Basin and Kerang, including the Corop Lakes system, and the Campaspe River corridor to north of Barnadown).
- *Murray Fans* bioregional boundary from Lake Boga to Narrung.
- *Robinvale Plain* bioregional boundary from Narrung to Mildura.
- *Murray Scroll Belt* bioregional boundary from Mildura to South Australian border.

KEY FEATURES OF THE RIVER RED GUM FORESTS STUDY AREA

The expanded study area covers approximately 268,000 ha of public land, an increase of approximately 187,000 ha from the draft terms of reference. This has resulted in significantly more of the key ecosystems which occur on public land to be considered (Table 2). Key blocks of public land along the Murray include Barmah, Gunbower, Nyah, Hattah Lakes, Wallpolla Island and Lindsay Island. The study area also includes important River Red Gum and Black Box Forests along seven major rivers flowing into the Murray — the Avoca, Loddon, Campaspe, Goulburn, Ovens, King and Kiewa. The Ovens and Goulburn are Heritage Rivers and the former is one of the least regulated rivers in the Murray-Darling system. Four of Victoria's 11 Ramsar Wetlands of International Importance occur within the study area (i.e. Hattah Lakes, Kerang Lakes, Gunbower Forest and Barmah Forest), as do numerous wetlands listed on the Directory of Important Wetlands in Australia (Environment Australia 2001). Further, of the six 'icon sites' identified by the recently-established Living Murray initiative (which aims to improve the health of the Murray River and adjoining ecosystems), five at least partly fall within the study area.

The Victorian Riverina bioregion contains numerous relatively small but ecologically important blocks of public land containing endangered native

grassland and wetland communities (e.g. grasslands in Terrick Terrick/Patho Plains region, Corop Lakes and Kerang Lakes). Within the Victorian Riverina a number of significant private properties have recently been acquired for the purpose of nature conservation as part of a strategic land purchase program by the Department of Sustainability and Environment (see Fitzsimons & Ashe 2003; Fitzsimons et al. 2004; Fitzsimons et al. 2006).

PUBLIC LAND USE PLANNING AT A LANDSCAPE SCALE: CONCLUDING COMMENTS

This paper presents details on the practicalities of determining study areas for public land use investigations based on bioregions and other attributes. The expanded boundary for the VEAC River Red Gum Forests Investigation study area allows for a sound comparative assessment of the reservation status of riverine and plains vegetation communities and habitats across northern Victoria. The inclusion of areas of plains grassland, plains grassy woodland and chenopod shrubland, some of the State's most depleted vegetation communities, is of particular significance. Some of these areas have not had a public land use investigation since 1985 and knowledge of their ecological processes and need for increased conservation has grown greatly since this time. However, to ensure that various components of biodiversity are well represented in reserves or by other protective measures, ecological surrogates may have to be considered as hierarchies (e.g. landscape, EVC, fine-scale habitat) to ensure general representativeness (as shown for Box-Ironbark ecosystems; Mac Nally et al. 2002).

Following the release of a discussion paper and draft proposals paper, both involving rounds of public consultation, the Victorian Environmental Assessment Council will make recommendations to the Victorian Government on public land use in the region, in accordance with its terms of reference. It is important to note that while the boundary for the VEAC River Red Gum Forests Investigation study area largely reflects ecological attributes of the riverine and plains systems of northern Victoria, similar and intricately linked ecosystems occur north of the Murray River in New South Wales (and along the Murray corridor into South Australia). Although not the subject of the VEAC investigation, consideration of current and potential future land use in NSW (and to a lesser extent, South Australia), will nonetheless be important if land use decisions in Victoria are to be effective at a landscape scale.

For full details on the VEAC River Red Gum Forests Investigation see http://www.veac.vic.gov.au.

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