NSW GOVERNMENT Office of Environment & Heritage

Australian Government
Water for the Future

Vegetation Mapping Project

Executive summary

NSW Rivers Environmental Restoration Program Subprogram II

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The views and conclusions expressed in this report are those of the authors and do not necessarily represent the official policies, either expressed or implied, by the Office of Environment and Heritage.

Cover photographs
Main: floodplain river red gums (photo: Stuart Cohen/OEH). Left to right: wavy marshwort (photo: W Johnson); river red gum tree canopy, Yanga National Park (photo: Steve Cox/OEH); water fern and nardoo at Piggery Lake, Yanga National Park (photo: Tanya Doody/CSIRO); yellow marshwort (*Nymphoides germinata*) (photo: Max Best); purple swamphen (*Porphyrio porphyrio*) nest in reeds (photo: Max Best).

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Contents

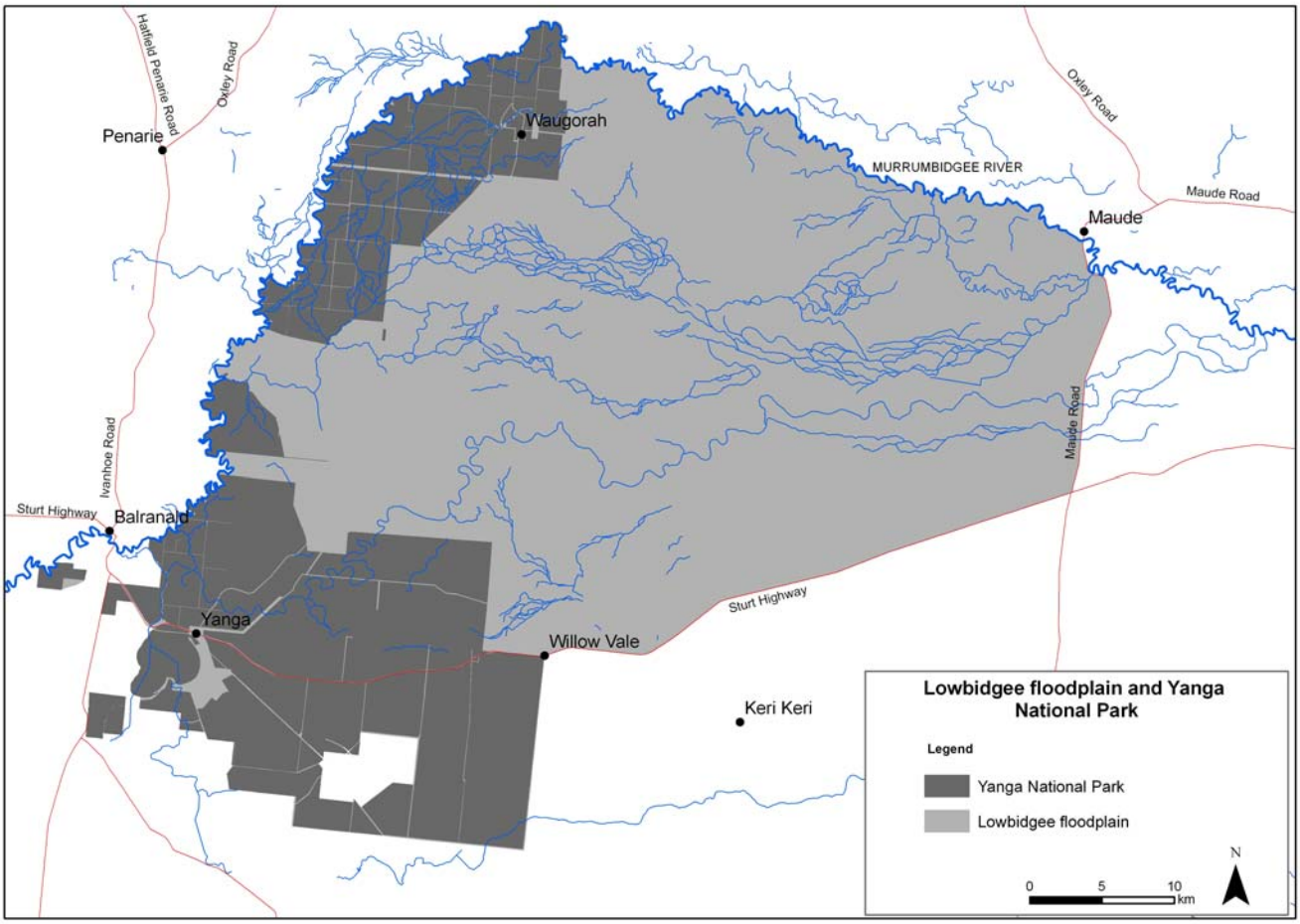
1. Background

This project was funded under the NSW Rivers Environmental Restoration Program (RERP) which aims to restore the health of five iconic floodplain wetlands in the Murray–Darling Basin, including the Lower Murrumbidgee wetlands, Lachlan wetlands, Gwydir wetlands, Narran Lakes and Macquarie Marshes.

The floodplain and wetland communities that occur on the Lower Murrumbidgee (Lowbidgee) floodplain have been in severe decline over their range since European settlement. This decline has accelerated over the last 30 years due to land clearing and altered hydrological regimes. The vegetation communities of these floodplains are highly fragmented and poorly conserved in NSW (Benson 1999). All remaining wetland and floodplain vegetation in the Lowbidgee floodplain is of conservation significance and is important for maintaining and restoring the ecological health of this unique inland floodplain wetland complex.

This study, carried out in 2010, mapped the extent of the vegetation communities of the Lowbidgee floodplain in 2008. The study area (totaling 222,277 ha) included Yanga National Park, located 20 km north-west of Balranald in southwestern NSW and the Lowbidgee for a distance of approximately 80 km east to the town of Maude (Figure 1).

Figure 1 Location of Yanga National Park and the Lowbidgee floodplain



The aims of this study were to:

- create maps of the distribution of vegetation communities in 2008 of the Lowbidgee floodplain and Yanga National Park using high-resolution digital aerial photography
- define the condition of river red gum communities in 2008
- establish a series of vegetation plots within key vegetation communities for more detailed floristic survey and as a benchmark for trend analysis
- make recommendations for monitoring the response of key flood-dependant vegetation communities to environmental water releases to assist in the adaptive management of environmental water.

The vegetation mapping project was critical to achieving the RERP objective: to enable better use of environmental water for maintenance of the ecological character for stressed wetlands. The RERP subprogram II was implemented under a hierarchy of objectives and this project contributed to the objectives highlighted in bold:

Level 1
- a. **increase knowledge of the water requirements to maintain the ecological character of nominated wetlands**
- b. increase efficiency of water use
- **c. increase capacity for adaptive management**

Level 2
- **a. flow ecological relationships**
  - **i. short-term**
  - **ii. long-term**
- **b. adaptive management**
- c. developmental tools
- d. complimentary management
- **e. communication**

Level 3
- **a. physical character**
- b. hydrological models
- **c. ecological response**
- **d. ecosystem services**
- **e. demonstrating ecological outcomes of environmental water**
- **f. Decision Support Systems (DSS)**
- **g. reference condition**
- **h. grazing**

2. Approach and key findings

The floodplain and wetland communities that occur on the Lowbidgee Floodplain have been in severe decline over their range since European settlement and this decline has accelerated in the last 30 years due to land clearing and altered hydrological regimes. The vegetation communities of these floodplains are highly fragmented and poorly conserved in NSW (Benson 1999). The Lowbidgee floodplain, including Yanga National Park (total area 222,277 ha) was identified by the NSW and Commonwealth Governments as areas of interest for research under subprogram II of the RERP.

Yanga National Park (Murrumbidgee Valley National Park)

Yanga National Park, gazetted in 2007, is now part of the larger Murrumbidgee Valley National Park, one of the Riverina River Red Gum Reserves created in July 2010.

A series of vegetation maps (historical time series vegetation mapping) of Yanga National Park was created from aerial photograph interpretation (API) of scanned aerial photographs from 1965, 1973, 1997 and 2005 (McCosker 2008).

The 2008 vegetation map was produced in 2010. It was created digitally 'on-screen' by overlaying the 2005 polygon boundaries (McCosker 2008) on high-resolution digital aerial photography (resolution 30 cm) captured in 2008 as part of the LiDAR project undertaken for the Department of Environment, Climate Change and Water NSW under the RERP. The 2005 polygons were amended to reflect any changes in the vegetation communities evident during API. The 2008 map was made using the mapping and spatial software ArcGIS 9.3 (produced by ESRI Australia).

To calibrate and validate the vegetation communities defined by API, targeted quantitative field vegetation and canopy condition surveys were undertaken during April and November 2009. Ninety-three sites were selected to sample all vegetation community types. Vegetation community descriptions were based on the vegetation classification of Benson (2008) and the vegetation formations of Keith (2004). More information is contained in Bowen & Simpson (2010a).

In addition to the vegetation community mapping, river red gum canopy condition mapping and tree-stem density analysis was undertaken by API of the 2008 imagery. Canopy condition classes were assigned on similarities in canopy cover, texture and colour to polygons containing reference plots, and by quantitatively assessing the percentage of dead or extremely stressed trees within randomly placed one-hectare squares. The tree density was assessed by counting the number of trees within these squares. The mean for the total plots in each polygon was used to give the number of stems per hectare for that polygon. Where necessary, the polygons were split to reflect differences in canopy condition and stem density. To calibrate the assessments made from API, the condition of the trees, along with the tree density, was measured in the field at 'reference sites'. Reference was also made to the 2005 mapping of crown condition (McCosker 2008). The following four condition classes were assigned based on the number of dead or extremely stressed trees at the points within each polygon:

- good (0–10 per cent dead canopy)
- intermediate (10–40 per cent dead canopy)
- intermediate/poor (declining) (41–80 per cent dead canopy)
- poor (81–100 per cent dead canopy).

The polygons were classified into one of four stem-density classes:

- < 200 stems per hectare
- 200–399 stems per hectare
- 400–800 stems per hectare
- > 800 stems per hectare.

Map 1 shows the distribution of the vegetation communities of Yanga National Park in 2008 and the area in hectares of each of these communities are in Table 2. In 2008, almost 75 per cent of the river red gum communities in Yanga National Park were in poor or declining (intermediate/poor) condition (Table 1). This may be due to water stress caused by changes in inundation regimes of these areas. Before OEH purchased the property in 2007, many of these areas were managed for timber production by artificially inundating higher ground using levee banks and many areas had not been inundated since 2000. Similarly, McCosker (2008) reported that these areas may not have supported this species prior to river regulation and water diversion, or the decline of the species in some areas is a natural process of thinning recruits that may have grown during the wet periods of 1950s and 1970s.

Table 1 River red gum condition and stem density in Yanga National Park

River red gum stem density	River red gum condition (areas in hectares)			
	Good	Intermediate	Intermediate/poor	Poor
< 200	3 089	1 339	3 695	6 679
200–399	10	917	778	243
400–800	0	108	376	46
> 800	0	0	154	2 959
Total (% total)	**3 099 (15%)**	**2 364 (11.5%)**	**5 003 (24.5%)**	**9 927 (49%)**

Lowbidgee floodplain

The vegetation communities of the Lowbidgee floodplain adjoining Yanga National Park and extending east to Maude (Figure 1) were also mapped in 2010 using high-resolution digital aerial photography captured in 2008. Part of the Lowbidgee floodplain had been mapped in 2002 by the Department of Land and Water Conservation (DLWC 2002). This 2002 map was used as a digital base map for overlay analysis in ArcGIS. Areas of change (mostly cleared and cropped areas) were updated from API of the 2008 photography. In the remainder of the mapping area, linework was generated digitally by feature-recognition software (Definiens eCognition) using SPOT 5 satellite imagery. Aerial photo interpretation of the 2008 photography was used to substantially modify this linework to reflect the vegetation communities present. Vegetation communities were assessed based on visual interpretation (API) with reference made to data from field surveys, digital elevation model (generated as part of the LiDAR project) and flood history map (Thomas et al. 2011). Historical mapping at a much larger scale for the area (Scott 1992) was also used for reference.

The distribution of vegetation communities in the Lowbidgee floodplain in 2008 are shown in Map 2. The area of the Lowbidgee floodplain mapped in this study outside of Yanga National Park is heavily developed with approximately 43 per cent of the floodplain cleared or cropped in 2008 (Map 2, Table 2). The remnant vegetation of the Lowbidgee floodplain is dominated by lignum shrublands and chenopod shrublands, with some isolated small areas of black box and river red gum. River red gum communities occur in the north along the Murrumbidgee River.

Vegetation communities listed as Endangered Ecological Communities (EEC) under both the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* , (EPBC Act) and the NSW Government *NSW Threatened Species Conservation Act 1995* (TSC Act) occur in the Lowbidgee floodplain (Table 2).

Table 2 Extent of vegetation communities of the Lowbidgee floodplain in 2008 (including Yanga National Park)

Functional group	Vegetation community	NSW vegetation classification and assessment plant community (Benson 2008)	Yanga NP area (in ha)	Lowbidgee Floodplain area (in ha)	Total area (in ha)
Flood-dependent vegetation					
Amphibious wetlands	Spikerush (*Eleocharis spp.)* dominated sedgeland	VCA ID 12 Shallow marsh of regularly flooded depressions on floodplains, largely in the semi-arid climatic zone; mainly in the Riverina and Murray–Darling Depression (MDD) bioregions	150	154	304
Shrubland wetland	Lignum (*Muehlenbeckia florulenta*) and nitre goosefoot (*Chenopodium nitrariaceum*) shrublands	VCA ID 17 Lignum shrubland of the semi-arid (warm) plains; mainly in the Riverina and MDD	1 336	38 769	40 105
Open water	Waterbody	VCA ID 238 Permanent and semi-permanent freshwater lakes; inland slopes and plains	1 980	205	2 195
Flood-dependant RRG forest and wood-land	River red gum *(Eucalyptus camaldulensis)* forests and woodlands	VCA ID 2 River red gum, sedge-dominated, very tall, open forest in frequently flooded sites along major rivers and floodplains; south-western NSW VCA ID 7 River red gum, warrego grass, herbaceous riparian, tall open forest; mainly in the Riverina VCA ID 9 River red gum, wallaby grass, tall woodland, on the outer river red gum zone; mainly in the Riverina VCA ID 11 River red gum woodland/shrubby lignum river cooba	21 307	5998	27 306
	River red gum–black box *(E camaldulensis – E. largiforens)* woodland	VCA ID 10 River red gum–black box woodland of the semi-arid zone; mainly in the Riverina and MDD	0	407	407
Flood-dependant woodland	Black box *E. largiforens* woodlands	VCA ID 13 Black box–lignum woodland of the inner floodplains in the semi-arid zone; mainly in the Riverina and MDD VCA ID 15 Black box open woodland with chenopod understorey, primarily on the outer floodplains in south-western NSW; mainly in the Riverina and MDD VCA ID 16 Black box, grassy open woodland of rarely flooded depressions in south-western NSW; mainly in the Riverina and MDD	9 346	18 365	19 299
Total			34 119	55 497	89 616
Non flood-dependent vegetation					
Floodplain vegetation	Chenopod shrublands (black bluebush (*Maireana pyramidata*), dillon bush (*Nitraria billardierei*), cottonbush (*M. aphylla*), old man saltbush (Atriplex nummularia), bladder saltbush (*A. vesicaria)*, poverty bush (*Sclerolaena divaricata*)&/or grasslands	VCA ID 153 Black bluebush, low open shrubland of the alluvial plains and sand plains zone VCA ID 157 Bladder saltbush shrubland on alluvial plains; semi-arid (warm) zone, including Riverina VCA ID 159 Old man saltbush; mainly of the semi-arid (warm) zone, south-western NSW VCA 163 Dillon bush (Nitre bush) shrubland; semi-arid and arid zones VCA ID 164 Cottonbush open shrubland; semi-arid (warm) zone VCA ID 250 Derived tussock grassland; central western plains and lower slopes	13 509	33 642	47 151
	Red mallee (*Eucalyptus oleosa)* woodland	VCA ID 170 Chenopod sandplain, mallee woodland/shrubland of the arid and semi-arid (warm) zones	721	0	721
	Prickly wattle (*Acacia victoriae* woodland	VCA ID 139 Prickly wattle, tall, open shrubland of dunes and sandplains of semi-arid and arid regions	70	0	70
	Yarran (*Acacia melvillei*) woodland	VCA ID 23 Yarran, tall, open shrubland of the sandplains and plains of the semi-arid and arid zones (endangered ecological community TSC Act)	4 879	0	4 879
	Weeping myall (*Acacia pendula)* open woodland	VCA ID 27 Weeping myall, open woodland; south-western slopes (critically endangered ecological community TSC Act / EPBC Act)	31	0	31
	Belah (*Casuarina cristata)* /rosewood (*Alectryon oleifolius*) woodland	VCA ID 58 Black oak–western rosewood, open woodland on deep sandy loams; mainly in the MDD	5 085	4	5 089
	White cypress pine (*Callitris glaucophylla*) woodland	VCA ID 54 Buloke–white cypress pine woodland; south-western slopes (endangered ecological community TSC Act/ EPBC Act)	0	32	32
	Bare areas and/or scalds	n/a	0	396	396
Total			24 290	34 079	58 369
Cleared or cropped land					
	Cleared or cropped land	n/a	6 049	68 243	74 292
Total (% of total area)			**64 458 (9)**	**157 819 (43)**	**222 277 (33)**

3. Implications for water management

Setting restoration and management targets

As part of the RERP, this study has provided the key baseline datasets to establish the current status of the vegetation communities of the Lowbidgee floodplain:

- a map of the extent of the vegetation communities of Yanga National Park (Bowen & Simpson 2010b) (see Map 1) in 2008 – this is held in OEH's vegetation information system (VIS)
- a map of the extent of the vegetation communities of the Lowbidgee floodplain Bowen and Simpson 2010c (see Map 2), including Yanga National Park, in 2008 – this is held in OEH's Vegetation Information System (VIS)
- benchmarking sites for baseline condition of the vegetation communities of the Lowbidgee floodplain (including Yanga National Park) in 2008 – this is held in OEH's vegetation survey database (VSD)

Along with the historical time series of Yanga National Park vegetation maps, this information is vital for setting restoration and management targets for key vegetation communities of the Lowbidgee floodplain. Water managers will meet these targets by carefully directing the delivery of environmental flows, both in the Lowbidgee floodplain and Yanga National Park.

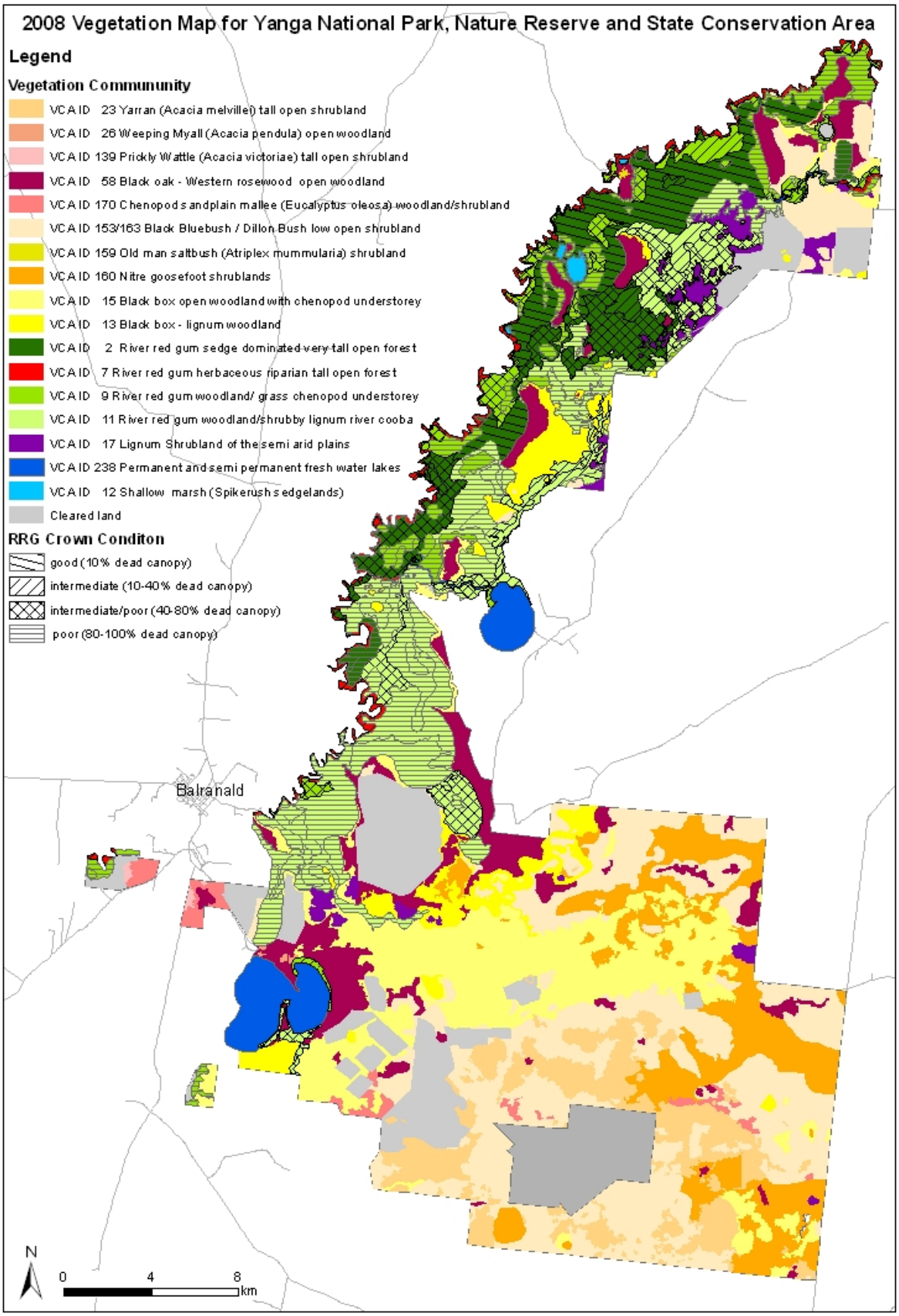
Adaptive monitoring of environmental water

To effectively manage environmental water, it is critical to monitor the outcomes of environmental water delivery. This monitoring determines how effectively managers are meeting their restoration and maintenance targets.

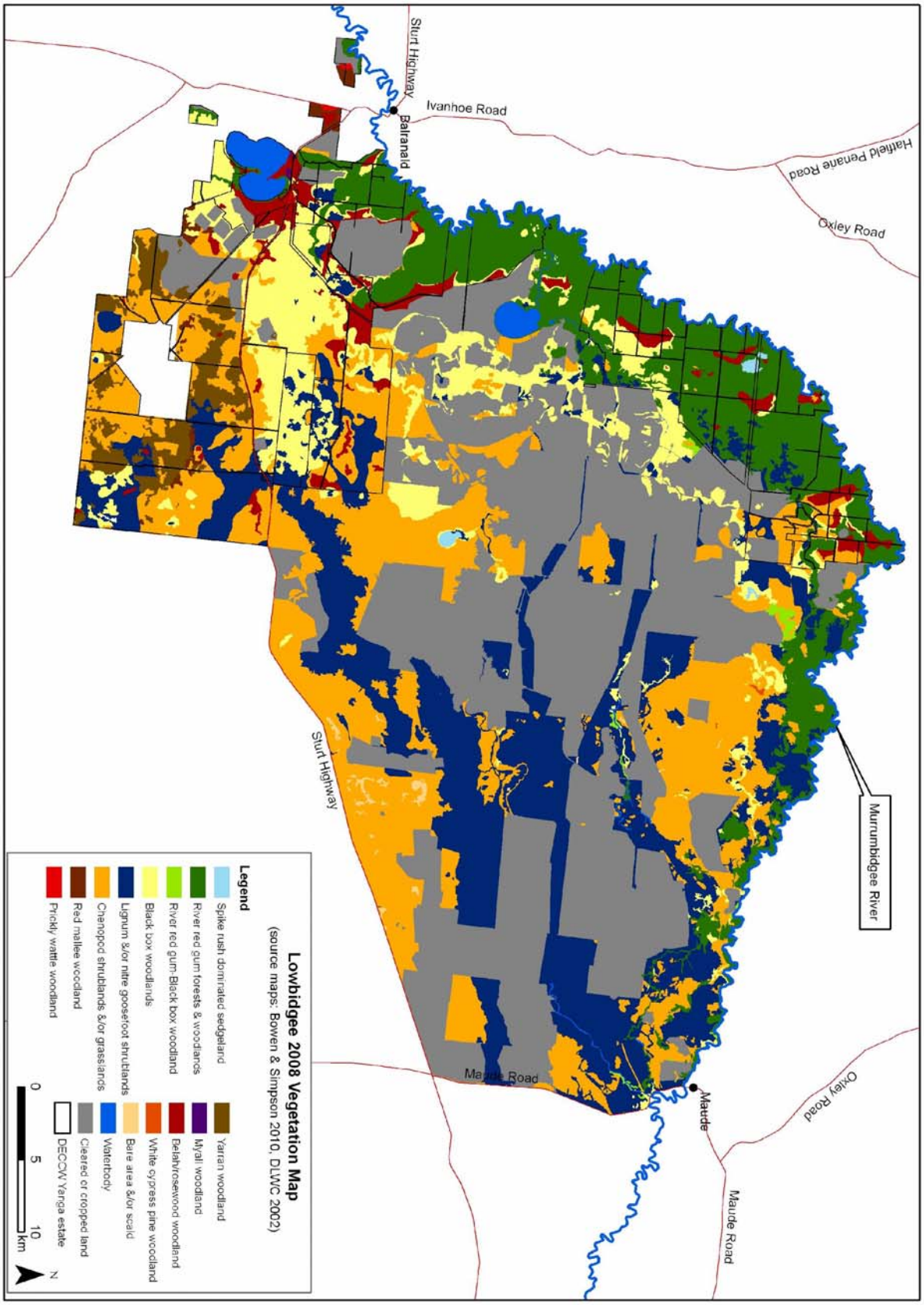
In an adaptive management framework, environmental water managers and policy makers need data on actual events as well as potential scenarios. This requires measuring vegetation community response (changes in condition and extent) to environmental flows and management regimes. Testing ecosystem response models and community resilience conceptual models using real data is also necessary. To meet these requirements, certain management actions are necessary and will be part of a vegetation monitoring strategy to be developed for the Lowbidgee including Yanga National Park:

1. Remap the extent of vegetation communities from high-resolution aerial photography every five years. This will determine any changes in the extent of wetland vegetation communities as a response to environmental water management.
2. Reference plots established in this study should be re-sampled every five years. This will determine the changes in the condition of these vegetation communities.
3. Undertake seasonal adaptive monitoring of amphibious and flood-dependant vegetation community responses to targeted environmental flows. This should be at key monitoring sites established during this study.

Map 1 Extent and condition of Yanga National Park vegetation communities in 2008 (source: Bowen & Simpson 2010)



Map 2 Vegetation map of the Lowbidgee floodplain (includingYanga National Park) floodplain in 2008 (source: Bowen & Simpson 2010)



4. Implications for research

Implications of this research for the wider scientific community include:

- The vegetation communities of the Lowbidgee floodplain have been under pressure from agricultural development in recent decades and connectivity of flow paths may be an issue for floodplain management and environmental water delivery.
- The condition of the river red gum communities of Yanga National Park is of concern and future management decisions will require scientific input into research for the restoration of ecological communities.
- Further research into the effects of flow the extent and condition of flood dependent vegetation communities is required to inform environmental flow management.

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To find out more about the NSW Rivers Environmental Restoration Program, or download a fact sheet, visit www.environment.nsw.gov.au/environmentalwater/rerp.htm

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