Molonglo River Rescue

Action Plan 2010

Molonglo River Rescue Action Plan 2010

ACT GOVERNMENT

ACT NATURAL RESOURCE MANAGEMENT COUNCIL

CARING FOR OUR COUNTRY

Acknowledgements

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Project partners

MOLONGLO CATCHMENT GROUP

ACT PARKS CONSERVATION AND LANDS

WATERWATCH Molonglo Catchment
Communities Caring for Catchments

RiverSmart AUSTRALIA
Rivers for people, wildlife and sustainability
www.riversmart.org.au

Greening Australia

Murrumbidgee CATCHMENT MANAGEMENT AUTHORITY

CIC AUSTRALIA

FROGWATCH ACT AND REGION

Abbreviations

ACT ..... Australian Capital Territory

ACT PLA ..... ACT Planning and Land Authority

ACT NRM Council ..... ACT Natural Resource Management Council

ACT PCL ..... ACT Parks, Conservation and Lands

ANU ..... Australian National University

CIC ..... CIC Australia Limited

CIT ..... Canberra Institute of Technology

COG ..... Canberra Ornithologists Group

DECCEW..... ACT Department of Environment, Climate Change, Energy & Water

DECCW ..... NSW Department of Environment, Climate Change & Water

EPBC Act ..... Federal Environment Protection and Biodiversity Conservation Act 1999

GA..... Greening Australia

GPT ..... Gross Pollutant Trap

K2C ..... Kosciuszko to Coast

LDA ..... Land Development Authority

LMWQCC ..... Lower Molonglo Water Quality Control Centre

LPMA ..... Land & Property Management Authority

MCG..... Molonglo Catchment Group

Murrumbidgee CMA ..... Murrumbidgee Catchment Management Authority

MDBA ..... Murray Darling Basin Authority

NC Act..... ACT Nature Conservation Act 1980

NCA..... National Capital Authority

NRM ..... Natural Resource Management

NSW..... New South Wales

NSW NPWS..... NSW National Parks and Wildlife Service

RARC..... Rapid Appraisal of Riparian Condition

TAMS ..... ACT Territory and Municipal Services

TSC ACT ..... NSW Threatened Species Conservation Act 1995

UMCCC ..... Upper Murrumbidgee Catchment Coordinating Committee

UMDR ..... Upper Murrumbidgee Demonstration Reach

Executive Summary

The Molonglo River is an iconic river, flowing through New South Wales and the Australian Capital Territory, and forming the centrepiece of Canberra in Lake Burley Griffin. The Molonglo River lies within the Upper Murrumbidgee River Catchment, and is a major contributor to the water quality and biodiversity of the Murrumbidgee River.

The Molonglo River has been highly modified. Water quality is often poor, exhibiting high nutrient and sediment loads, as well as heavy metal pollution from previous mining activities. The riparian zone, like much of the catchment, has been extensively modified, and in many places it is subject to considerable infestations from Willows and other woody weeds. Despite this, the river is home to a number of endangered ecological communities as well as numerous threatened species including the largest known population of the vulnerable Pink-tailed Worm-lizard (*Aprasia parapulchella*), the threatened Murray Cod (*Maccullochella peelii peelii*) and Macquarie Perch (*Macquaria australasica*), and the only known population of the endangered Green and Golden Bell Frog (*Litoria aurea*) in the Southern Tablelands. Consequently, the Molonglo River has high conservation values and requires immediate and long-term attention to rehabilitate and restore riparian vegetation and water quality, now and into the future.

This Action Plan describes the river profile including:

- The historic condition of the Molonglo River;
- Land use and recreation;
- People, including population growth and land use changes, and indigenous heritage;
- Water discharge and flow;
- Geology, soils and geomorphology;
- Climate; and
- Biodiversity including flora, fauna, threatened species, connectivity and areas of high conservation value.

The Plan then describes existing and future threats to the Molonglo River including:

- Declining water quality (from heavy metal leachate, eutrophication, erosion and sedimentation);
- Habitat destruction and urban expansion;
- Invasive species (plants and animals);
- Water extraction and low flows;
- Salinity;
- Climate change; and
- Key knowledge gaps.

The Action Plan identifies nine reaches along the entire Molonglo River:

- *Reach One - Headwaters south of Captains Flat to Hoskinstown Road*
  Reach One begins at the headwaters in Tallaganda National Park in NSW south of the township of Captains Flat, to the where the river is crossed by the Hoskinstown Road bridge approximately 20 kilometres north of Captains Flat.
- *Reach Two - Hoskinstown Road to Briars Sharrow Road*
  This reach is approximately 17 kilometres in length and incorporates the Hoskinstown (or Carwoola) Plain, from Hoskinstown Road north of Captains Flat to where the river is crossed by Briars Sharrow Road, west of Hoskinstown.
- *Reach Three - Briars Sharrow Road to Burbong Bridge*
  Reach Three extends from Briars Sharrow Road in Hoskinstown to the Burbong Bridge where the Kings Highway crosses the Molonglo River west of Queanbeyan. This reach is approximately 14 kilometres long and represents the final section of the River to occur in NSW.
- *Reach Four - Burbong Bridge to Molonglo Gorge*
  This reach is approximately 10 kilometres long and extends from Burbong Bridge on the Kings Highway to the eastern end of the Molonglo Gorge.
- *Reach Five - Molonglo Gorge*
  Molonglo Gorge occurs downstream of Burbong, flanked by Kowen Forest, and is managed by Parks, Conservation and Lands.
- *Reach Six - Molonglo Gorge to Lake Burley Griffin*:
  This reach begins at the western end of the Molonglo Gorge, through Queanbeyan and Fyshwick until the River meets Lake Burley Griffin in the centre of Canberra. This reach is approximately 17 kilometres in length.
- *Reach Seven - Lake Burley Griffin Precinct*
  This reach includes the 664 ha lake and 40.5 kilometres of foreshore and is managed by the National Capital Authority (NCA) for recreation and amenity.

- *Reach Eight - Scrivener Dam to the Lower Molonglo River Corridor Nature Reserve*
  This reach is approximately 10 kilometres long, beginning at Scrivener Dam at the western end of Lake Burley Griffin and extending to the Lower Molonglo River Corridor Nature Reserve at Coppins Crossing.
- *Reach Nine - Lower Molonglo River Corridor Nature Reserve*
  This reach begins at Coppins Crossing until the confluence with the Murrumbidgee River approximately 16 kilometres north-west of Canberra.

The Action Plan highlights opportunities for the rehabilitation of the Molonglo River through best practice management, community engagement and partnerships between government, business, landholders, interested community organisations and others within the following priority reaches:
Reach One, Two, Three, Four, Six and Eight.

Riparian restoration activities proposed include staged weed removal, fencing and exclusion of stock, off-stream watering points and revegetation. The Plan also highlights other opportunities such as recreational improvements, improvement of habitat for flora and fauna, storm-water management, community education and engagement, and engagement with the development and business sector.

Finally, the Plan describes a proposed monitoring program to ensure actions implemented are successful and / or adapted as necessary. Monitoring includes community-focussed activities like Waterwatch, Frogwatch and Platypus Count. Waterwatch and revegetation sites will also include appropriate photo points to track progress. A social survey including a program to monitor community attitude change to the river and restoration works is also proposed.

Rivers are an integral part of the landscape and their appropriate management is necessary to maintain all the assets that they provide. The Molonglo River is the key water course running through urban Canberra and its restoration must form part of any vision for the city which prides itself on being the "Bush Capital".

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1. Introduction

1.1 Background

In 2008, the Molonglo Catchment Group (MCG), along with the ACT Natural Resource Management (ACT NRM) Council, Greening Australia Capital Region (GA), the Murrumbidgee Catchment Management Authority (Murrumbidgee CMA), ACT Parks, Conservation and Lands (ACT PCL) and RiverSmart Australia, began discussions on developing a coordinated approach to river management and rehabilitation of the Molonglo River within both the ACT and NSW.

Funding was successfully negotiated through an Australian Government *Caring for our Country* grant application. The grant had a dual aim:

- To commence rehabilitation works on the Molonglo River; and
- To create an Action Plan to guide further rehabilitation works into the future.

1.2 Who is involved?

The project currently includes nine partner organisations:

- ACT Natural Resource Management Council
- Murrumbidgee Catchment Management Authority
- Molonglo Catchment Group
- Greening Australia Capital Region
- ACT Parks, Conservation and Lands
- ACT Waterwatch
- Frogwatch ACT & Region
- RiverSmart Australia Ltd
- CIC Australia Ltd

All project partners have contributed towards the development of this Action Plan. Prior to publication, consultation was also sought from the National Capital Authority (NCA), the ACT Land Development Agency (LDA), Industry & Investment NSW, the NSW Department of Environment, Climate Change and Water, various Landcare groups that work on the Molonglo River, and Queanbeyan, Cooma-Monaro and Palerang Councils. The draft plan was also placed on the Molonglo Catchment Group website for public comment.

The Molonglo River Rescue Project creates a cohesive framework for the activities of the many different natural resource management groups in the ACT/NSW region. The project aims to provide a model approach for projects where a range of rehabilitation tasks are required covering a broad spectrum of land tenures and jurisdictional boundaries.

1.3 Purpose of the Action Plan

The purpose of the *Molonglo River Rescue Action Plan* is to guide and support investment in on-ground action through various natural resource management (NRM) groups, land managers and stakeholders in both NSW and the ACT for the rehabilitation of the Molonglo River. Rehabilitating the Molonglo River will provide a healthier and more resilient system that will be better able to withstand future changes in land uses and climate in the region.The Plan also considers how the improvement of the environmental condition of the river could result in positive conservation, aesthetic, educational and recreational benefits for the wider community.

Specifically the Plan aims to:

- Provide a detailed overview of the Molonglo River in a catchment context;
- Discuss threats to the river;
- Identify and discuss each reach of the Molonglo River;
- Identify specific actions for rehabilitation along the River;
- Identify other assets and opportunities relevant to the project; and
- Detail a monitoring strategy for the Molonglo River Rescue Project.

1.4 Action Plan Development

The Action Plan was developed in several phases:

- *Consultation*

Targets and actions were obtained from community inputs in workshops as part of the Molonglo Catchment Strategy (2005), and meetings with representatives of various NRM organisations.

- *A Literature Review*

Compilation of existing regional strategies and maps, a review of scientific and historic literature, future development proposals, and existing management plans.

- *Establishment of On-ground Works*

Establishing cooperative rehabilitation works on the River as part of the Molonglo River Rescue Project.

- *Production of the draft Action Plan*

Collating data, writing a draft and submitting the draft for review to the Steering Committee.

- *Communication of the draft plan to multiple audiences*

Completion of the plan based on feedback from the steering committee and roll-out of the plan to relevant stakeholders and other interested parties for input and feedback;

- *Launching the Action Plan*:

To ensure the final Action Plan is distributed to relevant stakeholders and other interested parties, and actions begin to be initiated.

1.5 Vision for the Molonglo River

The Vision for Molonglo River Rescue is:

A Healthy River Managed for Sustainability and Enjoyment...

Supporting this vision are the following concepts:

- To stop further degradation of the river, and see it become healthier, more attractive and more accessible through actions such as:
  - Improving the health of instream and riparian habitats;
  - Improving water quality, particularly reducing sediment and nutrient input;
  - Creating an environment that fosters native flora and fauna, and is accessible and amenable to people;
  - Protecting threatened species and communities where they occur on or near the river;
  - Reducing the spread and impacts of woody weeds particularly Willow, Blackberry and other deciduous trees; and
  - Making best use of available and environmental flows to improve the health of the river.
- To demonstrate what is possible through strategic, coordinated interventions involving government and non-government organisations and landholders working together;
- To strengthen community and commercial interest and engagement in working to restore the Molonglo River.

1.6 Links to other initiatives, existing and related plans

The Action Plan considers the following initiatives / documents:

- 2010 *Caring for Our Country* Upper Murrumbidgee Demonstration Reach (UMDR) and associated Action Plan and Carp Management Plan
- 2009 ACT Natural Resource Management Plan, ACT NRM Council
- 2009 National Capital Plan, National Capital Authority
- 2009 ACT Weeds Strategy 2009 - 2019, DECCEW
- 2009 Upper Murrumbidgee Willow Management Strategy, Upper Murrumbidgee Catchment Coordinating Committee (unpublished)
- 2009 Vegetation mapping of the Molonglo River to the ACT border, ACT Parks, Conservation & Lands (unpublished)
- 2009 Draft Blue-green Algae Management Plan for Lake Burley Griffin, NCA and ACT Health
- 2008-2009 ACT Annual Water Report, ACT Government
- 2008 Murrumbidgee Catchment Action Plan, Murrumbidgee CMA
- 2007 Canberra Spatial Plan, ACT Planning & Land Authority
- 2007 Palerang Social and Community Development Plan , Palerang Council
- 2006 Jerrabomberra Wetlands Nature Reserve Draft Management Plan, ACT Territory & Municipal Services
- 2006 ACT 'Ribbons of Life' Draft Aquatic Species and Riparian Zone Conservation , ACT Territory & Municipal Services
- 2006 National Recovery Plan for Natural Temperate Grassland of the Southern Tablelands (NSW and ACT): An Endangered Ecological Community, Environment ACT
- 2006 Lake Burley Griffin Willow Management Plan, Molonglo Catchment Group
- 2005 Molonglo Catchment Strategy 2004 to 2024, Molonglo Catchment Group
- 2005 Jerrabomberra Creek Plan of Management DRAFT, Queanbeyan City Council
- 2004 'Woodlands for Wildlife' ACT Lowland Woodland Conservation Strategy, Environment ACT
- 2004 ACT Natural Resource Management Plan 2004-2014, ACT Natural Resource Management Board;
- 2002 A Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands, Martin Falding for NSW NPWS
- 2003 'Think Water, Act Water' Draft Strategy for Sustainable Water Resource Management in the ACT, Environment ACT
- 2003 Molonglo Catchment Project Planning Framework and Information Resource, Conservation Council of the South East Region and Canberra
- 2002 Weston-Woden Sub-catchment Plan, Southern ACT Catchment Group
- 2001 Lower Molonglo River Corridor Management Plan, Environment ACT
- 2001 Canberra's Urban Lakes and Ponds Plan of Management, EDAW (Aust.) Pty Ltd & Cooperative Research Centre for Freshwater Ecology
- 2000 Sustainable Water Action Management Project (SWAMP) Strategy and Action Plan, Environment ACT
- 1998 Canberra Nature Park Draft Plan of Management, Environment ACT
- 1998 Management Plan for the Molonglo River Water Reserve and Associated Blocks, by Michael Treanor
- 1997 The Flora of South-east Yarrowlumla Preliminary Assessment, by Peter Barrer
- ACT Heritage Register and Commonwealth/National Heritage Lists
- Light industrial land release reports and green space concept zoning for Fyshwick and Molonglo River Corridor, Land Development Authority
- Proposed Molonglo Valley Development and associated data
- Development if a Conceptual Framework for the landscape conservation assessment in the Kosciuszko to Coast (K2C) Partnership area to inform the CAP review process, by Tom Barrett
- Existing water quality data via Waterwatch and Frogwatch, through ACT Waterwatch
- NSW Threatened Species Profiles and Priority Actions Statements

2. The Molonglo River Catchment Profile

2.1 Introduction

The Molonglo River is an iconic river, flowing through NSW and the ACT and forming the centrepiece of Canberra, the national capital, in Lake Burley Griffin. The river is approximately 115 kilometres in length and flows from the Great Dividing Range above Captains Flat in NSW through the ACT to the Murrumbidgee River. The total catchment area is around 200,000 hectares (ha) (MCG 2005). The Molonglo Catchment lies within the Upper Murrumbidgee River Catchment, and is a major contributor to the water quality of the Murrumbidgee River. The Molonglo River Catchment includes a number of tributaries: Jerrabomberra, Reedy, Woolshed, Ballinafad, Primrose Valley, Chimney, Yandiguinula, Yarralumla, Weston and Sullivans Creeks. The river is currently utilised for a variety of uses, including agriculture, primary production and associated extraction, light industry and recreation.

The Molonglo River has been highly modified. Water quality is often poor, exhibiting high nutrient and sediment loads, as well as heavy metal pollution from previous mining activities. The riparian zone, like much of the catchment, has been extensively modified, and in many places it is non-existent, and subject to considerable infestations from Willow and other woody weeds. Despite this, the River is home to threatened species and communities including the largest known population of the vulnerable Pink-tailed Worm-lizard (*Aprasia parapulchella*), the threatened Murray Cod (*Maccullochella peelii peelii*) and Macquarie Perch (*Macquaria australasica*), and the only known population of the endangered Green and Golden Bell Frog (*Litoria aurea*) in the Southern Tablelands. Consequently, the Molonglo River has high conservation values and requires immediate and long-term attention to rehabilitate and restore riparian vegetation and water quality.

2.2 Historic Condition of the Molonglo River

The first Europeans to visit the area arrived in 1820 (MCG 2005). Vegetation in the region is likely to have comprised a mosaic of forest, shrubland, woodland, and grassland (Johnston *et al.* 2008; TAMS 2009; Dowling undated). Low elevation grasslands and grassy woodlands on the 'Limestone Plains' were grazed from the 1820s and this continued in parts of what is now suburban Canberra until quite recently. There was also the growing of cereal and fodder crops, some dairying along the river and cropping on river flats (Commonwealth Department of the Interior 1965).

Land degradation began with large-scale tree clearing for agriculture, and was exacerbated by overstocking, soil type and condition, and the climatic variability in the region (MCG 2005; Ryan *et al.* undated). A review of historic journals and other literature suggests that the river and its tributaries prior to European settlement are likely to have been 'a chain of ponds' (Eyles 1977; Starr undated; Johnston *et al.* 2008; TAMS 2009). Historic land management practices, particularly ring-barking of trees, the grazing of sheep and cattle, along with the boom in rabbit numbers between 1840 and 1950, caused many chains of ponds systems to suffer from scouring, gully erosion, incised channels, fixed bar ponding and permanently flowing streams replacing the natural chain of ponds sequence (Eyles 1977).

2.3 Land Use & Recreation

The Molonglo River corridor and adjoining areas include a range of different land tenure types:

- NSW freehold broad acre farmers and peri-urban hobby farmers and lifestyle landholders;
- Lands managed by NSW Department of Environment, Climate Change and Water (DECCW) such as National Parks and Nature Reserves;
- Lands managed by Forest NSW notably pine plantations;
- NSW Crown lands managed by local Council
- NSW Crown Water Reserve managed by the Land and Property Management Authority;
- ACT unleased Territory lands managed by Parks Conservation & Lands;
- ACT leased Territory lands managed by rural landholders;
- National unleased lands; and
- National leased lands.

The Catchment has been largely cleared for agriculture and urban development, with less than one third still retaining native vegetation (Wasson *et al.* 1998). Sheep and beef cattle grazing dominate the remaining large pastoral areas of the upper Molonglo sub-catchment in NSW and the rural areas of the lower Molonglo in the ACT. The fertile alluvium on the river flats east of Lake Burley Griffin support a turf farm, grazing country, and in the past, dairy farms (MCG

2005). Other types of agricultural land use include horticulture, viticulture, and horse agistment. There is a growing shift towards the conversion of rural lands to peri-urban development around Queanbeyan (MCG 2005). Urban land uses dominate within the catchment between Queanbeyan and Lake Burley Griffin. Currently, the lower Queanbeyan, Fyshwick, Weston, Woden, Lake Burley Griffin and Sullivans Creek sub-catchments are heavily urbanised with an 80-85% built environment (MCG 2005). Remaining sections of the Lower Molonglo and around Fyshwick have been utilised for light industrial development and the conversion of farm land into industrial areas is earmarked to continue in these parts of the catchment. Residential development is likely to continue around Queanbeyan and the suburbs of Wright and Coombs are proposed in areas adjacent to the Molonglo River below Scrivener Dam.

Three sewerage treatment works are also located along the Molonglo River, which process 100% of the effluent generated within Canberra and Queanbeyan (Queanbeyan Sewage Treatment Plant, Fyshwick Sewage Treatment Plant and the Lower Molonglo Water Quality Control Centre).

There are approximately 3,000 ha of land in nature reserves, the majority of which occurs in the Canberra Nature Park system managed by Environment ACT. There is 30,355 ha of National Parks in the catchment and 14,100 ha of land managed by State Forestry Commissions (9,600 ha in ACT and 4,500 ha in NSW) (MCG 2005). Forestry management occurs in Kowen Forest, Kowen Escarpment, and Molonglo Gorge.

Land use in both NSW and the ACT are managed by planning instruments. In NSW, Local Environment Plans (LEPs) are strategic planning documents that outline acceptable and unacceptable uses for different lands within a Local Government Area. They also determine where future development and conservation will occur (EDO 2008). All three Councils in the locality (Cooma-Monaro, Palerang and Queanbeyan Councils) are currently reviewing their LEPs. This provides an opportunity to legislate responsible land management along the Molonglo River in NSW. In the ACT, the Territory Plan is the key statutory planning document which determines land use change and development. The Territory Plan is also currently under review. Rural land leased in the ACT also includes Land Management Agreements (LMA). As leases come up for renewal, the ACT Government includes new management objectives in regards to environmental stewardship, again providing an opportunity for better river management.

Lake Burley Griffin Precinct

As the centrepiece of Canberra, Lake Burley Griffin provides the setting for buildings of national importance and a venue for aquatic recreation. As part of the Molonglo River, the lake also plays a key role in downstream water quality and biodiversity management. Lake Burley Griffin supports a variety of water-based commercial and recreational uses. These include canoeing, kayaking, dragon boating, rowing, ferry services, charter boats, water taxis, sailing, fishing, swimming, model boating, triathlon, restricted power boating, water skiing, windsurfing, picnicking, walking, cycling, and foreshore events and ceremonies. The Australian Institute of Sport (AIS) rowing program is based in Canberra and use the waters for training. There are 3,000 powered and non-powered boats moored/ stored on the lake and nearby areas.

2.4 People

2.4.1 Population Growth and Land Use Changes

The population of the Molonglo Catchment was approximately 130,000 in 2002 (MCG 2005), with an annual population growth of 1.5% (Murrumbidgee CMA 2008). The Catchment contains the city of Queanbeyan and parts of Canberra. Proposed future urban development in the Molonglo Valley and the Kowen Plateau will substantially increase the urban population living in close proximity to the Molonglo River (ACT Government 2007).

One of the main challenges to river and riparian restoration, and the on-going management of the Molonglo River, is the diversity of land tenure along the river corridor. There has been a growing trend over the past several decades of people moving from the cities in the ACT to rural sub-catchments in peri-urban areas. At the growth rates experienced between 1997 and 2002 the population in peri-urban reaches would increase by over 25,000 people in the next 20 years, significantly changing current population densities in the catchment (MCG 2005). On the NSW side, approximately 15% of the Molonglo catchment is comprised of rural residential development (NSW DLWC 2000) and this area is increasing.

Growth of smaller lots will make biodiversity and waterway protection more complex and present new challenges to river management. Rural residential developments may involve landowners with little knowledge of land management, and who are time poor, however, these landowners also tend to be well-educated and interested in NRM issues (MCG 2005; Conkey & Aslin 2006).

2.4.2 Indigenous Heritage in the Molonglo

The Molonglo River valley was an important ceremonial site and prime source of food and water for the local indigenous people prior to European settlement. Archaeological evidence suggests that the low elevation riverine and adjacent woodland and grassland environments were the focus of Aboriginal occupation of the Southern Tablelands. The river valley was relatively resource rich and a major trading route and means of access to the Limestone Plains (now Canberra city) for local and visiting Aboriginal people (NCPA 1995; cited in Environment ACT 2007). Many sites have been recorded particularly on river flats, terraces and spurs from ridges leading to watercourses (Bulbeck and Boot 1990). There are hundreds of indigenous heritage places listed on the ACT Heritage Register and NSW National Parks and Wildlife Service database for the Molonglo River (Grinbergs 2003; cited in MCG 2005) including:

- Art sites;
- Sites where flaked stone tools were made;
- Burial and ceremonial sites;
- Stone arrangements, and
- Scarred or carved trees.

2.5 Water Discharge and Flow

The Molonglo River is the second largest river within the Molonglo Catchment, being exceeded in length and discharge by the Queanbeyan River. These two rivers confluence below the city of Queanbeyan. Mean annual discharge of the Molonglo River is 55 gigalitres with seasonal stream flows peaking between September and November (ACT Government 2007).

The Molonglo River has two major water holding areas: Captains Flat Dam just south of the town of Captains Flat in the upper Molonglo, and Scrivener Dam which forms Lake Burley Griffin, on the lower Molonglo. Water is also withheld in Googong Dam on the Queanbeyan River tributary (TAMS 2007). These dams, along with extraction for commercial and domestic purposes, have resulted in reduced river levels and flow variability. Within the ACT, where water is collected from the landholder's property or where a property directly abuts a waterway, the taking of surface water for stock and domestic purposes does not require a license (ACT Government 2007). A licence is required, however, to take and use groundwater for any purpose, including irrigation of a domestic garden, and a licence is required to drill a bore (UMCCC undated; DECCEW 2009a; DECCEW 2009b).

In NSW, the *Farm Dams Policy* states that landholders have the right to capture 10% of the average regional yearly rainfall runoff for their property for any use or purpose (DLWC 1999). As the majority of dams constructed prior to 1st January 1999 exceed this, it is likely that extraction is exceeding sustainable yields. The full extent of current ground and surface water extraction and its ecological impact on the Molonglo River is not known.

2.6 Geology, Soils & Geomorphology

Sediments laid down 460 million years ago from ancient oceans forms the geology underlying the ACT and region today. These sediments have become sandstone, limestone, siltstone and shales. Silurian rocks form many of the major peaks in the region. Granitic intrusions and deep alluvial deposits are also well represented (MCG 2005). The Molonglo, Pialligo, Captains Flat and Bennison soil landscape types dominate the majority of the Molonglo River. The Molonglo and Pialligo landscapes are level to gently undulating floodplains on Quaternary alluvium (Department of Land and Water Conservation 2000). The Captains Flat and Bennison landscapes are undulating to rolling rises and flats on Silurian volcanics (Department of Conservation & Land Management 1993). In urban areas, building spoil has been introduced along parts of the river and consists of a mix of topsoil, subsoil, boulders and building materials (TAMS 2006).

The Molonglo River and many of the smaller tributaries within the catchment are likely to have been a distinct 'chain of ponds' style of morphology. Chains of ponds are oval to round, reed-lined, deep waterholes often with an interconnecting channel (Eyles 1977). Currently the river exhibits a low to medium sinuosity planform, and an incised channel with largely discontinuous alluvial floodplains within confined valley settings, to broad, flat, swampy meadows and floodplains in the more open country (Ishiyama *et al.* unpublished). The river becomes confined by bedrock through the Molonglo Gorge, downstream of the Hoskinstown (Carwoola) Plain, and within places along the lower Molonglo River below Scrivener Dam before its confluence with the Murrumbidgee River.

2.7 Climate

The region experiences hot summers with days regularly over 30° C, and very cold winters with daily minimum temperatures reaching below freezing. Long term records indicate evenly distributed rainfall throughout the year, however the past decade has experienced some extremely dry conditions, well below the 600 millimetre average annual rainfall (BOM 2009).

2.8 Biodiversity

2.8.1 Flora

Vegetation Communities

Much of the native vegetation of the Molonglo Catchment has been removed, with estimates that up to 70 percent of the original native vegetation cover has been lost (Wasson *et al.* 1998). Remaining native vegetation includes a broad range of vegetation types, including a number of rare and threatened plant communities. Riparian vegetation, where it exists, is diverse, and changes frequently along the length of the river in response to gradient, rocky outcrops, aspect, river flows and other factors (Johnston *et al*. 2008; TAMS 2009; Barrer 1997).

Thirteen vegetation communities have been identified along the Molonglo River (Johnston *et al*. 2008; Ishiyama *et al*, unpublished; TAMS 2009; Barrer 1997) and are presented in Table 1 below. A detailed description of each community is provided in Appendix B.

Table 1 Vegetation Communities identified along the Molonglo River

No.	*Vegetation Communities **	*Equivalent NSW Biometric Vegetation Type (Murrumbidgee CMA)*
1	Red Stringybark–Scribbly Gum (*Eucalyptus macrorhyncha–Eucalyptus rossii)* Tableland Forest	Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest on skeletal hills of the tablelands, South Eastern Highlands
2	Black Cypress Pine *(Callitris endlicherii)* Tableland Woodland	Black Cypress Pine - Red Stringybark - Box low open forest on rocky outcrops of the NSW South Western Slopes and adjoining South Eastern Highlands Bioregion
3	Snow Gum–Candlebark (*Eucalyptus pauciflora–Eucalyptus rubida*) Tableland Woodland	Snow Gum - Candle Bark Woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands
4	River Sheoak *(Casuarina cunninghamiana)* Tableland Riparian Woodland	River Oak forest and woodland of the NSW South Western Slopes and South Eastern Highlands Bioregions
5	Yellow Box-Blakely's Red Gum (*Eucalyptus melliodora-Eucalyptus blakelyi*) Tableland Grassy Woodland (Box Gum Woodlands)	Various Yellow Box-Blakely's Gum Woodland Associations
6	Tableland Shrubland	NA
7	Tableland Dry Tussock Grassland (includes Natural Temperate Grassland of the Southern Tablelands)	Sub-alpine grasslands of valley floors, southern South Eastern Highlands and Australian Alps Wallaby Grass - Redleg Grass low grassland of the South Eastern Highlands
8	Montane Dry and Wet Tussock Grassland	River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands

No.	Vegetation Communities *	Equivalent NSW Biometric Vegetation Type (Murrumbidgee CMA)
9	Swamp Gum (*E. ovata*) Grassy Woodland (Barrer 1997)	River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands
10	Willow – Elm (*Salix fragilis-Ulmus procera)* Tableland Riparian Woodland Disclimax	NA
11	Tableland Riparian Fringing Vegetation Complex	NA
12	Tableland Riparian Floating and Submerged Vegetation Complex	NA
13	Hill Oak (*Allocasuarina verticillata*) Dry Sclerophyll Forest (Barrer 1997)	NA
* Based on the following ACT publications: Johnston *et al.* 2008; Ishiyama *et al.*, unpublished; TAMS 2009, and work done in NSW by Barrer 1997.		

2.8.2 Fauna

Aquatic Fauna

Five native fish species have been recorded in the Molonglo River below Lake Burley Griffin (Hogg 1990; cited in Environment ACT 2001): Murray Cod (*Maccullochella peelii peelii*), Golden Perch (*Macquaria ambigua*), Macquarie Perch (*Macquaria australasica*), Western Carp Gudgeon (*Hypseleotris klunzingeri*), and Australian Smelt (*Retropinna semoni*). Introduced fish species include Carp (*Cyprinus carpio)*, Redfin (*Perca fluviatilis*), Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*), Goldfish (*Carassius auratus auratus*) and Plague Minnow *(Gambusia holbrooki)* (TAMS 2006).

Platypus are thought to be moderately common throughout the Molonglo River (Luke Johnston, *pers comm*. 21 Oct 2009). They were known to occur in Lake Burley Griffin until the early 1980's, and there had been no confirmed reports since, until a Platypus was accidentally killed by anglers in the lake in January 2010 (ACT Government unpublished; ABC News, Friday January 15, 2010). Other recent records are from Molonglo Gorge, Jerrabomberra Wetlands and Sullivans Creek (Luke Johnston, *pers comm*. 21 Oct 2009). The Eastern Long-necked Tortoise *(Chelodina longicollis)*, Eastern Water Rat (*Hydromys chrysogaster*), and Murray River Crayfish (*Euastacus armatus*) have also been recorded in the Molonglo River (TAMS 2006; Environment ACT 2001).

Terrestrial Fauna

Remnant woodland along or adjacent to the River is likely to provide habitat for a range of woodland birds (Standing Committee on Planning and Environment 2008; Reid 1999). The Molonglo River also provides an important route for bird movements and includes breeding habitat for high numbers of raptors, especially in the lower Molonglo (Standing Committee on Planning and Environment 2008; ACT Government 2007; Environment ACT 2001). High numbers of native birds have been recorded at Jerrabomberra Wetlands Nature Reserve including seven species listed under international agreements for their migratory status (TAMS 2009).

Nine species of frog have been identified along the Molonglo River: Common Eastern Froglet (*Crinia signifera*), Pobblebonk (*Limnodynastes dumerelii*), Striped Marsh Frog (*Limnodynastes peronii),* Spotted Marsh Frog (*Limnodynastes tasmaniensis*), Peron's Tree Frog (*Litoria peronii*), Smooth Toadlet (*Uperoleia laevigata*), Plains Froglet (*Crinia parinsignifera*), Whistling Tree Frog (*Litoria verreauxii*), and the endangered Green and Golden Bell Frog (*Litoria aurea*) (ACT Frogwatch 2008; Environment ACT 2001).

Native mammals include Common Wombat (*Vombatus ursinus*), the ubiquitous Eastern Grey Kangaroo (*Macropus giganteus*), Red-necked Wallaby (*Macropus rufogriseus*) and Swamp Wallaby (*Wallabia bicolor*) (ACT Government 2007). The Lower Molonglo Corridor also provides habitat for a large population of the regionally uncommon Eastern Wallaroo (*Macropus robustus*) (Environment ACT 2001). Other fauna include *Antechinus* species, native rodents (*Rattus* sp), Echidna (*Tachyglossus aculeatus*), Common Brushtail Possum (*Trichosurus vulpecula*), Common Ringtail

Possum (*Pseudocheirus peregrinus*) and Sugar Glider (*Petaurus breviceps*) (Environment ACT 2001). A range of microchiropteran bat species are also known to occur in riparian areas of the ACT (Environment ACT 2001). At least 20 species of reptile are known from the Molonglo River corridor (Environment ACT 2001).

2.8.3 Threatened Species

The following table lists threatened species and communities that have been recorded in or near the Molonglo River. A detailed description of each species / community including where they have been located and their status under relevant legislation is provided in Appendix B.

Table 2 Threatened Species of the Molonglo River

Group	Description
Endangered Ecological Communities (EEC)	Box-Gum Woodlands (including the White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Australian Government); White Box Yellow Box Blakely's Red Gum Woodland (NSW) and Yellow Box–Red Gum Grassy Woodland (ACT). Natural Temperate Grassland of the Southern Tablelands of NSW and the Australian Capital Territory (Australian Government, NSW and ACT) (Note this community is included in the Tableland Dry Tussock Grassland Community description in Appendix B)
Flora	Button Wrinklewort (*Rutidosis leptorrhynchoides*) Pale Pomaderris (*Pomaderris pallida*) Tarengo Leek Orchid (*Prasophyllum petilum*) Silky Swainson-pea (*Swainsona sericea*) Small Purple-pea (*Swainsona recta*)
Fish	Murray Cod (*Maccullochella peelii peelii*) Macquarie Perch (*Macquaria australasica*)
Invertebrates	Murray River Crayfish *(Euastacus armatus)* Perunga Grasshopper *(Perunga ochracea)*
Frogs	Green and Golden Bell Frog (*Litoria aurea*)
Lizards	Pink-tailed Worm-lizard (*Aprasia parapulchella*) Striped Legless Lizard *(Delma impar)*
Birds	Brown Treecreeper (Eastern Subspecies) (*Climacteris picumnus victoriae*) Varied Sittella (*Daphoenositta chrysoptera*) Superb Parrot (*Polytelis swainsonii*) Diamond Firetail (*Stagonopleura guttata)* White-winger Triller *(Lalage tricolor)*

2.8.4 Connectivity

The Molonglo River is one of the important wildlife corridors providing a link between the Murrumbidgee River, the nature reserves of Canberra and remnant stands of vegetation (Environment ACT 2001). The topography, vegetation, and rocky outcrops along the Molonglo River valley and riparian zone provide important wildlife habitat and connectivity in an otherwise sparsely treed and open landscape lacking shelter or enclosed habitats (Environment ACT 2007a).

A number of initiatives are currently being undertaken to improve connectivity in the region including the K2C Project and the Great Eastern Ranges Initiative.

2.8.5 Areas of High Conservation Value

A number of areas of high conservation value exist along the Molonglo River. Formal reserves include:

- Tallaganda National Park;
- Jerrabomberra Wetlands Nature Reserve;
- Molonglo Gorge Recreation Area; and
- Lower Molonglo River Corridor Nature Reserve.

A number of other areas of conservation value exist along the river but are not formally protected under any reserve system. There are remnants of high value Snow Gum Woodland around Glen Burn in Kowen Forest, scattered patches throughout the lower Molonglo as the river enters the Lower Molonglo Gorge (Johnston *et al*. 2008; TAMS 2009; MCG 2007), and in the upper Molonglo, notably, in a Travelling Stock Reserve (TSR) on crown land near Captains Flat, and Captains Flat Cemetery. The 'Kama' property between Central and East Molonglo, south of William Hovell Drive, consists chiefly of partially modified Yellow Box-Red Gum Grassy Woodland and Natural Temperate Grassland. This property has been nominated for inclusion in the ACT Heritage Register and is proposed for designation as a nature reserve (Standing Committee on Planning and Environment, 2008). Barrer (1997) identified lightly grazed or ungrazed bushland surrounding the Captains Flat area as being rich in native plant species and recommended further surveys with the aim of conserving more intact and valuable remnants. Yarramundi Reach, a natural grassland on the shores of Lake Burley Griffin, and Stirling Ridge, an extensive grassy woodland also on the shores of the Lake, are managed by the NCA in partnership with the ANU Fenner School and the Friends of Grasslands (FOG) Group. There is also a patch of Natural Temperate Grassland managed by Sydney University near the Mills Cross Radio Telescope, Hoskinstown NSW.

About 2.5 kilometres north-west of Coppins Crossing on the northern side of the river is an important geological feature comprising fossiliferous limestone and shale. This has been described as one of the best documented fossil fauna assemblages from the Middle Silurian in south-eastern Australia, and of extremely high paleontological value (Rosengren 1985).

Other areas of high conservation are likely to exist along the river, including remnants on private land.

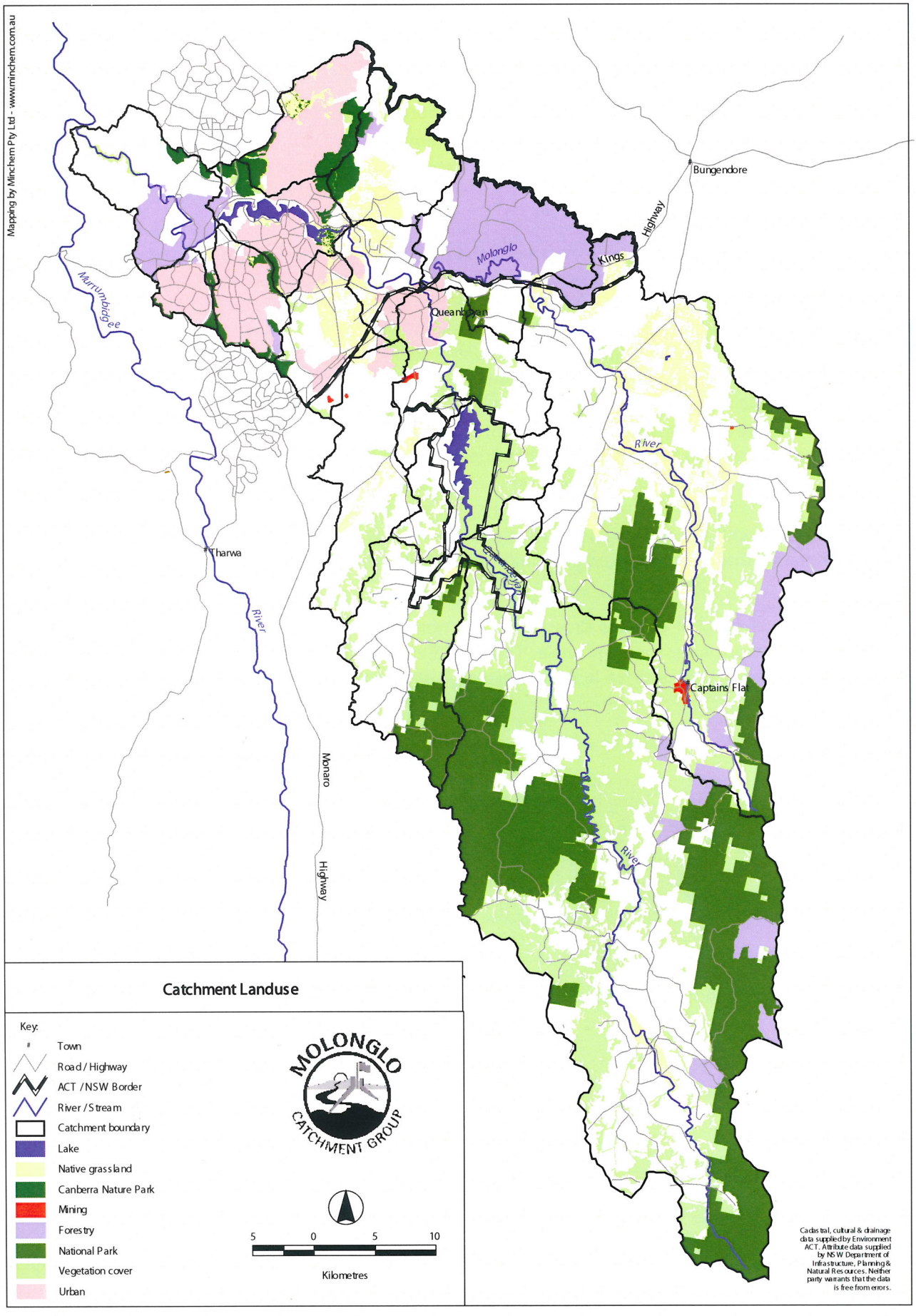

Figure 1 Molonglo Catchment Map including Land Use

3. Major Threats to the Molonglo River

3.1 Declining Water Quality

3.1.1 Heavy Metal Leachate from the Captains Flat Mine

Mining for copper, gold, lead and zinc first commenced at Captains Flat in 1882, but was abandoned at the turn of the century. Full-scale mining recommenced in 1939. The collapse of mine waste dumps at Captains Flat in 1939 and again in 1942 and 1945 resulted in mine waste contamination of the River and associated floodplain. In the 1960s the tailings dam associated with the mine failed, contributing base metal leachate to the river system. These collapses released large quantities of heavy metals including zinc, copper and lead, which virtually removed the entire fish population in the Molonglo River (Anon 1974; Norris 1986; ACT Government 2007). The mine site underwent some remediation in the 1970s (capping and revegetation of slag heaps), resulting in some improvements to water quality, however leachate still flows from the mine site and the river is still unable to support fish life for at least fifteen kilometres downstream of Captains Flat (ACT Government 2007).

The only known population of the threatened Green and Golden Bell Frog (*Litoria aurea*) on the Southern Tablelands occurs down-stream from the mine. Research is currently being conducted by the University of Canberra on this species and impacts from the mine.

3.1.2 Eutrophication

The main sources of nutrient input along the Molonglo River can be attributed to urban development, sewerage treatment plants (STP) e.g. Queanbeyan STP, Fyshwick STP and the Lower Molonglo Water Quality Control Centre, stormwater run-off and intense land use, and stream/lakeside development. Salt is a particular problem coming from the water treatment processes at the Lower Molonglo Water Quality Control Centre with substantial funding being provided by the federal government to seek ways of reducing salt input (ACTEW 2007).

Extensive clearing of native riparian vegetation has resulted in stream bank erosion and sedimentation problems, which also produces siltation and nutrient enrichment. Unrestricted stock access to watercourses is also a contributor to increased nutrients in some parts of the catchment. Nutrient pollution of waterways, combined with warm, calm water, can lead to conditions which foster Cyanobacterial (blue-green algal) blooms. Such blooms regularly force the closure of Lake Burley Griffin. Certain Cyanobacteria present a potential health risk if present in drinking water supplies or in surface waters used for recreational purposes.

3.1.3 Erosion and Sedimentation

With less than a third of the catchment remaining under timber or mature growth (Wasson *et al.* 1998), erosion and sedimentation along the Molonglo River and its tributaries continues to be a source of degradation. Large areas of the river have experienced significant erosion, primarily as a result of the high incised banks which are prone to slumping from flood undercutting. Unimpeded stock access to the river and existent/persistent nick-points have also exacerbated erosion issues. Significant areas of erosion have been subject to past remediation although these are beginning to fail (Lynton Bond *pers comm.* 1 Dec 2009). The incised streams which have replaced the original 'chain of ponds' system have high stream powers, and provide a hostile environment for plant regeneration. This also results in a simplified ecosystem structure which provides little in the way of suitable habitat for macroinvertebrates that require a diverse range of substrates (Harrison *et al.* 2008). Erosion and sedimentation cause high levels of turbidity and fine sediment accumulation which also creates a hostile environment for many native fish species (DPI 2005).

3.2 Habitat Destruction and Urban Expansion

Past and present land use practices have resulted in the extensive modification or complete replacement of native ecological communities throughout the catchment. Much of the Molonglo River has lost intact riparian and fringing vegetation. A range of fauna (e.g. platypus) are threatened by the clearing of riparian vegetation and stock trampling, and the sedimentation of pools (Lintermans & Osborne 2002; cited in ACT Government 2007). Degradation of native riparian vegetation is listed as a key threatening process in NSW under the *Threatened Species Conservation Act 1995* (TSC Act).

The expansion of Canberra, Queanbeyan and adjacent peri-urban areas, will continue to result in further pressure being placed on the remaining vegetation communities and the ecosystems that they support. Urban impacts include predation and disturbance by cats and dogs, removal of bush rock, removal of fallen timber by local residents or for fire hazard fuel reduction, dumping of garden waste, planting out into riparian reserves from adjacent backyards, and spread of invasive pest plants (ACT Government 2007). Development may also fracture or reduce the size of habitat for threatened species and endangered ecological communities and result in a loss of landscape connectivity (Standing Committee on Planning and Environment 2008). Development may also impact the river if appropriate stormwater drainage and other run-off measures are not effectively implemented (LDA, 2007).

3.3 Invasive Species

3.3.1 Weeds

Riparian areas are particularly vulnerable to invasion by weed species due to disturbance associated with flood events, and the recurrent input of large amounts of weed propagules from upstream, adjoining tributaries, and from adjacent land. Weeds are considered one of the most significant threats to biodiversity in the ACT (DECCEW 2009), and are one of the largest and most resource demanding ecological management issues in the Molonglo River corridor.

- *Willows (Salix spp.)* dominate the banks of the river in many sections. Willows negatively affect the health of river systems by colonising and obstructing waterways, whereby flow is diverted onto banks or outside the main watercourse resulting in erosion and sedimentation. Additionally they spread aggressively and displace native vegetation creating monocultures without habitat diversity. Willows, being deciduous, also impact temperature and light fluctuations impacting on instream habitats. Willow removal requires careful management, incorporated with ongoing revegetation with appropriate native plant species (Boyer 2003). They are listed as a noxious weed under the *NSW Noxious Weeds Act 1993* and as a Weed of National Significance (WONS) by the Federal Government.

- *Blackberry (Rubus fruticosus aggregate)* suppresses native vegetation and forms dense thickets wherever soil moisture is moderately high (e.g. riverbanks, floodplains, gullies). Appropriate control of Blackberry thickets requires considerable resources to not only treat thickets, but also for subsequent follow-up treatment and revegetation. Blackberry is listed as a noxious weed under the *NSW Noxious Weeds Act 1993*, a pest plant under the *ACT Pest Plants and Animals Act 2005*, and is also listed as a Weed of National Significance.

- *Other Significant Weeds:* English Elm (*Ulmus procera*), Black Alder (*Alnus glutinosa*) and White Poplar (*Populus alba*) forms dense stands with Willow on some parts of the Molonglo River. Montpelier and Scotch (or English) Broom (*Genista monspessulana, Cytissus scoparius*) cover large tracts of the riparian zone in the upper reaches of the river around Captains Flat. Serrated Tussock (*Nassella trichotoma*), African Lovegrass (*Eragrostis curvula*), Chilean Needlegrass (*Nassella neesiana*), Paterson's Curse (*Echium* spp) and St. John's Wort (*Hypericum perforatum*) are also particularly widespread throughout the Molonglo Catchment (MCG 2005; MCG 2007). Garden escapees and pasture ferals also impact the river corridor.

3.3.2 Animals

There are numerous species of introduced fish within the Molonglo River and Lake Burley Griffin, which contribute to the degradation of the River and its instream habitats. Carp, Redfin and Plague Minnow are widespread in many of the waterways in the catchment. Other pest animals known in the catchment include rabbits, dogs, cats, goats, foxes, deer, and pigs. Detailed descriptions of pest animals are provided in Appendix B.

3.4 Water Extraction and Low Flows

Flow in the Molonglo River has been significantly altered by both Scrivener Dam and Googong Dam (on the Queanbeyan River) (TAMS 2007). The river also contains another water supply dam at Captains Flat. While these water holding areas are effective sediment traps protecting downstream reaches, the altered flow regime and release of cold bottom water often with low dissolved oxygen, high suspended solids and bacterial load, have a significant impact on water quality (Environment ACT 2001). These dams, along with extraction for commercial and domestic purposes, have resulted in reduced river levels and flow variability. In rural and peri-urban areas the number and capacity of farm dams is rarely monitored on private non-commercial properties, and may account for higher than expected extraction (Skinner 2009). Excessive farm dam development can have a significant impact on stream flow (Neal *et al.* 2002; cited

in Cetin *et al*. 2009). Water extraction coupled with the severe drought has resulted in very low discharges along the Molonglo River in recent years. These low flows may adversely impact native vegetation communities dependent on more regular wetting and drying regimes, such as swamps and wetlands, and may also impede the recovery of riparian vegetation from disturbances such as fire and land clearing. Low flows also allow for the build-up of sediment and encroachment of vegetation such as Willows and fringing vegetation into the river channel.

The contribution of groundwater to the Molonglo River is not known however, the ACT Government has begun monitoring groundwater and aims to ensure environmental flows are available for all rivers, streams, dams, lakes and groundwater aquifers in the ACT (ACTEW 2009).

3.5 Salinity

Some saline scalding has been identified on foot slope areas in the catchment (MCG 2005). Works to combat the effects of salinity were conducted in 1989-90. Although salinity does not appear to be a growing problem, further revegetation works throughout the catchment are likely to help manage this issue.

3.6 Climate Change

Projections based upon global climate models conducted by CSIRO for the ACT region indicate that climatic change will manifest in several significant ways. The mean annual temperature could increase which may lead to changes in the frequency of extreme temperatures. Climate change is also likely to result in changes to the average annual rainfall and result in an increase in extreme rainfall events. Coupled with projections of annual evaporation increases, this is likely to equal significant water shortages (Environment ACT 2004). Climate change will also affect the frequency and severity of fire in the landscape which has many adverse consequences including loss of life and property, loss of biodiversity from too-frequent fires, and a decrease in potable water (ACT Government 2004).

3.7 Key Knowledge Gaps

Key knowledge gaps for the Molonglo River include:

- Important habitat features particularly in the mid and upper Molonglo;
- Assessment of erosion and areas of instability along the Molonglo River in the ACT (and possible update of NSW data);
- Ground and surface water extraction and its impact on the Molonglo River;
- Quality fish habitat areas and barriers to fish movement;
- The relevant Riverstyles Framework for the Molonglo River including specific fluvial geomorphology;
- Requirement / placement of instream woody debris and other features of importance for native fish and macroinvertebrates;
- No detailed knowledge of changes in attitudes of land holders to the River and associated restoration works especially in regards to peri-urban land dwellers.

4. The Molonglo River at a Reach Scale including Targeted Actions in Priority Reaches

Nine reaches have been identified along the Molonglo River (see Figure 2):

- ***Reach 1 Headwaters south of Captains Flat to Hoskinstown Road***
  Reach 1 begins at the headwaters in Tallaganda National Park in NSW south of the township of Captains Flat, to the where the river is crossed by the Hoskinstown Road bridge approximately 20 kilometres north of Captains Flat.
- ***Reach 2 Hoskinstown Road to Briars Sharrow Road***
  This reach is approximately 17 kilometres in length and incorporates the Hoskinstown (or Carwoola) Plain, from Hoskinstown Road north of Captains Flat to where the river is crossed by Briars Sharrow Road, west of Hoskinstown.
- ***Reach 3 Briars Sharrow Road to Burbong Bridge***
  Reach 3 extends from Briars Sharrow Road in Hoskinstown to the Burbong Bridge where the Kings Highway crosses the Molonglo River west of Queanbeyan. This reach is approximately 14 kilometres long and represents the final section of the River to occur in NSW.
- ***Reach 4 Burbong Bridge to Molonglo Gorge***
  This reach is approximately 10 kilometres long and extends from Burbong Bridge on the Kings Highway to the eastern end of the Molonglo Gorge.
- ***Reach 5 Molonglo Gorge***
  Molonglo Gorge occurs downstream of Burbong, flanked by Kowen Forest, and is managed by PCL.
- ***Reach 6 Molonglo Gorge to Lake Burley Griffin***
  This reach begins at the western end of the Molonglo Gorge, through Queanbeyan and Fyshwick until the river meets Lake Burley Griffin in the centre of Canberra. This reach is approximately 17 kilometres in length.
- ***Reach 7 Lake Burley Griffin Precinct***
  This reach includes the 664 hectare lake and 40.5 kilometres of foreshore and is managed by the NCA for recreation and amenity.
- ***Reach 8 Scrivener Dam to the Lower Molonglo River Corridor Nature Reserve***
  This reach is approximately 10 kilometres long, beginning at Scrivener Dam at the western end of Lake Burley Griffin and extending to the Lower Molonglo River Corridor Nature Reserve at Coppins Crossing.
- ***Reach 9 Lower Molonglo River Corridor Nature Reserve***
  This reach begins at Coppins Crossing until the confluence with the Murrumbidgee River approximately 16 kilometres north-west of Canberra.

4.1 Goals

The Actions identified for each priority reach aim to meet the following goals for the Molonglo River:

- Create a functioning riparian community supporting a wide variety of natural processes, providing important habitat and links through the landscape;
- Create a stable channel morphology, with vegetated banks, preserving the natural landforms and fenced off to stock;
- Inbuilt community resilience to changes in fluctuating climatic conditions and hydrological events (e.g. flood and drought conditions);
- Continuous community input through activities such as Landcare, Parkcare, Waterwatch, Frogwatch and Platypus Count groups;
- An improvement in recreational opportunities and amenity along the river;
- Develop useful partnerships between community, business and government to the benefit of the Molonglo River;
- A reduction in invasive species coupled with an increase in native vegetation extent and condition;
- An improvement in the sustainability of key native fauna populations;
- An increase in the recovery of threatened species, populations and communities;
- An improvement in the condition of important wetlands, and groundwater dependant ecosystems;
- Long-term reduction in the nutrient levels and incidence of Cyanobacterial blooms particularly in Lake Burley Griffin; and
- Conservation of sites of cultural significance.

4.2 Prioritisation of Reaches

Six reaches have been targeted as a priority for rehabilitation works:

- Reach 1: Headwaters south of Captains Flat
- Reach 2: Hoskinstown Road to Briars Sharrow Road
- Reach 3: Briars Sharrow Road to Burbong Bridge
- Reach 4: Burbong Bridge to the Molonglo Gorge
- Reach 6: Molonglo Gorge to Lake Burley Griffin
- Reach 8: The lower Molonglo from Scrivener Dam to the Lower Molonglo Nature Reserve

Targeted actions for each priority reach are detailed in Section 4.3 below. As the Molonglo Gorge and Lake Burley Griffin precinct have their own managing authorities these have been excluded as priority reaches. Similarly, the Lower Molonglo River Corridor Nature Reserve also has an existing management plan which details rehabilitation activities for the reserve and is therefore also excluded.

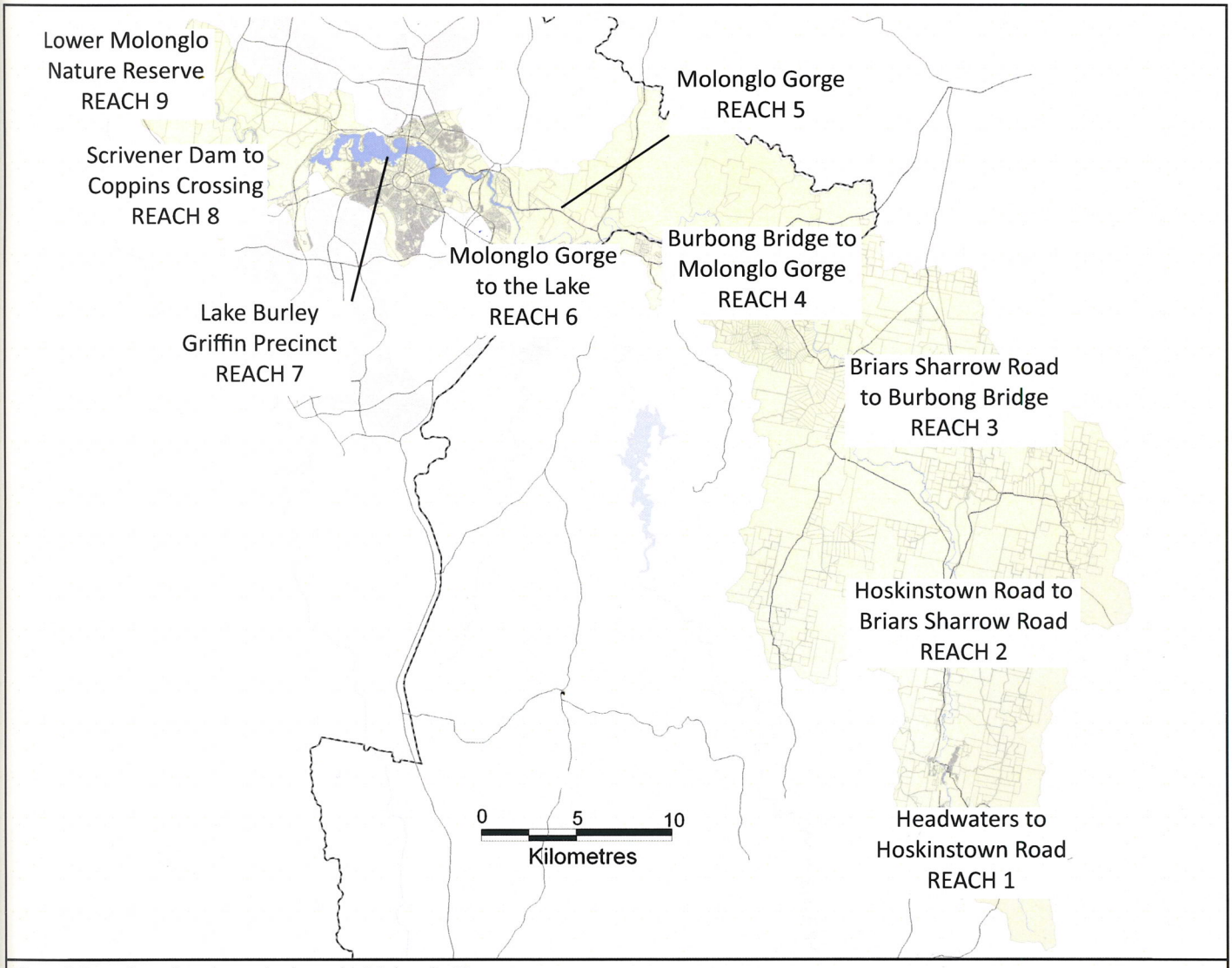

Figure 2. Location of each reach along the Molonglo River

4.3 Reach 1: Headwaters to Hoskinstown Road

4.3.1 Summary Description of Reach 1

Figure 3. The Molonglo River upstream of Captains Flat. Note the absence of native riparian vegetation and patches of Willow.

The river originates in the undulating foothills of Tallaganda National Park of the still forested Jerangle/Captains Flat area. Landform comprises undulating and rolling terrain, mountains and hills (Gunn *et al.* 1969). This area is ideal for cool temperate farming, and the original tussock grassland with grassy woodland fringes has been largely replaced with improved pasture and windbreaks of northern hemisphere trees. Following post-European disturbance, much of the river is now composed of a straightened, incised reach with a large channel capacity relative to its mean annual discharge. There is a significant loss of native riparian vegetation along much of the river, with Willow dominating in many areas. These upstream populations of Willow provide a considerable source of inoculate for downstream reaches. Montpelier Broom (*Genista monspessulana*) is also a significant problem within this reach. Native vegetation in this reach includes Swamp Gum Grassy Woodland on the river north of Captains Flat (Barrer 1997), patches of Yellow Box-Blakely's Red Gum Grassy Woodland (EEC), and Snow Gum-Candlebark Tableland Riparian Woodland (Barrer 1997). Ungrazed areas of woodland demonstrate high plant diversity and are worthy of conservation (Barrer 1997).

Summary	Assets	Threats
• Headwaters begin in Tallaganda National Park • Township of Captains Flat • Captains Flat Mine • Predominately rural landholdings	• Remnants in good condition around Captains Flat • Links with Cooma-Monaro and Palerang Council • Areas of Endangered Ecological Community (EEC) and threatened species	• Loss of riparian vegetation and adjacent areas via historic clearing • Damage to bank and riparian zone due to unimpeded stock access and overgrazing • Woody weed invasion • Mine leachate contamination

4.3.2 Targeted Actions for Reach 1

4.3.2 Targeted Actions for Reach 1

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
RIPARIAN REHABILITATION					
Protection of existing native vegetation	H	• Use baseline surveys (see section 4.12) to identify areas of existing native vegetation • Engage landholders • Secure funding for fencing, weed control, supplementary planting if appropriate, and conduct works on targeted sites • Educate landholders re protection of native vegetation and existing incentive schemes for fencing etc	Areas identified during baseline surveys protected via fencing and stock management and / or conservation agreements	Local Council Murrumbidgee CMA GA MCG Land & Property Management Authority (LPMA)	2015
Targeted removal of Willow in areas of native riparian vegetation around Captains Flat	H	• Identify appropriate sites (Barrer 1997; UMCCC Willow Strategy ; baseline surveys see section 4.12) • Identify extent of sawfly invasion and potential future effects on Willow densities • Secure funding • Engage landholders and other relevant stakeholders • Undertake works	Willow eradicated from areas of native riparian vegetation in this reach	Local Council Murrumbidgee CMA GA MCG LPMA	2010-2015
Program of weed removal from headwaters to Captains Flat	H	• Develop partnership with Palerang & Cooma-Monaro Councils, LPMA and local Landcare groups • Secure funding • Engage landholders and other relevant stakeholders • Undertake habitat assessment & staged weed removal to minimise habitat loss • Undertake works • Continue to promote funding and education opportunities for landholders for fencing and stock exclusion via advertising and direct contact (mail, phone etc)	Weeds removed and/or managed from headwaters to Captains Flat	Local Council Captains Flat Landcare Landholders LPMA MCG	2010 - ongoing
On-going fencing of riparian zone to exclude stock & provision of off-stream watering sites	H	• Secure funding • Engage landholders and other relevant stakeholders • Undertake works	Riparian zone fenced & off stream watering sites provided as required	Local Council Murrumbidgee CMA GA MCG LPMA	2010 - ongoing

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
Staged ongoing removal of Willow, Montpelier Broom, Blackberry and other woody weeds throughout the reach, north from Captains Flat including follow up and revegetation	M	• Develop partnership with Palerang Council and local Landcare groups • Secure funding • Engage landholders and other relevant stakeholders • Undertake habitat assessment & staged weed removal to minimise habitat loss • Undertake works • Continue to promote funding and education opportunities for landholders for fencing and stock exclusion via advertising and direct contact (mail, phone etc)	Woody weeds managed throughout the reach, north from Captains Flat	Local Council Murrumbidgee CMA GA MCG Captains Flat Landcare LPMA	2010 - ongoing
Targeted revegetation of cleared banks	H	• Use baseline surveys (see section 4.12) to identify areas of existing native vegetation • Secure funding • Engage landholders and other relevant stakeholders • Undertake revegetation works of identified cleared banks using appropriate species	Cleared banks revegetated including follow-up and maintenance programs using appropriate species	Local Council Murrumbidgee CMA GA MCG Captains Flat Landcare LPMA	2015
THREATENED SPECIES MANAGEMENT					
Green and Golden Bell Frog (GGBF) Habitat	H	• Report known sites of GGBF to NSW NPWS threatened species unit • Protect known sites of GGBF (in partnership with local Council and NSW NPWS) • Undertake survey of potential habitat within the reach to identify additional sites of GGBF • Protect additional sites • Establish Frogwatch sites at known GGBF sites to ensure on-going monitoring	• GGBF sites identified and protected • Frogwatch established at known sites and ongoing monitoring undertaken	ACT Waterwatch / Frogwatch NSW NPWS Local Council Livestock Health & Pest Authority	2010 - ongoing

Goal | Priority | Action | Key Outputs / Measure of | Potential Project | Completed

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
CONSERVATION LANDS					
Protect lands of conservation value **e.g. Travelling Stock Reserves or habitat for threatened species**	M	• Identify areas of conservation value (see baseline surveys s4.12) • Liaise with local Council, K2C, NSW NPWS, LPMA, local indigenous groups and other relevant stakeholders to protect lands	Areas of high conservation identified and protected	NSW NPWS K2C Local Council Livestock Health & Pest Authority Indigenous Groups LPMA	2015
ENGAGEMENT					
Landholder engagement	M	Landholder engagement via: • Market Days • Workshops / field days • Landcare • Promotion & uptake of incentive schemes • Specific projects from baseline surveys, mail outs etc	• Number of courses run • Number of new recruits to Landcare, etc • Number of market stalls • Responses to incentive schemes	GA MCG Local Council Captains Flat Landcare Murrumbidgee CMA	2010 - ongoing
Education	M	• Ongoing distribution of relevant educational material • Production of new relevant educational aids	Educational material / aids produced and distributed	MCG GA Local Council	2010 - ongoing
FISH & INSTREAM HABITATS					
Re-establishment of chain of ponds / swampy meadows Riverstyles where feasible	L	• Use baseline survey (see section 4.12) to identify appropriate sites • Identify ongoing processes which may impact on any remediation works i.e. stock control, fencing etc and undertake appropriate management agreements/ property plans with relevant landholders • Engage relevant landholders • Secure funding • Undertake cross sectional and longitudinal surveys to determine slope, stream power and mean discharges. • Design appropriate structures to return chain of ponds / swampy meadows where the style has been recognised to exist prior to degradation • Undertake rehabilitation works • Ensure fish passage maintained (i.e. sites identified should be naturally constrained)	Chain of ponds / swampy meadows re-established at identified sites	Murrumbidgee CMA MCG Landcare Industry & Investment (I&I) NSW LPMA	2013 -2020

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
Removal of fish barriers and / or re-instatement of fish habitat	M	• Use baseline survey (see section 4.12) to identify appropriate sites • Engage relevant landholders • Secure funding • Undertake works	Fish habitat (pools, riffles etc) re-established at appropriate sites Fish barriers removed	Murrumbidgee CMA MCG Landcare I&I NSW LPMA	2013
Establishment or rehabilitation of wetland habitat	M	• Use baseline survey (see section 4.12) to identify appropriate sites • Engage relevant landholders • Secure funding • Undertake rehabilitation works	Wetlands rehabilitated or where appropriate re-instated	Murrumbidgee CMA MCG Landcare GA LPMA	2013
WATER QUALITY AND FLOW					
Improvement in 'mine leachate problem'	M	• Liaise with Industry & Investment NSW (I&I NSW) • and University of Canberra • Investigate rehabilitation methods e.g. tree planting, wetland to capture or slow leachate etc • Consider using local community groups such as Captains Flat Landcare in rehabilitation works	• Leachate from dam better managed • Aquatic life returns to Molonglo below Captains Flat Mine	Local Council I&I NSW Captains Flat Landcare	2015
Captains Flat Dam & Captains Flat STP	M	• Engage Palerang Council re: management of flows from Captains Flat Dam and investigate water saving opportunities to increase environmental flows from Dam • Engage Palerang Council re impact of water from STP • Explore impact and management of cold water releases	• Water saving opportunities identified • Discharge from Captains Flat STP investigated and methods for improvement identified if necessary • Environmental flows from Captains Flat Dam increased • Cold water releases managed	Local Council MCG DECCW MDBA	2010

4.4 Reach 2: Hoskinstown Rd to Briars Sharrow Road

4.4 Reach 2: Hoskinstown Rd to Briars Sharrow Road

4.4.1 Summary Description of Reach 2

Figure 4. The Molonglo River downstream of Captains Flat, degraded due to unimpeded stock access, overgrazing, erosion, and loss of riparian vegetation.

The Carwoola Plain (or Hoskinstown Plain) is bordered to the east by the low ridges of the Turallo Range, Forbes Creek Ridge and Thurralilly Hill before the steep rise up to the top of the Great Dividing Range. The Plain is a natural frost hollow and large areas naturally contain few or no trees. The dominant vegetation communities in this reach are Montane Tussock Grassland or improved pastures. Other communities include Yellow Box-Blakely's Red Gum Grassy Woodland, and Snow Gum-Candlebark Grassy Woodland and occasional patches of Tableland Riparian Shrubland. The river here is likely to have originally been a chain of ponds / swampy meadows style.

Land use in this reach is predominately broad acre sheep and cattle grazing (Barrer 1997). Some properties experience over grazing and erosion issues (see Figure 4). The River is largely unfenced in this section. Grazing may actually act to reduce the spread of riparian weeds within this reach (Lynton Bond *pers comm*. 1 Dec 2009) although it is likely to reduce the spread of native vegetation as well.

The threatened Green and Golden Bell Frog has been identified in this reach.

Summary	Assets	Threats
• Flat predominately treeless plain • Rural landholdings • Small number of land holders abutting the river	• Natural Frost Hollow - ecologically distinct • Low number of land holders and consistent land use • Green & Golden Bell Frog	• Damage to bank and riparian zone due to unimpeded stock access and overgrazing • Potential woody weed invasion

4.4.2 Targeted Actions for Reach 2

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
RIVER RESTORATION					
Protection of existing native vegetation	H	• Engage land holders • Educate landholders re: riparian and bank protection and sustainable land management practises • Fence out important patches of native vegetation	Areas identified during baseline surveys protected via fencing and stock management and / or conservation agreements	MCG Murrumbidgee CMA GA LPMA	2010-2015
FISH & INSTREAM HABITATS					
Wetlands / establishment of native aquatic macrophytes, reed beds	M	Engage land holders re: protection of wetland areas, re-creation of wetland habitat, exclusion of stock	Areas identified during baseline surveys protected via fencing and stock management and / or conservation agreements	MCG Murrumbidgee CMA GA LPMA	2010-2015
THREATENED SPECIES MANAGEMENT					
Green and Golden Bell Frog (GGBF) Habitat	H	• Report known sites of GGBF to NSW NPWS threatened species unit • Protect known sites of GGBF (in partnership with local Council, NSW NPWS and other relevant stakeholders) • Undertake survey of potential habitat within the reach to identify additional sites of GGBF • Protect additional sites • Establish Frogwatch sites at known GGBF sites to ensure on-going monitoring	GGBF sites identified and protected Frogwatch established at known sites and ongoing monitoring undertaken	ACT Waterwatch / Frogwatch NSW NPWS Palerang Council LPMA Livestock Health & Pest Authority	2010 - ongoing
RESEARCH					
Impact of fencing off the riparian zone in a natural frost hollow - does this develop into a woody weed problem?		• Engage a research organisation and willing landholder to undertake study • Use data to inform future management strategies	Research undertaken and management strategies developed	MCG GA Universities	2013

4.5 Reach 3: Briars Sharrow Road to Burbong Bridge

4.5 Reach 3: Briars Sharrow Road to Burbong Bridge

4.5.1 Summary Description of Reach 3

Figure 5. Between Briars Sharrow Rd and Burbong Bridge. View clearly shows smaller peri-urban lots and changing land uses. Molonglo River is visible as the row of trees at the base of the hill

This section of the river contains a mixture of land uses. The left bank facing downstream is dominated by rural residential properties with river frontage. The right bank is characterised by broad acre farming. Vegetation communities include grassy woodlands such as Yellow Box-Blakely's Red Gum Grassy Woodland, and Snow Gum-Candlebark Tableland Riparian Woodland, as well as Tableland Shrubland and Willow-Elm Tableland Riparian Disclimax, with Apple Box (*E. bridgesiana*) and Broad-leaved Peppermint (*E. dives*) also occurring. This area is hilly, with a short (200m) but deep (up to 50m) gorge occurring on the river where it cuts through Balcombe Hill just downstream from Briars Sharrow Road.

The riparian zone has been significantly disturbed in this reach, and the surrounding landscape cleared for agriculture or rural residential development. Small land holdings and intensive land uses have resulted in a rising water table, and high nutrient and organic levels in the water (Carosene, 2003).

Summary	Assets	Threats
• Hilly country with small gorge on the river • Mix of rural residential and broad acre farming • Growth in smaller landholdings, increasing population, high property ownership turnover	• Patches of Snow Gum Woodland and Yellow Box - Red Gum Grassy Woodland EEC	• Loss of riparian vegetation and adjacent areas via historic clearing • Loss of instream and bed complexity • Damage to bank and riparian zone due to unimpeded stock access and overgrazing • Woody weed invasion • Possible uncontrolled surface and groundwater extraction • Variety of land uses / inconsistent NRM practices

4.6 Reach 4: Burbong Bridge to Molonglo Gorge

4.6.1 Summary Description of Reach 4

Figure 6. Molonglo River below Burbong Bridge. Note mix of rural lands and forestry plantations. Dead willows in the riparian zone controlled by PCL.

This reach is approximately 12.5 kilometres in length and encompasses the Molonglo River from Burbong Bridge (at the ACT border) to Molonglo Gorge. It also includes the Queanbeyan River from the ACT border to its confluence with the Molonglo River.

The riparian zone exhibits a wide range of conditions, from serious states of degradation with weed infestation, unrestricted stock access and associated erosion and sedimentation, to properties managed with a focus on sustainability, conservation and rehabilitation. Native riparian vegetation, where it exists, consists predominantly of Tableland Shrubland with isolated patches of Snow Gum Tableland Riparian woodland. Willow and Poplar (*Populus* spp) occur frequently in degraded sections of this reach.

This reach is mostly rural lands and pine plantations. Forestry activities have resulted in erosion from tracks, road networks and traffic (Carosene, 2003).

Summary	Assets	Threats
• Mix of rural lands and forestry activities	• Deep pools present - potential fish habitat • Patches of Snow Gum Woodland	• Loss of riparian vegetation and adjacent areas via historic clearing • Damage to bank and riparian zone due to unimpeded stock access and overgrazing • Woody weed invasion

4.6.2 Targeted Actions for Reach 2 and 4 (combined)

4.6.2 Targeted Actions for Reach 3 and 4 (combined)

Goal	Priority	Action	Measure of Success	Potential Project Partner	Completed by ...
RIPARIAN REHABILITATION					
Protection of existing native vegetation	H	• Use baseline surveys (see section 4.12) to identify areas of existing native vegetation • Engage landholders • Secure funding for fencing, weed control, supplementary planting if appropriate, and conduct works on targeted sites • Educate landholders re protection of native vegetation and existing incentive schemes for fencing etc	Areas identified during baseline surveys protected via fencing and stock management and / or conservation agreements	Murrumbidgee CMA Palerang Council GA MCG ACT PCL LPMA	2010-2015
The Molonglo River within rural lands fenced to exclude grazing stock as applicable and provision of off-stream watering as required	M	• Use baseline surveys (see section 4.12) to identify targeted areas for rehabilitation • Source funding • Engage landholders identified as having priority sites • Continue to promote funding and education opportunities for other landholders for fencing and stock exclusion via advertising and direct contact (mail, phone etc) • On-going land holder education via Landcare, CMA initiatives	Riparian zone fenced & off stream watering sites provided as required	Murrumbidgee CMA Palerang Council GA MCG ACT PCL LPMA	2010 - ongoing
Revegetation of cleared banks	H	• Identify & engage land holders • Planting on banks that have been denuded, using species appropriate for the community and locality	Cleared banks revegetated including follow-up and maintenance programs	Murrumbidgee CMA Palerang Council GA MCG	2015
Staged ongoing removal of Willow and other woody weeds throughout the reach including following up and revegetation	M	• Identify properties for Willow removal • Undertake habitat assessment & stage weed removal to minimise habitat loss • Secure funding • Undertake works	Woody weeds managed throughout the reach	Murrumbidgee CMA ACT PCL GA Palerang Council LPMA	2010 - ongoing

Goal	Priority	Action	Measure of Success	Potential Project Partner	Completed by ...
Re-instatement of instream and emergent vegetation	M	• Identify areas appropriate for rehabilitation / reinstatement of instream & emergent vegetation and / or wetland habitat • Install instream and emergent vegetation via tube stock, transplanting or seed	Instream and emergent vegetation re-established in appropriate areas	Murrumbidgee CMA ACT PCL GA MCG LPMA	2010 - ongoing
ENGAGEMENT					
Peri-urban landholder engagement	H	• Targeted education program for peri-urban landholders particularly in regards to escapee plants, water extraction and chemical use • Broaden networks to ensure access to peri-urban landholders including consultation with local environmental groups, NRM groups and community groups as relevant • Explore new angles to engage these landholders e.g. platypus, fish • Engage horse groups and use to disseminate information • Continue engagement of land holders in incentive schemes	• Number of landholders engaged • Increase in participation in community groups • Number of courses run • Number of educational materials produced & distributed • Number properties targeted and conservation agreements established	MCG Murrumbidgee CMA GA Landcare Palerang Council	2010 - ongoing
Engagement of other landholders and broader community	L	• On-going land holder education via Landcare, CMA initiatives • Education of landholders re: voluntary conservation agreements, Biobanking opportunities, carbon sink opportunities. • Increase participation in community groups e.g. Landcare • Workshops • Distribution of educational aids	• Increased participation in community initiatives, conservation outcomes. • Number workshops created and attended • Educational aids designed and distributed	Landcare Palerang Council ACT PCL NSW DECCW MCG GA Murrumbidgee CMA K2C	2010 - ongoing

Potential Project Completed

Goal	Priority	Action	Measure of Success	Potential Project Partner	Completed by ...
FISH & INSTREAM HABITATS					
Fish & instream habitat protection and rehabilitation	M	• Establishment of Platypus Count in this reach • Identification of relevant fish habitat during baseline surveys e.g. deep pools targeted for rehabilitation • Identification & removal of barriers to fish movement where possible	• Platypus Count sites established • Areas of potential fish habitat rehabilitated & barriers removed	I & I NSW LPMA	2015
Carp Management	M	• Identify Carp hotspots (extension of UMDR Carp Management Plan) • Source funding • Undertake management as appropriate (e.g. installation of carp traps, electrofishing etc)	Carp numbers reduced	I&I NSW LPMA	2015
SIGNIFICANT VEGETATION					
Snow Gum Woodland	H	• Areas of Snow Gum Woodland identified during baseline surveys (see section 4.12) targeted for protection and rehabilitation (e.g. fencing, stock management) • Land holder education	Areas of Snow Gum Woodland protected or conserved	MCG GA Local Council Murrumbidgee CMA NSW DECCW	2010 - ongoing
Forestry Activities	M	Liaise with Forestry re: management of forestry activities on Molonglo River e.g. paths, weeds, erosion issues, buffers etc	Forestry activities have minimal or no impact on river or tributaries	MCG ACT & NSW Forestry	2010

4.7 Reach 5: Molonglo Gorge

4.7.1 Summary Description of Reach 5

Figure 7. Molonglo Gorge

Molonglo Gorge occurs downstream of Burbong, flanked by Kowen Forest, which following the 2003 bush fires, is now the principal forestry plantation in the ACT. The gorge is characterised by steep slopes, which are occasionally susceptible to erosion. Rock outcrops in the Molonglo Gorge form the structure of the channel, defining the pools, boulders and rapids. The riparian zone of the upper gorge area is comprised of a complex bedrock floodplain flanked by steep channel walls. The riparian zone vegetation community is comprised of Tableland Shrubland with Aquatic Fringing Vegetation Complex, tending to Black Cypress Pine *(Callitris endlicherii)* Tableland Woodland further downstream (Johnston *et al.* 2008; TAMS 2009). The hill slope vegetation includes patches of Black Cypress Pine Tableland Woodland and Red Stringybark–Scribbly Gum *(Eucalyptus macrorhyncha-E. rossii)* Tableland Forest both leading into Yellow Box – Blakely's Red Gum (*E. melliodora-E. blakelyi)* Grassy Woodland in less steep areas (Johnston *et al.* 2008; TAMS 2009). This reach includes the most easterly known occurrences of Buloke (*Allocasuarina luehmannii).* Within the Gorge, riparian vegetation is generally in good condition.

This area is managed by ACT PCL, and as the gorge is in relatively good condition it is not considered a priority reach in this report. Key activities for this reach include continued engagement with ACT PCL, continue existing follow-up weed control in the riparian corridor, and liaison with the neighbouring pine plantation manager to control weeds of national significance (WONS) and other weeds in areas adjacent to the riparian corridor.

Summary	Assets	Threats
• Existing protected area managed by PCL (Molonglo Gorge Recreation Area) • Areas of good quality remnant vegetation though woody weed issues	• Good areas of native vegetation • Fish habitat present	• Woody weed invasion • Adjacent land uses

4.8 Reach 6: Molonglo Gorge to Lake Burley Griffin

4.8 Reach 6: Molonglo Gorge to Lake Burley Griffin

4.8.1 Summary Description of Reach 6

Figure 8. The Molonglo River as it passes by Fyshwick.
Note the extremely heavy infestation of Willow and Blackberry

This reach extends from where the River leaves the bedrock confined Molonglo Gorge and enters into the gently undulating to flat land of Queanbeyan and Fyshwick, and includes the confluence with the larger Queanbeyan River. This reach is significantly modified and includes the largest density of urban dwellings, and various agricultural and industrial uses, including the Queanbeyan Sewerage Treatment Plant (STP). Much of the river through this section is degraded, fringed by Willow-Elm Tableland Riparian Disclimax (see Appendix B). There are several tributaries which are located within cleared agricultural land flanking the Molonglo River in this reach which have been largely denuded of vegetation and are severely eroded. There is a general lack of riparian vegetation connectivity in this reach (ACT Government 2007). Despite this the river corridor includes threatened flora and ecological communities (see Appendix B).

Light industrial and residential development in Fyshwick and Oaks Estate is earmarked for further expansion. This reach also contains major infrastructure in the form of Canberra International Airport, and extractive industries including Canberra Sand & Gravel. The River here is high profile, being directly under the flight path of the Airport, and also the upstream limit of waterskiing within Molonglo Reach. This reach represents the final section of river prior to Lake Burley Griffin, and as such, impacts on water quality in the Lake. Open space facilities for Fyshwick workers are limited in comparison with other major Canberra employment centres and there are no open space facilities at all in the eastern half of Fyshwick (LDA 2007). Development in this reach is constrained by the 1 in 100 year flood line and by River Frontage Zoning, providing an opportunity for rehabilitation and the creation of "green space".

Summary	Assets	Threats
• Mix of industrial, rural and urban areas • Proposed increase in industrial & urban development	• Variety of community and business groups to engage • High profile and accessible • Areas of threatened species • Jerrabomberra Wetlands • Opportunities to utilise river corridor as green space for Fyshwick • Area of National Land adjacent to river	• Expanding industrial & urban development • Queanbeyan STP • Highly degraded riparian zone • Extensive areas of woody weeds • Land zoning, use and lease issues

4.8.2 Targeted Actions for Reach 6

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
RIPARIAN REHABILITATION					
Protection and enhancement of existing native vegetation	H	• Identify areas for protection (baseline surveys see section 4.12) • Engage landholders • Secure funding for fencing, weed control, supplementary planting if appropriate, and conduct works on targeted sites	Remnant native vegetation in this reach protected and managed	ACT PCL GA MCG	2010
Appropriately staged (long-term) removal of Willows, Blackberry and other large woody weeds, including follow-up and in association with staged revegetation	H	• Engage ACT Planning & Land Authority / LDA and other relevant stakeholders • Secure funding - opportunities via local business, recreation groups, government grants schemes • Undertake habitat assessment & stage weed removal to minimise habitat loss • Provide feedback on strategic planning to LDA, local Government, developers • Work in conjunction with the Queanbeyan Council River Management Plan	Large woody weeds removed and replaced with appropriate native revegetation	ACT PCL GA MCG	2010-2020
Connectivity between riparian zone and areas of adjacent remnant woodland or grassland	H	• Engage with ACT PLA / LDA and other relevant stakeholders • Engage developers at planning stage to negotiate protection of riparian zone and other areas of native vegetation	Areas of connectivity between riparian vegetation and adjacent remnants identified and protected	ACT PCL LDA Developers	2010-2015
Fencing out of stock on rural lands & installation of off-stream watering sites if required	H	• Source funding • Engage landholders • Install fencing and off-stream watering sources	Riparian zone protected from stock via fencing	ACT PCL MCG	2010-2015
Staged weed removal and revegetation undertaken on Queanbeyan River tributary in ACT	M	• Source funding • Engage landholders • Undertake works	Weeds replaced with native along Queanbeyan River in ACT	Queanbeyan City Council ACT PCL	2010 - ongoing

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
ENGAGEMENT					
Engagement of land holders	H	Landholder engagement via: • Displays at community events • Mail-outs • Workshops • Landcare / Parkcare	• Number of courses run • Number of market stalls etc • Number of recruits to community groups	Local Council ACT PCL MCG GA	2010 onwards
Engagement of the Land Development Authority (LDA)	H	Liaise with LDA to establish MRR Action Plan as baseline for river corridor management in this reach	Development in this reach conducted in line with MRR Action Plan	MCG LDA	2010 onwards
Engagement of developers	H	• Approach ACT government to identify relevant developers along the Molonglo River • Continue relationship with CIC Australia and foster relationships with other developers • Ensure accessible 'point-of-contact' for developers (e.g. MRR Program Facilitator) • Where developers are obliged to create Vegetation Management Plans (VMPs) for native habitats in development zones, promote community consultation / liaison with groups such as MCG & GA • Encourage "sustainability in developments" - can lead to extra opportunities with developers	• Developers contacted as relevant • Action Plan forwarded to developers • On-going partnerships formed • Interaction between developers and community groups	ACT Government LDA CIC Australia MCG GA	2010
Community engagement	H	• Consultation with local environmental groups , NRM groups and community groups • Engagement of local business and staff in rehabilitation works • Engagement of recreational users of River and Lake • Waterwatch and Frogwatch sites established • Molonglo River Festival	• Community groups consulted and engaged • Local business and staff engaged in on-ground works • Recreational users engaged • Community monitoring sites established • Molonglo River Festival established (see section 4.11)	MCG GA ACT Waterwatch	2010 - ongoing

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
Indigenous Awareness	M	• Identify local indigenous stories about the river • Murals / use of indigenous art in interpretative signage, promotional material	Indigenous stories and values promoted via signage / material	ACT NRM Council Indigenous Groups	2010-2015
RECREATION					
Provision of passive recreational facilities e.g. • **Walking / cycling from Queanbeyan to LBG** • **Management of the area above Lake Burley Griffin for waterskiing as well as environmental outcomes** • **Non-powered boats to travel from Queanbeyan to Lake Burley Griffin**	M	• Liaise with PCL re: use of river corridor for recreational activities • Foster on-going relationships with ACT government, developers, LDA and the recreational groups (see Chapter 5) • Secure funding through partnerships to undertake restoration works, create access points and install paths etc	• Ability to walk or cycle, from Queanbeyan to Lake Burley Griffin via Molonglo River • Water-ski area managed to protect ecological values	ACT NRM Council ACT PCL Community Groups National Capital Authority (NCA) LDA	2015
Interpretative walkway including interpretative signage along proposed walk/cycle ways, from Fyshwick, through Jerrabomberra Wetlands to Lake Burley Griffin	L	• Design interpretive walkway (themes, story etc) • Determine signage and other requirements • Secure funding • Establish walkway and signage	Interpretative walkway with signage established promoting Molonglo River	ACT PCL MCG RiverSmart	2015
Green Space in Fyshwick	L	Inform strategic planning authorities re: value of Molonglo River corridor as valuable green space in Fyshwick for local residents and business as well as ecological values of protection and enhancement of this zone	Green space requirements of Fyshwick met via protection and enhancement of Molonglo River Corridor	LDA ACT Government MCG ACT PCL	2015

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
URBAN WATERWAY PROTECTION					
Installation of gross pollutant traps (GPT)	H	Survey undertaken of stormwater entry points to Molonglo River in this reach and assessment of GPTs requirements	• GPTs installed as appropriate • Responsibility for cleaning and maintenance delegated	Queanbeyan City Council DECCEW ACT Government	2010
Promotion of appropriate water management techniques to protect the river from pollution and other run-off issues e.g. water sensitive urban design	H	Management of stormwater basins for waterway protection and biodiversity e.g. wetlands to slow & filter stormwater and to also provide habitat for birds and frogs	• Stormwater impacts mitigated in urban areas • Wetlands managed for biodiversity and habitat • Weeds controlled	MCG LDA ACT Government	2010 - ongoing
Management of nutrient and sediment input	H	• Identify areas of high nutrient and sediment input (e.g. via Waterwatch data). • Engage landholders • Examine opportunities to reduce sediment and nutrient input	Sources of sediment and nutrients identified and measures implemented to reduce impacts	ACT Government LDA MCG ACT Waterwatch	2010 - ongoing
Tree removal from developments	H	• Utilise removed trees for instream woody debris or terrestrial riparian habitat • Develop an information aid for developers	• Number of trees from impending developments shifted to river corridor • Information aid for developers created and distributed	Developers LDA ACT PCL	2010 - ongoing

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
INSTREAM HABITATS					
Long-term management of toxic / planktonic Cyanobacteria (blue green algae) in Lake Burley Griffin	H	• Engage NCA • Determine point source pollution and instigate management • Management of chronic impacts e.g. run-off from high nutrient activities e.g. golf courses • Protect and improve riparian vegetation • Investigate use of wetlands to manage run-off and storm water at new sites. Consider retrofitting at existing sites.	Long term trends demonstrate a decrease in Cyanobacterial outbreaks in Lake Burley Griffin	MCG ACT Waterwatch NCA	2010 - ongoing
Installation of instream woody debris	M	• Place trees and branches in water along this reach (salvaged from developments etc) to provide habitat for fish, macroinvertebrates and birds	Establishment of instream woody debris at appropriate sites	PCL	2010 -ongoing
Platypus Habitat	M	• Identify areas of potential Platypus habitat for rehabilitation • Secure funding for specific habitat re-creation and enhancement • Monitor for migration of Platypus into habitat zones • Engage an individual / organisation to undertake a Platypus Count site on this reach with a focus of on or near the Lake	• Areas of potential Platypus habitat created • Return of Platypus to areas where it is currently not present • Platypus Count sites established	MCG ACT Waterwatch NCA Australian Platypus Conservancy (APC)	2015
Carp Management	M	• Identify Carp hotspots (extension of UMDR Carp Management Plan) • Source funding • Undertake management as appropriate (e.g. installation of carp traps, electrofishing etc)	Carp numbers reduced	ACT PCL (Research & Planning) Canberra University	2015

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
JERRABOMBERRA WETLANDS					
Staged removal of woody weeds e.g. Willow and White poplar and follow-up revegetation with appropriate native trees and shrubs	H	• Engage PCL and Narrabundah Landcare in discussions re: riparian rehabilitation • Organise on-ground activities to systematically remove woody weeds and revegetate with natives • Undertake habitat assessment & stage weed removal to minimise habitat loss • Develop a follow-up program to ensure rehabilitated area are maintained	• Woody weeds removed and replaced with native trees and shrubs • Follow-up program developed and implemented	ACT PCL Landcare MCG	2010-ongoing
Fencing to exclude agisted stock from the riparian zone	H	• Funding sourced • Fencing erected • Off-stream watering provided if required	Stock excluded from riparian zone in Jerrabomberra Wetlands	ACT PCL	2011
Management of Carp and other pests	M	• Engage with UMDR (UMDR Carp Management Plan planned for finalisation in May 2010), Invasive Animals CRC and ACT PCL re: carp and other pest management in wetlands • Develop a management plan for carp within the wetlands and implement • Develop management strategies for other pest species within the wetlands (e.g. fox and rabbits)	• Management plan for carp developed and implemented • Management strategies for other pest species identified and undertaken	ACT PCL UMDR RiverSmart Landcare MCG Invasive animals CRC	2015
HERITAGE					
The Oaks	L	• Protection and enhancement of this feature in association with river restoration and community engagement • Engagement of local community in riparian restoration and other community monitoring programs such as Waterwatch, Frogwatch and Platypus Count	• The Oaks protected and enhanced • River restoration undertaken in this area • Community engaged in MRR and associated on-ground works	MCG Developers ACT PCL ACT Waterwatch GA	2015

4.9 Reach 7: Lake Burley Griffin Precinct

4.9.1 Summary Description of Reach 7

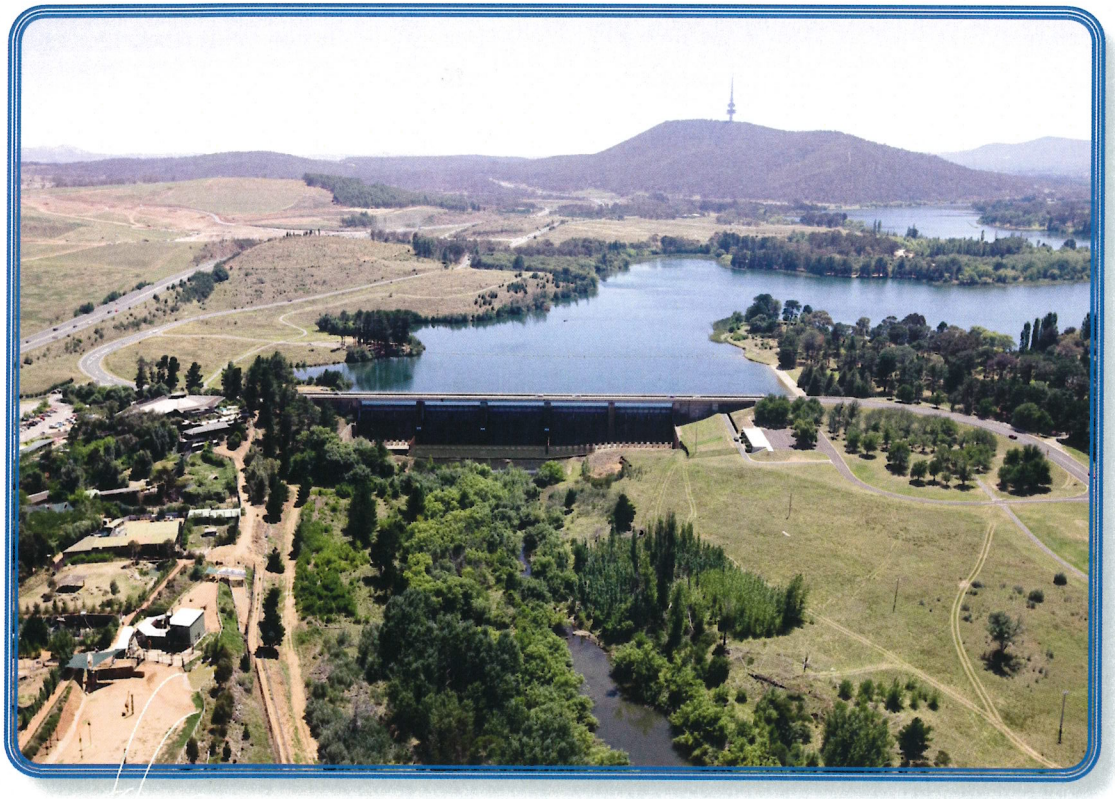

Figure 9. Lake Burley Griffin at Scrivener Dam

Lake Burley Griffin is the centrepiece of the city of Canberra. The lake was formed by the damming of the Molonglo River in 1963 and consists of the waters of the Molonglo River between Scrivener Dam and the Dairy Road Bridge. The Lake covers 664 hectares with 40.5 kilometres of shoreline. The lake serves as an important flood control structure in the upper catchment of the Murrumbidgee River, and the scheme has created valuable wetland habitats upstream of the lake (Jerrabomberra Wetlands). The lake is entirely managed as a public recreation area. Adjacent land uses include agriculture on private leaseholds, defence activities, business and recreation. Areas adjacent to the Lake also support threatened species and ecological communities including Yellow Box – Blakely's Red Gum Grassy Woodland, Natural Temperate Grasslands, Button Wrinklewort, Striped Legless Lizard, and *Perunga* Grasshopper. The threatened Murray Cod has been recorded in the lake (this species is stocked) however, the Lake also exhibits habitats that favour exotic fish at the expense of natives and may directly impact threatened fish species.

Lake Burley Griffin is managed by the NCA and therefore its management or rehabilitation is not within the scope of this report. However, engagement with the NCA is likely to be important for river-wide rehabilitation strategies to be effective, and particularly in regards to Cyanobacteria (blue-green algae), weeds and water quality within the Lake.

Summary	Assets	Threats
• Managed by NCA for amenity and recreation	• Engagement opportunities • Upstream management necessary for health of Lake	• Water quality and Cyanobacteria outbreaks • Competing uses

4.9.2 Targeted Actions for Reach 7

4.9.2 Targeted Actions for Reach 7

Goal	*Priority*	*Action*	*Key Outputs / Measure of Success*	*Potential Project Partner*	*Completed by ...*
ENGAGEMENT					
Engage NCA as project partners of Molonglo River Rescue	H	Engage NCA as project partners	NCA engaged as project partners	NCA MCG ACT NRM Council	2010
MANAGEMENT					
Use partnership with ACT PCL and engagement of NCA for development of 'actions' for Lake Burley Griffin Precinct as part of Molonglo River Rescue	M	• Engage ACT PCL, NCA and other relevant stakeholders • Undertake a workshop to develop an Actions Table for riparian rehabilitation and water quality improvement in the Lake Burley Griffin Precinct (consideration to existing Willow Management Plan for LBG)	Actions Table developed for the Lake Burley Griffin precinct in partnership with NCA, ACT PCL & MCG as part of Molonglo River Rescue	NCA ACT PCL MCG GA RiverSmart ACT NRM Council	2010
HERITAGE					
Ensure any rehabilitation works respect existing heritage values	M	Cross-reference Actions Table with existing items of heritage value Liaise with NCA and ACT Heritage Council prior to rehabilitation works being undertaken to ensure heritage values protected	Heritage items not adversely impacted by Molonglo River Rescue actions for Lake Burley Griffin Precinct	NCA ACT PCL MCG	2010 - ongoing

4.10 Reach 8: Scrivener Dam to the Lower Molonglo River Corridor Nature Reserve

4.10.1 Summary Description of Reach 8

Figure 10. Lower Molonglo below Scrivener Dam, dominated by exotic trees

This reach is approximately 10 kilometres long, extending from Scrivener Dam past Coppins Crossing Road to the Lower Molonglo River Corridor Nature Reserve. The volume of water in this reach is comprised of flows from Lake Burley Griffin, and the (heavily eroded) Yarralumla and Weston Creeks, together with catchment drainage in the general area.

The riparian vegetation within this reach is thought to have originally consisted of River Sheoak Tableland Riparian Woodland (Johnston et al. 2008; TAMS 2009) however, in many areas the riparian zone vegetation is comprised of almost entirely exotic species. The dominant riverbank species include Willow, Blackberry and Poplars, with Pine wildings *(Pinus radiata)* regenerating following the 2003 fires from previous forestry plantations on the valley slopes. Downstream from Misery Hill, native riparian vegetation returns (River Sheoak Tableland Riparian Woodland) and includes a marked decrease in Willow. Despite the high levels of degradation, this Reach provides important habitat for rare and threatened species, including the Pink-tailed Worm-lizard *(Aprasia parapulchella)*.

Surrounding land uses have included grazing country and pine forestry. The Lower Molonglo is currently the subject of several proposed new Canberra suburbs: Molonglo, North Weston, Wright and Coombs.

Summary	Assets	Threats
• Degraded riparian zone • Previous rural or forestry land • Impending suburban development • Scrivener Dam	• Pink-tailed Worm-lizard habitat • Some good remnant riparian vegetation • Some good instream habitat (pools, riffles) • Developments may result in improvement in riparian corridor via Parkcare or developer contributions	• Possible unsustainable development practises • Increase in human impacts

4.10.2 Targeted Actions for Reach 8

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
RIPARIAN REHABILITATION					
Appropriately staged removal of Willows, Blackberry and other large woody weeds, in association with staged revegetation	H	• Engage ACT PLA / LDA and other relevant stakeholders • Secure funding - opportunities via local business, recreation groups, government grants schemes • Undertake habitat assessment prior to works to minimise habitat loss • Provide feedback on strategic planning to LDA, local Government, developers	Large woody weeds removed and replaced with native revegetation	ACT PCL GA MCG LDA	2010-2020
Connectivity between riparian zone and areas of adjacent remnant woodland or grassland	H	• Engage with ACT PLA / LDA and other relevant stakeholders • Engage developers at planning stage to negotiate protection of riparian zone and other areas of native vegetation	Areas of connectivity between riparian vegetation and adjacent remnants identified and protected	ACT PCL Developers LDA	2010-2015
Contain spread of Tall African Lovegrass so that it stays downstream of Scrivener Dam	H	• Engage with ACT PLA / LDA and other relevant stakeholders • Secure funding • Undertake ongoing management	Tall African Lovegrass stays contained below Scrivener Dama and is reduced in cover on the lower Molonglo River	ACT PCL GA LDA	2019
THREATENED SPECIES PROTECTION AND MANAGEMENT					
Protection of threatened species habitat	H	Provide feedback to LDA and other relevant authorities re: threatened species survey and management in proposed development areas	Threatened species habitat protected	ACT PCL Developers LDA	2010 -ongoing

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
ENGAGEMENT					
Engagement of the Land Development Authority (LDA)	H	• Liaise with LDA to establish MRR Action Plan as baseline for river corridor management in this reach	Development in this reach conducted in line with MRR Action Plan	MCG LDA	2010 -ongoing
Engagement of developers	H	• Approach ACT government to identify relevant developers along the Molonglo River • Consider model of Bush on the Boundary Project developed for the new Forde suburb for proposed suburbs in Reach 8 • Continue relationship with CIC Australia and foster relationships with other developers • Ensure accessible 'point-of-contact' for developers (e.g. MRR Program Facilitator) • Where developers are obligated to create vegetation management plans for native habitats in development zones, promote community consultation / liaison with groups such as MCG & GA through 'point-of-contact' • Encourage "sustainability in developments" - can lead to above and beyond opportunities with developers	• Developers contacted as relevant • Action Plan forwarded to developers • On-going partnerships formed • Interaction between developers and community groups	ACT government LDA CIC Australia MCG GA	2010
Community engagement	H	• Consultation with local environmental groups, NRM groups and community groups • Establish Parkcare Groups in new suburbs • Establish Waterwatch, Frogwatch and Platypus Count sites is new suburbs	• Community groups consulted and engaged • Recreational users engaged • Community monitoring sites established	MCG GA ACT Waterwatch	2010 - ongoing

Goal	Priority	Action	Key Outputs / Measure of Success	Potential Project Partner	Completed by ...
RECREATION					
Ensure recreational facilities within new suburbs are ecologically friendly	M	• Foster on-going relationships with ACT government, developers, LDA and the recreational groups • Create partnerships to ensure eco-friendly access points, paths etc to Molonglo River in new developments • Create green space that encourages recreation away from the river • Create off leash areas for dog owners away from the river	Recreational facilities in new suburbs are ecologically friendly and do not adversely impact on the river or surrounds	ACT NRM Council ACT PCL Community Groups LDA	2015
URBAN WATERWAY PROTECTION					
Management of stormwater basins for nutrient and sediment trapping as well as for biodiversity	H	• Promotion of appropriate water management techniques to protect the River from pollution and other run-off issues e.g. water sensitive urban design • Management of stormwater basins for biodiversity e.g. wetlands to slow & filter stormwater and to also provide habitat for birds and frogs	• Stormwater impacts mitigated in urban areas • Wetlands managed for biodiversity and habitat • Weeds controlled	MCG LDA ACT Government	2010 - ongoing
Installation of gross pollutant traps (GPT)	H	GPT established as appropriate in new developments	• GPTs installed as appropriate • Responsibility for cleaning and maintenance delegated	ACT Government DECCEW LDA	2010
Tree removal from developments	H	• Utilise removed trees for instream woody debris or terrestrial riparian habitat • Develop an information aid for developers	• Number of trees from impending developments shifted to river corridor • Information aid for developers created and distributed	Developers LDA ACT PCL	2010 - ongoing

4.11 Reach 9: Lower Molonglo River Corridor Nature Reserve

4.11.1 Summary description of Reach 9

Figure 11. This reach retains some good native vegetation cover, however, there are woody weeds in the riparian zone, and along the gullies, and surrounding areas have been cleared and over-grazed

This reach extends from Coppins Crossing to the confluence of the Molonglo with the Murrumbidgee River. In this reach, the river is well incised below the surrounding topography and displays a variety of geomorphic forms. Sections of the Lower Molonglo Gorge contain a high diversity of native plant species and are of conservation value (ACT Government 2007). This reach also includes important breeding habitat for a range of raptors (Environment ACT 2001), as well as habitat for the threatened Pink-tailed Worm-lizard and the threatened plant Pale Pomaderris *(Pomaderris pallida)*. A management plan for the Lower Molonglo River Corridor was prepared in 2001 and details actions for the protection and conservation of this reach including:

- Identify and protect areas of conservation value;
- Remove grazing from areas of *Pomaderris pallida*;
- Protect *Aprasia parapulchella* habitat from disturbance;
- Restrict access to significant raptor breeding sites;
- Monitor water quality and populations of aquatic fauna;
- Research the health of the Lower Molonglo River;
- Research fauna populations and assemblages;
- Revegetate banks with local native species where applicable; and
- Ensure water pumps on rural lands are placed to protect natural values.

Summary	Assets	Threats
• Open country • Broad acre farming • Surrounding areas earmarked for future development	• Areas of good quality riparian vegetation, threatened species • River corridor zoned for nature conservation with existing management plan • Surrounding areas of quality grassland and woodland (EEC) • Lower Molonglo Gorge	• Loss of riparian vegetation and adjacent areas via historic clearing • Damage to bank and riparian zone due to unimpeded stock access and overgrazing • Woody weed invasion • Expanding urban development • Lower Molonglo Water Quality Control Centre

4.12 Targeted Actions for the Molonglo River as a whole

The following table identifies actions that affect the river as a whole and are not specific to any reach.

Goal	*Priority*	*Action*	*Key outputs / Measure of Success*	*Potential Partner*	*Completed by ...*
BASELINE SURVEYS					
Protection of assets **Targeted areas for protection and enhancement identified and mapped**	H	• Based on above data and areas previously identified as being of conservation value (e.g. PCL mapping and Barrer 1997) produce a map identifying areas for protection and enhancement	High quality areas identified and where feasible measures implemented to protect and/or enhance	ACT PCL NSW DECCW ACT NRM Council MCG K2C	2011
Vegetation Mapping • **Mapping of existing native vegetation**	M	Note: previous works undertaken by ACT PCL included aerial Rapid Appraisal of Riparian Condition (RARC) with vegetation mapping, condition and prioritisation of rehabilitation for the ACT section of the Molonglo River. Barrer (1997) undertook vegetation and condition mapping by for the Palerang region: • Discuss with ACT PCL if existing RARC work undertaken for Molonglo River in the ACT can be extended for the length of river in NSW • Consider extension of existing Lower Molonglo Community Mapping Project to Upper Molonglo	Vegetation & condition of Molonglo River mapped	ACT PCL MCG NSW DECCW	2012
Fish • **Mapping instream habitats and barriers to fish movement**	M	• Identify barriers to fish movement and investigate possible removal or improvement • Identify features of relevance for native fish including: • Pool & riffles • Snag loadings • Depth of refuge pools • Sedimentary slugs • Wetlands & ground-water dependent ecosystems • Indentify an appropriate reference reach for comparison • Develop a monitoring program to gauge the effectiveness of improved passage opportunities	• Fish habitat and barriers mapped • Snag loading (frequency of snags per km) identified • Recommendations formed as to management of priority barriers and improvement of habitat	I & I NSW NSW DECCW ACT PCL	2012

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Historic Data • **Historic species assemblages & communities** • **Historic condition**	L	• Identify historic species assemblages to inform habitat management and enhancement, and possible future re-introductions via desktop assessment and habitat mapping • Consolidate historic anecdotal information on the Molonglo River (e.g. "we used to be able to swim..." etc • Utilise historic information to motivate community through ideas such as " returning the river to how it was" • Considering interviewing long-term residents	• Report of historic species and assemblages focussing on threatened species • Detail on historic condition of the Molonglo to use in education aids, motivational material, Placestories etc.	I & I NSW NSW DECCW ACT DECCEW ACT PCL MCG GA	2010 +
Erosion & Sedimentation	L	Assessment of erosion and areas of instability in ACT & NSW including: • Detailed erosion maps • Explore the impact of erosion on Lake Burley Griffin (LBG) in conjunction with National Capital Authority • Explore tributary contributions to sedimentation in Molonglo River • Liaise with eWater CRC re: using eWater tool for erosion management on the Molonglo River (e.g. CHUTE)	• Areas of erosion and sedimentation identified • Impacts of erosion and sedimentation on LBG identified • Management measures identified, prioritised & implemented	Murrumbidgee CMA eWater Cooperative Research Centre (CRC) NCA MCG NSW DECCW	2015
Riverstyles Framework	L	• Undertake river style assessments to determine style on a reach by reach basis • Utilise State Geomorphologist to confirm assessment results • Identify an appropriate reference reach e.g. Queanbeyan River above Googong Dam • Use Riverstyles Framework to inform management strategies	Riverstyles Framework undertaken and fed into management strategies	I & I NSW	2010

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Identification of land ownership Including crown land, Council land, private land etc to prioritise works and manage engagement	L	• Create a map indicating land ownership along the length of river • Use above information to engage land managers / owners	Map created and used to prioritise works and target engagement actions	Local Councils LPMA ACT PCL	2011
Social Survey	M	Engage a social scientist to undertake a survey and produce report • Undertake social surveys of community values concerning river health and use • Identify recreational users of River and Lake • Consider a social reference reach to compare River usage and identify opportunities • Identify range of community 'hopes' for the River (e.g. 'I would like to see .... on the Molonglo') • Identify level of community participation in each priority reach • Identify areas to target for education (e.g. a reach with no Landcare; peri-urban areas) • Include a program to track changes in landholder attitudes over course of Project to demonstrate success of education programs	Survey & report	ACT NRM Council MCG Local Council	2011
SURFACE & GROUNDWATER EXTRACTION					
Surface & Groundwater Extraction	M	• Requirement for data similar to that undertaken for the Yass River Catchment by DIPNR (Franklin & Parker 2004) for the Molonglo Catchment: • Current levels of surface water utilisation • Current levels of ground water utilisation • Assessment as to sustainability of current surface & groundwater utilisation • Recommendations as to management of surface & groundwater extraction • Consider using modelling tools such as TEDI, CHEAT or WaterCAST (Cetin *et al* 2009) to assess the impacts of farm dams on surface waters of the Molonglo River	Report on current surface & groundwater extraction and advise as to current and future sustainability of extraction.	ACT NRM Council NSW DECCW ACT DECCEW MCG Murrumbidgee CMA	2012

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Water Budgeting & Environmental Flows	H	Note: existing commitment by ACT government re: water extraction and environmental flows. • Investigate environmental flow requirements for the Molonglo River (timing & duration) • Identify opportunities for water saving and potential environmental flows • Analyse discharge from Captains Flat Dam and identify possible water saving opportunities aiming to result in an increase in environmental water • Consider utilising eWater Tool developed by CSIRO Cooperative Research Centre (CRC) • Create/promote community education programs to improve water efficiency in home, work, schools	• Liaise with CRC re using eWater tool for Molonglo River • Using surface & groundwater data (above) investigate environmental water and provide recommendations • Improved community education and community responsibility for water use	Local Council MCG NSW DECCW ACT DECCEW CSIRO	2015
WEED MANAGEMENT					
Implement prioritised weed control projects	H	• Target weed control in large remnant vegetation as a priority • Target most invasive species first	Reduced cover of target weeds	PCL NCA GA LDA LPMA Murrumbidgee CMA Developers Land holders	2019
FISH & INSTREAM HABITATS					
Management of carp in Molonglo River	M	The Upper Murrumbidgee Demonstration Reach (UMDR) Project Carp Management Plan is currently being produced. This will identify carp hotspots in lower Molonglo River. Use UMDR data to undertake management of hotspots. Extend data for entire length of Molonglo River. • Identify carp hotspots • Identify appropriate management of hot spots • Source funding • Undertake on-going control of carp	• Management of carp hotspots • Decline in carp numbers	UMDR Project ACT PCL I & I NSW NCA	2010-2020

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Fish Habitat	M	• Use habitat mapping from baseline surveys to target quality areas of fish habitat for protection / rehabilitation & removal of fish barriers • Consider engaging recreational fishers in rehabilitation works • Explore options for future stocking	• Improvement of native fish habitat on Molonglo River • Increase in native fish species	ACT PCL I&I NSW National Capital Authority (NCA)	2010-2012
THREATENED SPECIES RECOVERY & CONSERVATION					
Undertake targeted threatened species recovery actions according to national and state guidelines	M	• Utilise base line data to produce a report including maps identifying threatened species and / or their habitat • Appropriately advise landholders with identified threatened species or threatened species habitat • Undertake threatened species recovery actions (e.g. fencing, monitoring, etc) as relevant	• Areas identified and protected • Threatened species populations stable or increasing	NSW DECCW ACT PCL Murrumbidgee CMA GA Federal Government Local Council	2010-2020
Conservation Lands	M	Promote possible conservation options during landholder engagement such as: • Bush Heritage • Nature Conservation • Voluntary Conservation Agreements (VCA) through NSW DECCW Engage with K2C project which has established networks for private and public landholder conservation	• Partnership formed with K2C • Increase in lands conserved along the Molonglo River	MCG PCL NSW NPWS K2C NSW DECCW LPMA	2010 - ongoing

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
ENGAGEMENT					
Engagement of business	H	• Establish relationship with local business in order to promote and rehabilitate the Molonglo River • Consider engaging a professional to target business and maintain relationships	Business Engagement achieved via: • In kind contributions • Cash sponsorships and/or donations • Using staff in on-ground works • Support of local community events / PR opportunities	RiverSmart MCG	2010 - ongoing
Engagement of Developers Opportunities re: development: • **Sustainable Developments and how this can benefit MRR** • **Biodiversity offsets in river corridor** • **Carbon offsetting** • **Public Relations** • **Community learning / development** • **Stewardship with communities** • **Sponsorship for on-ground works**	H	• Develop engagement opportunities and partnerships with developers and developments • Ensure a clear point of contact for developers to engage with (e.g. Molonglo River Rescue Program Facilitator)	• Developers engaged and partnerships formed • On ground activities undertaken	CIC Australia LDA MCG GA Murrumbidgee CMA ACT PCL ACT PLA NSW Department of Planning Federal Government	2010 - ongoing
Engagement with recreational user groups	M	• Use social survey from baseline surveys to identify recreational users and areas on Molonglo River • Engage recreation users of Lake Burley Griffin and other areas of Molonglo River • Liaise with healthy lifestyle program and consider forming partnerships	• Recreational users engaged in MRR • New recreational opportunities on the Molonglo River identified taking into consideration ecological values	NCA RiverSmart MCG	2010 - ongoing

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Online Tools • **Interactive Website including 'live map' showing current works, past works, community group sites etc to inform community about works being undertaken and opportunities to join in** • **Action Plan established as a 'live' document that is updated online as new goals are set & works are completed** • **Allow for upload of before & after photos of restoration works by landholders / community groups** • **Create a downloadable template for landholders on condition / indicator including GPS points, RARC**	M	• Engage appropriate IT specialist to design and upload website and Live Map • Have the Action Plan online and regularly updated to reflect current works and future targets • Promote internet links to online tools in literature and promotional material to ensure website is used • Ensure responsibility of managing and updated the tools is appropriately delegated • Explore utilising Canberra Institute of Technology (CIT)	• Online tools established and regularly updated • Online tools regularly accessed by public	MCG Murrumbidgee CMA ACT NRM Council Local Council	2011
Calendar of events utilising existing events and creating new events relevant to the river	M	• Create a MRR calendar with a series of events utilising existing days (e.g. Clean up Australia Day, National Tree Day) for actions on the Molonglo River • Include new event ideas such as Molonglo River Festival (see below) • Engage business, community, government, industry and research groups etc for funding, participation, support • Utilise media attention for promotion and coverage of events	• Calendar produced and distributed • Links created with other relevant stakeholders e.g. GA • Activities widely promoted and well attended	MCG GA Local Council Murrumbidgee CMA RiverSmart	2010

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Molonglo River Festival • **Creation of an annual event will aim to provide longevity and the opportunity for on-going engagement**	M	• Develop a Festival promoting all the values of the Molonglo River in partnership with RiverSmart including ecological, recreational values etc • Engage recreational users, local business, government - ensure project has strong community support • Seek professional advice	• Annual Festival established with extensive local business, government & community support • Engagement of community especially recreational users • Promotion of MRR and other opportunities to support and rehabilitate the Molonglo River	RiverSmart MCG GA	2010 - ongoing
Schools and educational aids	M	• Teach the reach program rolled out in schools on or near the Molonglo River • Extension of Waterwatch, Frogwatch, Platypus Count & RiverSmart programs in schools & community • Identify relevant / useful aids that could be created and distributed e.g. water plants of the Molonglo River • Secure funding and create	• Schools engaged in Teach the Reach, Waterwatch etc • Useful aids produced	ACT Waterwatch RiverSmart MCG GA Invasive Animals CRC	2010-2012
Platypus as a charismatic species and focus for rehabilitation works		• Identify existing areas of habitat mapping during baseline surveys • Utilise local anecdotal information and engage community by promoting APC "Have you seen a platypus?" scheme as part of the Platypus Care program • Use this scheme to look at where platypus are and are not, and use this information to target areas for rehabilitation • Engage NCA re: possibility of improving LBG for platypus	• Increase in numbers of platypus in Molonglo River • Increase community groups involvement in Platypus monitoring on the Molonglo River • Areas identified for rehabilitation • Areas of LBG appropriate for Platypus habitat re-installation identified and rehabilitation undertaken	APC ACT PCL ACT Waterwatch NCA MCG NSW DECCW	2010 - ongoing

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
Signage	M	• Key points for signage identified • Install interpretative signage at identified sites • Link in with community groups for dual purpose signage • Ensure sign quality (e.g. fade resistant)	Key points for signage identified, signs created and installed	MCG ACT Government Local Council LPMA	2010-2012
HERITAGE					
Indigenous and European	M	• Engagement of indigenous groups in restoration works (work crew) • Ensure that European and indigenous culture heritage issues are highlighted and built into onsite signage, education materials etc • Protection of identified areas of cultural heritage at restoration sites • Engagement with Aboriginal Groups re: management of heritage sites in restoration areas • Potential to link to other funding programs	Indigenous and European heritage along the Molonglo protected and where appropriate promoted	ACT NRM Council	2010 - ongoing
RESEARCH					
Opportunity to establish a research program in partnership with local universities / research organisations for Molonglo River	M	• Engage universities • Identify who's doing what where - what are our information gaps, what needs to be known • Create partnership with research organisations to address research gaps	Students / organisations engaged in research on the Molonglo River	MCG ACT NRM Council Canberra University ANU CSIRO	2010 - ongoing
MONITORING					
Identify key strategies and locations for appropriate monitoring of rehabilitation works along the Molonglo River	H	• Waterwatch, Frogwatch and Platypus Count sites established or continuing • Photo monitoring points installed • Ensure there is communication between monitoring groups - establish a network to allow for dissemination of information • Link monitoring back to 'hopes' for the river identified during social survey • Ensure access to AUSRIVAS data for Molonglo River and include in reporting	Monitoring indicates improvements in environmental condition and community awareness and understanding	ACT Waterwatch MCG APC ACT PCL NSW DECCW	2010

Goal	Priority	Action	Key outputs / Measure of Success	Potential Partner	Completed by ...
MAINTENANCE					
Follow-up and maintenance of works undertaken	L	• Any funding procured as part of MRR will include a relevant maintenance program • Encourage maintenance on private property by funding being targeted to landowners willing to commit to undertaking maintenance, larger areas of rehabilitation etc • Identify and create a Showcase Site demonstrating need for follow-up and maintenance	• Sites successfully maintained and become self-sustaining • Showcase Site established and used to educate landholders, government etc as to requirement of follow-up and maintenance	GA Murrumbidgee CMA MCG ACT PCL	Ongoing from 2010
GOVERNANCE					
Appoint a facilitator to oversee and manage current and future work	H	• Secure funding for MRR Facilitator position • Advertise & interview	Facilitator appointed	MCG & steering committee	2010
Is the MRR project meeting its goals?	M	• Use on-going monitoring and management data (including periodic follow-up of baseline data) to determine the success or failure of each element of rehabilitation • Review goals and milestones, address any concerns which may have arisen in a review of strategic plan for MRR project • Changes in land holder awareness, weed removal, revegetation and improved water quality demonstrated	Reports produced annually and distributed to relevant stakeholders	Molonglo River Rescue Program Facilitator & steering committee	Annually from 2010

5. Partnership and Engagement

5.1 Opportunities

The Molonglo River, running through rural, peri-urban, suburban and industrial areas and incorporating Lake Burley Griffin, provides a unique opportunity for community engagement as well as the engagement of business and development interests. The following table identifies a range of potential partners for the Molonglo River Rescue project beyond those already engaged.

Table 4 Engagement opportunities

Organisation / Activity	*Comments*
National Capital Authority (NCA)	It is recognised that upstream impacts from the Molonglo river (and Queanbeyan river flowing into it) affect the water quality of Lake Burley Griffin, and conversely, the quality of Lake Burley Griffin affects downstream habitats. Opportunity exists to work in collaboration with the NCA, to manage these impacts, particularly in regard to the management of blue-green algae and carp.
Landholders	A number of schemes are already in place to engage landholders, particularly on rural lands, for rehabilitation works along on the Molonglo River (willow removal, revegetation, fencing incentives etc). Extension of these projects is an important element in the rehabilitation of the Molonglo River. Also key is educating landholders as to the value of riverine environments and landholder responsibilities in regards to management e.g. through workshops, community information boards, displays at community events etc
Indigenous Engagement	The opportunity exists to engage indigenous groups in field days, interpretative signage ideas, protection of heritage, and on-ground works.
Sport and Recreation	The river and lake are utilised by a wide range of groups for sporting and recreational purposes. These groups have a direct interest in the quality and amenity of the river and lake and provide an opportunity for engagement, education and participation in projects. Groups to consider include: • Australian Institute of Sport (AIS) Rowing, Canberra; • ACT Rowing Association; • Waterski ACT; • KayakCanberra; • Canberra Yacht Club; • ACT Anglers • Canberra Fishermen's Club • Local Pony Clubs
Schools	Utilising and working with schools, colleges and universities provide an opportunity for education, engagement and research. School programs already exist through ACT Waterwatch.

Organisation / Activity	*Comments*
Government	A range of government departments not already engaged may be relevant to works undertaken on the Molonglo River, for example: • NSW National Parks and Wildlife Service • NSW Department of Arts, Sport and Recreation • NSW Land and Property Management Authority • ACT Health • Local Council
Development companies	The opportunity exists to work in partnership with CIC Australia and other development companies, to undertake rehabilitation of the Molonglo River in areas adjacent to, or associated with new developments, and to engage the community and promote 'green' values. The opportunity also exists to engage workers in adjacent employment zones in community / corporate tree planting or clean-up days once these areas have been developed, or to foster on-going ownership of sites along the river.
Business sector	This initiative presents an opportunity for the business sector, both regionally and locally, to 'buy in' through project sponsorships, staff deployments to site-based activities (see above), and support for the initiative via endorsements and incentive schemes to encourage community participation.
Media organisations	Engaging the media allows for community education, the dissemination of information, and the promotion of activities and events associated with the Molonglo River.
Environmental Groups	Groups with an environmental and sustainability interest or concern could also play a key role in rehabilitation and awareness raising programs for the Molonglo River. Groups already engaged or to seek engagement with include: • ACT Conservation Council • RiverSmart Australia Ltd • Greening Australia • ACT Waterwatch • ACT & Region Frogwatch • Canberra Ornithologists Group (COG) • The Australian Platypus Conservancy • Australian Native Plant Society, Canberra Region • Landcare and Parkcare Groups • Meteorological Society • Friends of Grasslands
Research Organisations	The Molonglo River provides an opportunity for research into threatened species resilience, rehabilitation in urban areas, platypus monitoring etc. Currently research is being conducted into the Green and Golden Bell Frog population in the Upper Molonglo by University of Canberra. The engagement of universities (e.g. ANU, University of Canberra) and research organisations (e.g. ANBG, CSIRO) will provide valuable data for the Molonglo River and may lead to an increased awareness and improved outcomes.

6. Monitoring and Evaluation

A monitoring framework is proposed to determine the success of rehabilitation works undertaken as part of the Molonglo River Rescue Project including data obtained from Waterwatch, Frogwatch and Platypus Count, photo monitoring points, and shifts in community attitudinal change.

6.1 Water Quality and Key Aquatic Species

6.1.1 Waterwatch & Frogwatch

On-going monitoring of water quality is being undertaken by ACT Waterwatch and community volunteers. It is generally accepted that the Waterwatch methodology is sufficiently robust and that community engagement is critical to the project. Seven sites are now being monitored each month on the Molonglo River for macroinvertebrates and the following key water quality parameters:

- Dissolved oxygen;
- Phosphates;
- Turbidity;
- Electrical conductivity;
- Temperature;
- Nitrates and nitrites, and
- pH.

On-going water quality monitoring indicates that the Molonglo River is in moderate condition, shifting to poorer during periods of low flow.

Frogs are being monitored through the existing ACT and Region Frogwatch program. ACT and Region Frogwatch undertake a program of annual monitoring with additional seasonal monitoring where there is a specific requirement. Regular reporting is used to provide feedback on the health of the Molonglo and other rivers in the region. The program is supported by ecologists from the Wildlife Research and Planning Section of the ACT Government as well as experts from the University of Canberra. There are currently 12 Frogwatch sites along the Molonglo River. Data from the 2009 census is currently being processed and will be added to the data from previous years to develop a temporal understanding of changes in frog species and abundance. The 2009 Frogwatch Census saw the discovery of the Green and Golden Bell Frog at a Carwoola site on the Molonglo River where it was not previously known. This threatened species is known to exist at other sites in the area but has not been found at this location before. Survey and protection of the Green and Golden Bell Frog in the Carwoola region are included in the actions in this Plan.

6.1.2 Platypus Count

The project also aims to establish a Platypus Count monitoring program on the Molonglo River. Two sites have currently been established off Moreshead Road in Campbell ACT, with a third proposed in the Captains Flat NSW area. Platypus Count will be run through ACT Waterwatch and in partnership with the Australian Platypus Conservancy (APC).

6.2 Photo Points

Each Waterwatch site will include an upstream and downstream photo point. These will be used to monitor riparian vegetation condition and any rehabilitation works that take place. This information will also help to link changes in aquatic condition with any riparian impacts. Where restoration has been undertaken on private lands or rural leases, landholders will be encouraged to collect data (including photos) on the success of plantings and which would then be fed back to the MCG.

6.3 Attitudinal Change

To accurately gauge the level of attitudinal change within any given group of landholders, it is important to establish a baseline survey. This will allow a measure of attitudes prior to commencement of works as part of the project. An opportunity exists to engage a social scientist to examine landholder attitudes to NRM practices along the Molonglo River, with the aim of tracking whether these attitudes are changing over time and why / why not. Questions to explore may include whether:

- There is a continual increase in land managers' awareness, knowledge and skills in NRM and adoption of practices, which improve natural resource outcomes;
- Land managers and other natural resource managers are actively engaged in collaborative action to improve the management of natural resources in the region; and
- There is a continual increase in the willingness of land managers, other stakeholders and the community to partner NRM organisation to deliver natural resource outcomes.

Attitudinal change and landholder engagement in NRM practices could also be tracked through:

- Collating questionnaire feedback at meetings and field days and reporting on comments made;
- Engagement of rural landholders in rehabilitation actions (numbers recorded and reported);
- Engagement of land developers in projects on the Molonglo;
- Events staged and numbers of people attending;
- Success of community monitoring groups Waterwatch, Frogwatch and Platypus Count;
- The number of media articles the project produces and the media attention it receives; and
- The demand and uptake of extension materials that the project produces.

The Australian Bureau of Statistics began collecting *Natural Resource Management on Australian Farms* data in 2004/2005 with the aim of collecting data every two years. This also provides an opportunity for understanding landholder attitudes to NRM practices, however, it excludes peri-urban lifestyle landholders.

6.4 Other indicators for monitoring and reporting

The following list identifies other data that could be collected for monitoring and reporting:

- Bird count survey data (e.g. in revegetation sites);
- Macroinvertebrate survey data;
- Long-term reductions in number and extent of Cyanobacterial blooms in Lake Burley Griffin;
- Natural regeneration from existing sources;
- Riparian lengths protected and / or enhanced (kilometres) including weeds removed, revegetation installed and fenced to exclude stock as necessary;
- Willows removed (kilometres);
- Off-site watering points installed (number);
- Erosion control works (kilometres);
- Educational aids developed and distributed (number); and
- Signs designed and installed (number).

7. Conclusion

The Molonglo River is a high profile river which has suffered from significant damage. The River has been impacted by the following:

- A loss of riparian and adjacent vegetation;
- A loss of habitat for native flora and fauna;
- Extensive weed infestations;
- On-going land use impacts;
- Declining water quality; and
- Low flows and less diverse flow regimes.

Its setting, running through the nation's capital, and being surrounded by a range of land uses including farming, rural residential, urban and light industrial lands, provides a unique opportunity to engage a range of stakeholders including land holders, developers, recreational groups, NRM bodies, research organisations, and schools, in restoration activities, and to coordinate across borders and jurisdictions.

This Action Plan details the next steps required for the rehabilitation of the river, prioritising reaches and actions, and provides scope for a range of other activities that will enhance the ecological, recreational and amenity value of the river. If implemented, the Plan will serve to substantially improve the Molonglo River now and for future generations.

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9. Appendix A Indigenous planting guide

The Molonglo Catchment Group have produced an indigenous planting guide for each section of the Molonglo River. For full brochure see:
http://www.molonglocatchment.com.au/freebies_&_downloads.htm#Molonglo_River_Revegetation_Pamphlet

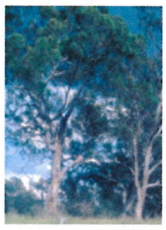
PLANTS RECOMMENDED FOR EACH SECTION OF MOLONGLO RIVER

Section 1

Trees
Callitris endlicheri
Casuarina cunninghamiana (on river terraces)
Eucalyptus bridgesiana
E. macrorhyncha
E. pauciflora

Shrubs
Acacia buxifolia
A. dealbata
A. mearnsii
A. rubida
Callistemon sieberi
Cassinia longifolia
Chrysocephalum apiculatum
Dodonaea viscosa subsp. angustissima
Hardenbergia violacea
Hibbertia obtusifolia
Indigofera australis
Kunzea ericoides
Lomandra longifolia

Ground Covers
Austrodanthonia spp.
Austrostipa densiflora
A. scabra
Bothriochloa macra
Bulbine bulbosa
Carex appressa
Chrysocephalum apiculatum
C semipapposum
Craspedia variabilis
Enneapogon nigricans
Leptorhynchus squamatus
Panicum effusum
Pimelea curviflora
Themeda australis

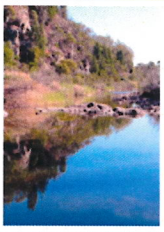


Section 2

Trees
Eucalyptus blakelyi
E. bridgesiana
E. melliodora
E. pauciflora
E. rubida

Shrubs
Acacia dealbata
A. mearnsii
A. rubida
Brachyloma daphnoides
Cryptandra amara
Daviesia genistifolia
Dillwynia sericea
Hardenbergia violacea
Hibbertia obtusifolia
Kunzea parvifolia
Lissanthe strigosa
Melichrus urceolatus
Rubus parvifolius
Stypandra glauca

Ground Covers
Austrodanthonia eriantha
A. racemosa
Austrostipa scabra
Bothriochloa macra
Bulbine bulbosa
Chloris truncata
Cymbopogon refractus
Chrysocephalum apiculatum
C. semipapposum
Craspedia variabilis
Dianella revoluta
Enneapogon nigricans
Joycea pallida
Leptorhynchus squamatus
Lomandra filiformis
L. longifolia
Microlaena stipoides
Panicum effusum
Poa caespitosa
Themeda australis
Vittadinnia muelleri



Section 3

Trees
Callitris endlicheri
Eucalyptus bridgesiana
E. macrorhyncha
E. rossii

Shrubs
A. buxifolia
A. dawsonii
A. dealbata
A. paradoxa
A. rubida
Astroloma humifusum
Callistemon sieberi
Calytrix tetragona
Cassinia longifolia
Clematis microphylla
Correa reflexa
Daviesia leptophylla
Derwentia perfoliata
Dodonaea viscosa subsp. angustissima
Hardenbergia violacea
Indigofera australis
Lomandra longifolia
Mirbelia oxylobioides
Pultenaea microphylla

Ground Covers
Austrodanthonia spp.
Austrostipa densiflora
A. scabra
Bothriochloa macra
Bulbine bulbosa
Carex appressa
Chrysocephalum apiculatum
C. semipapposum
Craspedia variabilis
Enneapogon nigricans
Leptorhynchus squamatus
Panicum effusum
Pimelea curviflora
Poa caespitosa
Themeda australis

Section 4

Trees
Acacia melanoxylon
Eucalyptus bridgesiana
E. dives
E. mannifera
E. melliodora
E. pauciflora
E. rubida

Shrubs
Acacia dealbata
A. rubida
A. siculiformis
Banksia marginata
Bursaria lasiophylla
Cassinia longifolia
Hardenbergia violacea
Indigofera australis
Kunzea parvifolia
Leptospermum continentale
L. myrtifolium
Rubus parvifolius

Ground Covers
Austrodanthonia spp.
Austrostipa densiflora
A. scabra
Bothriochloa macra
Carex appressa
Chloris truncata
Chrysocephalum apiculatum
Dianella revoluta
Enneapogon nigricans
Lomandra longifolia
Microlaena stipoides
Panicum effusum
Persicaria prostrata
Phragmites communis
Poa sieberiana
Themeda australis
Typha spp.

Section 5

Trees
This area was mainly treeless but verges on Yellow Box and Snow Gum woodland. Suitable trees species would be:
Eucalyptus bridgesiana
E. melliodora
E. pauciflora
E. rubida

Shrubs
Acacia siculiformis
Bursaria lasiophylla
Callistemon sieberi
Hakea microcarpa

Ground Covers
Austrodanthonia spp.
Austrostipa bigeniculata
A. scabra
Bulbine bulbosa
Calotis anthemoides
Carex appressa
Chrysocephalum apiculatum
C. semipapposum
Eleocharis acuta
E. sphacelata
Enneapogon nigricans
Lepidosperma laterale
Leptorhynchus squamatus
Panicum effusum
Persicaria prostrata
Phragmites communis
Poa labillardieri
P. caespitosa
Ranunculus lappaceus
Scleranthus biflorus
Stackhousia monogyna
Themeda australis
Vittadinia muelleri

Section 6

Trees
Acacia melanoxylon
Eucalyptus bridgesiana
E stellulata
E. pauciflora
E. rubida
E. viminalis
Exocarpos cupressiformis

Shrubs
Acacia dealbata
A. mearnsii
A. rubida
A. siculiformis
Bursaria lasiophylla
Cassinia longifolia
Daviesia mimosoides
Leptospermum continentale
L. lanigerum
L. myrtifolium
Rubus parvifolius

Ground Covers
Acaena novae-zelandiae
Ajuga australis
Austrodanthonia spp.
Austrostipa scabra
Bothriochloa macra
Bulbine bulbosa
Carex appressa
Chrysocephalum apiculatum
C. semipapposum
Craspedia variabilis
Eleocharis acuta
Enneapogon nigricans
Joycea pallida
Lepidosperma laterale
Leptorhynchus squamatus
Microlaena stipoides
Panicum effusum
Phragmites communis
Poa sieberiana
Themeda australis
Typha spp.

Riparian and Callitris Woodland	Yellow Box Woodland	Molonglo Gorge	Fringing Snow Gum Woodland	Grassy Floodplains	Wet Forest

10. Appendix B Vegetation communities, threatened species and pest species in the Molonglo

10.1 Vegetation Communities on the Molonglo River

The following vegetation communities have been identified as occurring along the Molonglo River. Descriptions are based on mapping recently undertaken by the ACT Government (*Ishiyama et al* unpublished; Johnston *et al* 2008; ACT Government 2007; TAMS 2009) and work undertaken by Barrer (1997) for the Palerang region. Where applicable, each community has also been identified as its NSW biometric vegetation type equivalent (Gibbons *et al* 2008).

Eucalyptus macrorhyncha-Eucalyptus rossii (Red Stringybark-Scribbly Gum) Tableland Forest

This community is widespread on sedimentary soils on exposed aspects in lowland areas of the ACT. It occurs in the riparian areas along the Molonglo River. Characteristic tree species include *E. Macrorhyncha* (Red Stringybark), *E. rossii* (Scribbly Gum), *E. mannifera* (Brittle Gum) and *E. dives* (Broad-leaved Peppermint), with *Daviesia leptophylla* understorey and *Joycea pallida* (Redanther Wallaby Grass) groundcover. Included in this community are relict stands of *Allocasuarina luehmannii* (Buloke) in the area below the Molonglo Gorge (ACT Government 2007). This community corresponds with the NSW biometric vegetation type *Red Stringybark - Brittle Gum - Inland Scribbly Gum dry open forest on skeletal hills of the tablelands, South Eastern Highlands.*

Callitris endlicherii (Black Cypress Pine) Tableland Woodland

This community is characterised by low woodland or open forest dominated by Black Cypress Pine or in association with Eucalypts or large shrubs. In riverine landscapes this community occurs with *Kunzea ericoides, Bursaria spinosa* and *Grevillea juniperina* with scattered Eucalypts such as *E. bridgesiana, E. blakeyi, E. rossi* and *E. melliodra*. (Johnston *et al.* 2008; TAMS 2009). This community corresponds with the NSW biometric vegetation type *Black Cypress Pine - Red Stringybark - Box low open forest on rocky outcrops of the NSW South Western Slopes and adjoining South Eastern Highlands Bioregion.* Examples of this community are reserved in Canberra Nature Park and Namadgi National Park, and it occurs both in the Molonglo Gorge and in the Lower Molongo River Corridor (ACT Government 2007). It is not listed under any threatened species legislation.

Eucalyptus pauciflora-Eucalyptus rubida (Snow Gum-Candlebark) Tableland Riparian Woodland

Also known as Snow Gum Grassy Woodland or Frost Hollow Grassy Woodland, this community is dominated by Snow Gum (*E. pauciflora*), in association with Candlebark (*E. rubida*) with an understorey of native tussock grasses, herbs and scattered shrubs (ACT Government, 2004). This vegetation community includes the various open and low open woodlands on lower slopes and river bottoms, especially in cold spots and frost hollows (Johnston et al. 2008; TAMS 2009). *E. pauciflora* has been recorded from the upper Molonglo River (Burbong) and a few sites in less rugged parts of the lower Molonglo River valley (ACT Government 2007) in the ACT and many sites above Burbong in NSW (Lynton Bond, MCG, *pers comm*. 1 Dec 2009).

This community corresponds with the NSW biometric vegetation type *Snow Gum - Candle Bark Woodland on broad valley flats of the tablelands and slopes, South Eastern Highlands.*Frost Hollow Gassy Woodland has been nominated for preliminary listing as an endangered ecological community under NSW TSC Act.

Casuarina cunninghamiana (River Sheoak) Tableland Riparian Woodland

This community is dominated by River Sheoak, generally in pure stands in narrow belts along water courses, mixed with *Acacia dealbata* on river flats. Willows occur as individuals or as extensive stands that may replace this community in some areas. *Eucalyptus bridgesiana, E. blakeyi* and *E. viminalis* may also occasionally occur within this community (Johnston *et al.* 2008; TAMS 2009). This community corresponds with the NSW biometric vegetation type *River Oak forest and woodland of the NSW South Western Slopes and South Eastern Highlands Bioregions*. This community has been recorded on the lower reaches of the Molonglo River (ACT Government 2007).

Box Gum Woodland

This community fringes the riparian zones on parts of the Molonglo River (ACT Government 2007; Barrer 1997; MCG 2007). This community is listed as an EEC under ACT, NSW and federal legislation. Below are the descriptions for each community as described under each Act:

- *Eucalyptus melliodora-Eucalyptus blakelyi (Yellow Box / Blakely's Red Gum) Tableland Grassy Woodland (Act NC Act)*
  Yellow Box-Red Gum Grassy Woodland is an open woodland community in which either or both of Yellow Box and Blakely's Red Gum are present. Apple Box (E. *bridgesiana*) is a frequent associate. The trees form an open canopy above a species-rich understorey of native tussock grasses, herbs and scattered shrubs. This community forms a mosaic of variegated vegetation patches with features that are transitional between forest and grassland, and the community is frequently interspersed with these other vegetation types (ACT Government 1999b).
- *White Box Yellow Box Blakely's Red Gum Woodland (NSW TSC Act)*
  White Box Yellow Box Blakely's Red Gum Woodland is an open woodland community (sometimes occurring as a forest formation), in which one or more of the following are dominant: White Box (*Eucalyptus albens),* Yellow Box (*E. melliodora)* and Blakely's Red Gum (*E. blakelyi)*. Intact sites contain a high diversity of plant species, including the main tree species, additional tree species, some shrub species, several climbing plant species, many grasses and a very high diversity of herbs. (NSW Scientific Committee, 2002).
- *Box-Gum Woodland and derived native grassland (Commonwealth EPBC Act)*
  Box Gum Grassy Woodland is characterised by a species-rich understorey of native tussock grasses, herbs and scattered shrubs, and the dominance, or prior dominance of White Box, Yellow Box or Blakely's Red Gum Trees (DEWHA undated).

Tableland Riparian Shrubland

The Tableland Shrubland community is dominated by Burgan (*Kunzea ericoides* - formerly *Leptospermum phylicoides*) and is associated particularly with river fringes, rocky riverbanks and gravel beds adjoining rapidly flowing water. It is frequently an early colonizer and stabilizer of riverbanks and may form extensive thickets up to three metres high. It is often in association with River Bottlebrush (*Callistemon sieberi*) (TAMS 2009). This community also includes other shrubland associations along the Molonglo River that do not contain *K. ericoides* (ACT Government 2007; Barrer 1997) including:

- Bursaria lasiophylla shrublands;
- Pomaderris angustifolia shrublands;
- Cryptandra propinqua (Silky Cryptandra) shrublands;
- Dodonaea viscosa-Acacia rubida shrublands;
- Acacia rubida- A. mearnsii-Bursaria spinosa shrublands; and
- Leptospermum obovatum-Callistemon sieberi shrublands.

Tableland Dry Tussock Grassland

This grassland community is associated with frost hollows along the Molonglo and Murrumbidgee Rivers and is characterised by a diverse flora dominated by tussock grasses and containing many native forb species. Characteristic species are *Themeda australis, Poa sieberiana, Austrostipa scabra ssp. falcata, Austrodanthonia spp., Bothriochloa macra, Chrysocephalum apiculatum, Convolvulus erubescens, Vittadinia muelleri, Desmodium varians* and *Carex inversa*. The community is naturally treeless or contains up to 10% projective foliage cover of trees, shrubs or sedges (ACT Government 2007). The community is found in valleys influenced by cold air drainage and on open plains. Generally this community merges into *Eucalyptus melliodora–Eucalyptus blakelyi* Tableland Grassy Woodland or *Eucalyptus pauciflora–Eucalyptus rubida* Tableland Woodland (ACT Government 2007). This community may correspond to the NSW biometric vegetation type *Sub-alpine grasslands of valley floors, southern South Eastern Highlands and Australian Alps* or *Wallaby Grass - Redleg Grass low grassland of the South Eastern Highlands.*

Tableland Dry Tussock Grassland includes the Natural Temperate Grassland community (ACT Government 2007) which is listed endangered ecological community under the Commonwealth EPBC Act, and the ACT NC Act:

- *Natural Temperate Grassland (NC Act)*
  Natural grassland is a native ecological community that is dominated by native species of perennial grasses including *Themeda*, *Poa, Stipa, Bothriochloa* and *Austrodanthonia* species. There is also a diversity of native herbaceous plants (forbs) present. An important characteristic of the community is that it is naturally treeless, or has less than 10% projective foliage cover of trees, shrubs and sedges in its tallest stratum (ACT Government, undated A).
- *Natural Temperate Grassland of the Southern Tablelands (EPBC Act)*
  Natural Temperate Grassland is grassy vegetation dominated by moderately tall (25–50 cm) to tall (50–100 cm), dense to open tussock grasses in the genera *Austrodanthonia, Austrostipa*, *Bothriochloa*, *Poa* and *Themeda*. Up to 70% of all plant species may be forbs (i.e. herbaceous, non-grassy/non-grass-like plants). The community may be treeless or contain up to 10% cover of trees, shrubs or sedges. It occurs within the geographical region of the Southern Tablelands of NSW and the ACT at altitudes between 560 metres in central and northern parts

of its distribution and 1200 metres in the south, in valleys influenced by cold air drainage and in broad plains (DEWHA 2010).

Montane Dry and Wet Tussock Grassland

These are tall tussock grasslands, principally of *Poa labillardierei* but with numerous other grasses and forbs, common along the alluvial river flats and lower reaches of larger creeks in montane valleys. This grassland is strongly associated with *Eucalyptus stellulata* woodlands forming the usual understorey to this woodland (Johnston *et al.* 2008). Montane Wet Tussock Grassland occurs in the south and west of the ACT in wetter parts of valleys and along creek-lines where the water table is high, and on moderately drained soils beside fens and creeks. It consists primarily of Carex sp. (Ishyiana *et al* unpublished). This community corresponds to the NSW biometric vegetation type *River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands*.

Salix fragilis/Ulmus procera (Willow-Elm) Tableland Riparian Woodland Disclimax

This is deciduous introduced woodland associated with rural and urban waterways. Localised but supported by domestic infrastructure, spreading into wasteland and undeveloped areas. The tree cover is dense and often coppicing, while shrubs may be restricted to openings and margins and groundcover ranges from sparse and weedy to manicured lawns. Dominant species include Willows and English Elm (Johnston *et al.* 2008; TAMS 2009). This community includes a Weed of National Significance (Willow).

Tableland Riparian Aquatic and Fringing Vegetation Complex

This community occurs periodically along the length of the Molonglo River. This community includes reedlands, sedgelands and rushlands. Associated species include *Salix* spp (Willow), *Phragmites australis* (Common Reed), *Typha* spp. (Cumbungi), *Schoenoplectus validus* (Sedge), *Isolepis fluitans* (Floating Club-rush), *Eleocharis acuta* (Common Spike-rush), *Cyperus* spp, *Carex appressa*, *Juncus* spp. and *Scirpus validus* (ACT Government 2007).

Tableland Riparian Floating and Submerged Vegetation Complex

This complex includes plants dependent on the presence of permanent water. It is most developed in permanent waters to a depth of about four metres, as occurs in ACT urban lakes and backed up river waters (ACT Government 2007) such as Lake Burley Griffin and where the back water of the Lake reach up into the River.

Hill Oak (Allocasuarina verticillata) Dry Sclerophyll Forest

This community occurs on the slopes of the Molonglo River downstream from the Molonglo River Floodplain, occurring as an extended narrow strip within a narrow altitudinal range. It is known from Balcombe Hill and Douglas Close in Radcliffe (Barrer 1997).

Swamp Gum (E. ovata) Grassy Woodland

This community is dominated by Swamp Gum, and may include with Snow Gum, Manna Gum (*E. viminalis*), Candlebark, Brittle Gum (*E. mannifera*) and Scribbly Gum (*E. rossii*). This community has been recorded in scattered locations on the Molonglo River north of Captains Flat (Barrer 1997) and may correspond to the NSW biometric vegetation type *River Tussock - Tall Sedge - Kangaroo Grass moist grasslands of the South Eastern Highlands.*

10.2 Threatened Species on the Molonglo River

Button Wrinklewort (Rutidosis leptorrhynchoides)

The Button Wrinklewort is a perennial, multi-stemmed herb, with local populations known from Goulburn, the Canberra - Queanbeyan area and at Michelago. This species inhabits Box-Gum Woodland, secondary grassland derived from Box-Gum Woodland or in Natural Temperate Grassland; and often in the ecotone between the two communities (DECC 2005). Button Wrinklewort has been recorded adjacent to the Molonglo River at Fyshwick (Hogg 2007). This species is listed as endangered under the NSW TSC Act, Commonwealth EPBC Act, and the ACT NC Act.

Pale Pomaderris (Pomaderris pallida)

Pale Pomaderris is a compact rounded shrub to 1.5 metres tall. It has been recorded from near Kydra Trig, north-west of Nimmitabel, Tinderry Nature Reserve, and the Queanbeyan River as well as along the lower Molonglo River in Canberra, downstream from Misery Hill. The main distribution is along the Murrumbidgee River in the ACT (DECC 2005). This species usually grows in shrub communities surrounded by Brittle Gum (*Eucalyptus mannifera*) and Red

Stringybark (*E. macrorhynca*) or *Callitris* woodland. It is listed as vulnerable under the NSW TSC Act and the Commonwealth EPBC Act.

Tarengo Leek Orchid (Prasophyllum petilum)

Tarengo Leek Orchid grows in association with grassy woodland at Captains Flat. Each plant produces a solitary, tubular, fleshy, dull green leaf, growing to 35 cm tall. The flower-spike emerges in early summer from a hole near the base of the leaf. The spike, reaching to 12 cm tall, has about 20 fragrant flowers with pointed petals. The flowers are usually a pale whitish green, but can be pink or pale purple (DECC 2005). It is listed as endangered under the NSW TSC Act and the Commonwealth EPBC Act.

Silky Swainson-pea (Swainsona sericea)

The Silky Swainson-pea is a prostrate or erect perennial, growing to 10 cm tall. Silky Swainson-pea has been recorded from the Northern Tablelands to the Southern Tablelands and further inland on the slopes and plains. This species is found in Natural Temperate Grassland and Snow Gum *(Eucalyptus pauciflora)* Woodland on the Monaro and in Box-Gum Woodland in the Southern Tablelands and South West Slopes. It is sometimes found in association with cypress-pines *(Callitris sp)* (DECC 2005). It has been recorded a few kilometres from the River at Jerrabomberra. It is listed as vulnerable under the NSW TSC Act.

Small Purple-pea or Mountain Swainson-pea (Swainsona recta)

Swainsona recta is a slender, erect perennial herb growing to 30 cm tall. Before European settlement it occurred in the grassy understorey of woodlands and open-forests dominated by Blakely's Red Gum (*Eucalyptus blakelyi*), Yellow Box (*E. melliodora*), Candlebark Gum (*E. rubida*) and Long-leaf Box (*E. goniocalyx*). It has been recorded a few kilometres from the River at Jerrabomberra and in the Queanbeyan area. This species is listed as endangered under the NSW TSC Act, Commonwealth EPBC Act, and the ACT NC Act.

Murray Cod (Maccullochella peelii peelii)

An Australian freshwater fish, reaching 113.6 kg and 1800 mm length, the Murray Cod was formerly widespread and abundant in the lower and mid-altitude reaches of the Murray-Darling Basin. Commercial fisheries data indicate that natural populations declined in the 1920s and then again dramatically in the 1950s. The species now has a patchy distribution and abundance across its historic range and was listed as nationally threatened in 2003. The Murray cod is an icon of the Murray-Darling Basin and forms the basis of a popular recreational fishery in south-eastern Australia where it is often stocked into dams and lakes. This species has been recorded in Lake Burley Griffin and the Lower Molonglo (ACT Government 2007), and is regularly stocked in the Lake for recreational fishing. It is listed as vulnerable under the Commonwealth EPBC Act.

Macquarie Perch (Macquaria australasica)

The Macquarie Perch is a moderately-sized fish growing to 46 cm and 3.5 kg, but commonly less than 25 cm and 1.5 kg. The Macquarie Perch is a riverine, schooling species. It prefers deep, rocky holes with lots of cover. Spawning occurs just above riffles (shallow running water). The natural geographical range of the Macquarie Perch is thought to be confined to the Murray-Darling Basin (DEWHA, 2009). Macquarie Perch were once common in the middle and upper reaches of the Murray River and its tributaries (DEWHA 2009). Records from the Molonglo River are scarce and the most recent records were only from the lower end of the river below Lake Burley Griffin (ACT Government 2007). The Macquarie Perch is listed as endangered under the Commonwealth EPBC Act, ACT NC Act and as vulnerable in NSW.

Murray River Crayfish (Euastacus armatus)

The Murray River Crayfish is reportedly the second largest freshwater crayfish in the world, growing to 3 kg. Adults average 20 to 30 cm in total length and are identified by their large white claws and ornately spined abdomen (ACT Government, undated). This species has been recorded in the Lower Molonglo, below Coppins Crossing (Environment ACT 2001). This species is listed as vulnerable under the ACT NC Act.

Green and Golden Bell Frog (Litoria aurea)

The Green and Golden Bell Frog is a relatively large, stout frog that is usually a vivid pea-green, splotched with an almost metallic brassy brown or gold. The species was formerly distributed from the NSW north coast near Brunswick Heads, southwards along the NSW coast to Victoria where it extended into east Gippsland, and west to Bathurst,

Tumut and the ACT. Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated (DECC 2005). There is only one known population on the NSW Southern Tablelands which is located on the Molonglo River. The Green and Golden Bell Frog is listed as endangered under the NSW TSC Act and the Commonwealth EPBC Act.

Pink-tailed Worm-lizard (Aprasia parapulchella)

The Pink-tailed Worm-lizard is a worm-like lizard with a dark-brown head and nape that gradually merges with the pale grey or grey-brown body. It is only known from the Central and Southern Tablelands, and the South Western Slopes. This species inhabits sloping, open woodland areas with predominantly native grassy groundlayers, particularly those dominated by Kangaroo Grass *(Themeda australis)* (DECC 2005). The largest known population of Pink-tailed Worm-lizard is from upstream of Coppins Crossing to the junction with the Murrumbidgee River, and is considered to be of national conservation significance (University of Canberra 2004). This species is listed as vulnerable under the NSW TSC Act and the Commonwealth EPBC Act.

Striped Legless Lizard (Delma impar)

The Striped Legless Lizard differs most obviously from a snake in having external ear openings, small scaly flaps for hind limbs, a long tail and a broad, undivided tongue. This species occurs in the Southern Tablelands, the South Western Slopes and possibly in the Riverina, as well as the ACT, Victoria and south-eastern South Australia. It is found mainly in Natural Temperate Grassland but has also been captured in grasslands that have a high exotic component, and in secondary grassland near Natural Temperate Grassland and occasionally in open Box-Gum Woodland (DECC 2005). This species has been identified within the Lake Burley Griffin Precinct and in the Lower Molonglo (ACT Government 1999a). The Striped Legless Lizard is listed as vulnerable under the NSW TSC Act, Commonwealth EPBC Act, and the ACT NC Act.

Perunga grasshopper (Perunga ochracea)

In the ACT, the Perunga Grasshopper has been found in both Natural Temperate Grassland dominated by *Danthonia* spp., *Austrostipa* spp. or *Themeda australis*, and in native pasture (Stephens 1998). The species may also occur in open woodland areas with a grassy understorey, including in Yellow Box/Red Gum Grassy Woodland. The species appears to use grass tussocks as shelter spaces. It is a cryptic grasshopper which is difficult to see unless first disturbed. It has been identified within the Lake Burley Griffin Precinct (ACT Government 1999a). The Perunga Grasshopper is listed as vulnerable under the ACT NC Act.

Declining Woodland Birds

Remnant woodland in Molonglo and North Weston provides refuge for four known threatened woodland birds: the Brown Treecreeper, Varied Sittella, Superb Parrot and White-winger Triller, each of which is listed as vulnerable under the ACT NC Act. The Brown Treecreeper is also listed as vulnerable under the NSW TSC Act, and Superb Parrot is listed as vulnerable under the NSW TSC Act and Commonwealth EPBC Act. Other uncommon species in the region include Diamond Firetail (listed as vulnerable under NSW TSC Act), Crested-Shrike-tit, Jacky Winter and Flame Robin (Standing Committee on Planning and Environment 2008). The Lower Molonglo Gorge is considered likely to provide habitat for the threatened Painted Honeyeater, which is listed as vulnerable under the NSW TSC Act and ACT NC Act (Environment ACT 2001).

10.3 Pest Animal Species in the Molonglo Catchment

Carp (Cyprinus carpio)

Carp are considered a pest throughout Australia. Carp damage streams and affect populations of native fish, causing their decline by competing for food, habitat and breeding sites. Carp are also known to predate the eggs native fish species. Carp have been implicated in the erosion of stream banks and the loss of soil binding vegetation. Carp increase turbidity causing increased levels of nutrients to be placed in suspension, which favours algae blooms, depletes light for aquatic macrophytes, and reduces the levels of dissolved oxygen, making conditions unsuitable for native fish (NSW DPI 2005).

Plague Minnow (Gambusia holbrooki)

Plague Minnow (or Mosquito Fish) are live bearers of young, helping them to out-compete native fish especially in degraded systems. Plague Minnow has been implicated in the decline of several native fish species (ACT Government 2007). Plague Minnow are aggressive and are likely to out-compete native fish for food and shelter (NSW NPWS 2003). They may also prey on native fish eggs and fry. Plague Minnow have been recorded predating on the eggs and tadpoles of numerous native frog species including the endangered Green and Golden Bell Frog (NSW NPWS 2003). Plague Minnows are listed as a Key Threatening Process in NSW.

Redfin (Percia fluviatilis)

Redfin are notorious predators, preying on small native fish such as Rainbow Fish and Western Carp Gudgeon, and also on the young of Murray Cod, Macquarie Perch, and Golden Perch. They have been recorded eating newly released Murray Cod fry in Lake Burley Griffin (Environment Act 2002). Redfin are a vector for the viral disease EHN, may affect native fish species such as Macquarie Perch, Silver Perch, Murray Cod and Mountain Galaxias (ACT Government 2007). The EHN virus has been recorded in Lake Burley Griffin (ACT Government 2007).

Rabbits (Oryctolagus cuniculus)

Rabbits prefer open ground, especially grazing land with adjacent shelter such as logs. Rabbit grazing will slow or stop natural regeneration, damage crops, reduce biodiversity (including reducing the survival and recruitment of a number of threatened flora species known in the catchment) and reduce ecosystem resilience. Rabbits also cause damage to natives planted as part of revegetation projects. By removing ground cover rabbits increase erosion and this disturbance increases weed recruitment. Rabbits exist throughout the catchment (MCG 2009). Rabbits are listed as a Key Threatening Process both in NSW and federally.

Foxes, Dogs and Cats

Foxes, dogs and cats (both domestic and feral) are known kill and harass native animals and domestic stock. They may also cause relocation of native animals due to scent marking, and may act as a disease vector (MCG 2009). The native prey of foxes and feral, stray and domestic cats includes mostly ground-dwelling small mammals, reptiles, frogs and birds commonly found on the ground or in lower understorey, and occasionally bats and small arboreal mammals (ACT Government 2007).

Predation by feral cats is listed as a Key Threatening Process by the federal government, and the predation and hybridisation of feral dogs is listed as a Key Threatening Process in NSW. Predation by European red fox is listed as a Key Threatening Process both in NSW and federally.

Deer and Goats

There are six species of deer in Australia. Deer feed on a combination of shrub, understorey and grass species. Deer will graze young plants, disturb soil and damage bark. Deer can hinder natural and planned revegetation and the disturbance they cause can result in an increase in weeds. Fallow deer are the most common deer species in the catchment and several hundred are likely to occur (MCG 2009). Goats, like deer, are intensive grazers. Goats are also known carriers of parasites and diseases that affect domestic stock. Sightings of up to 30 goats are common in parts of the Molonglo catchment often adjacent to National Parks and Nature Reserves (MCG 2009). Competition and land degradation caused by goats is listed as a Key Threatening Process in NSW and federally.

Pigs

Pigs are opportunistic omnivores who will forage on vegetation, grains, fruit, roots, insects, small mammals, ground-nesting birds and carrion. Pigs are a problem because of predation on native species, habitat degradation, competition and disease transmission. Pigs cause significant soil disturbance, contributing to soil erosion and a reduction in water quality. They also foul and damage waterholes (MCG 2009). Predation, habitat degradation, competition and disease transmission by feral pigs is listed as a Key Threatening Process in NSW.

11. Appendix C Previous Works including Molonglo River Rescue Pilot Reach

Table 5 Past rehabilitation works undertaken on the Molonglo River

Previous Actions	Date	Agency
Molonglo River Rescue Pilot Reach: 3 km of fencing along the river corridor to restrict access of stock Provision of alternate stock watering where applicable Follow-up control 8 km of Willows Follow-up control 20 km of Blackberry in the ACT	2009/10	MCG GA PCL Murrumbidgee CMA
Molonglo River Park (800m riparian strip): Willow & Blackberry Control Revegetation including mechanical ripping and weed management Fencing and signage On-going monitoring and follow-up weed management	2009	Palerang Council Carwoola Landcare Murrumbidgee CMA
CIC Australia Development Establishment of wetland to manage run-off Rehabilitation of riparian vegetation including weed removal and revegetation	2010	CIC Australia GA MCG
Trial Willow Removal One km of river frontage with various landholders over a 3 km discontinuous reach with rehabilitation of the Molonglo River at Wilkins Park	2009	Carwoola Landcare Captains Flat Landcare GA Local landholders
Molonglo Reach Riparian Restoration Project Included large scale removal of weeds and revegetation with natives. Repair of eroded shoreline.	2008/9	PCL
Molonglo Reach (Campbell) 1.5 km of Willow removal follow-up	2008/9	PCL
Molonglo Gorge riparian corridor 15 km of follow-up weed control (Willows & Blackberry)	2008/9	PCL
Scrivener Dam outflow 400m Willow and other woody weed control	2008/9	NCA / PCL
Molonglo River below Coppins Crossing 13km of Blackberry control	2008/9	PCL
Molonglo River from Woolshed Ck to Dairy Rd bridge 650m of Willow & woody weed control	2008/9	ACT Roads

Previous Actions	*Date*	*Agency*
Lake Burley Griffin 600m Black Alder control from Black Mountain Peninsula & Lady Denman Drive 900m Willows	2009/10	PCL
Lake Burley Griffin (various foreshore areas managed by PCL west of Commonwealth Ave bridge) Blackberry control	2008/9 2009/10	PCL
Upstream of Coppins Crossing 3km of Blackberry control	2009/10	PCL
Downstream of Coppins Crossing 3km of Willow control	2009/10	PCL
Tributaries (willow & woody weed control), targeted projects: Jerrabomberra Creek & Jerrabomberra wetlands Queanbeyan River (Googong) Woolshed Creek (upper reaches)	2005-10	PCL
Lake Burley Griffin 80m west of Sullivans Ck outflow Willow & woody weed removal	2008/9	PCL