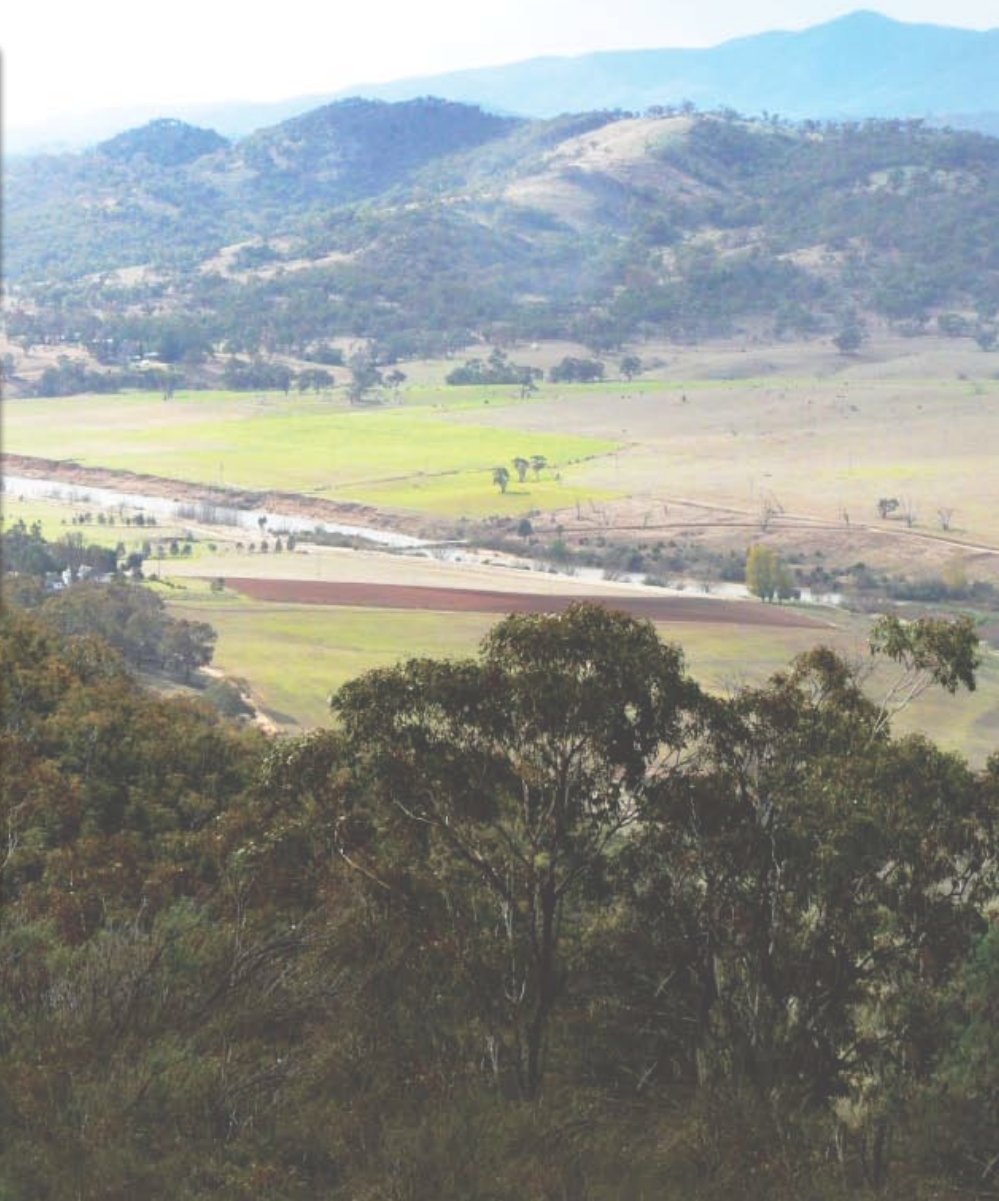




# Upper Murrumbidgee Demonstration Reach

# Implementation Plan







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# Implementation Plan

## Sponsors:

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# About this initiative and plan

The health of the Upper Murrumbidgee River is under threat from a range of environmental concerns. The native fish community within the Upper Murrumbidgee and its tributaries account for as little as four percent of the total catch recorded in monitoring programs (Lintermans and Osborne 2002). Alien fish species, in particular carp, are widespread, comprising between 70 and 100% of total biomass at survey sites within the reach. Ninety-nine percent of the Murrumbidgee River's headwater flows are diverted away to the Snowy Hydro Scheme at Tantangara Dam leaving reduced discharge and flow variability downstream. Loss of instream habitat due to widespread sediment deposition has been observed for over 100 years, while clearing of riverbank vegetation and spread of weeds have contributed to a reduction in resilience of the riverine ecosystem.

The fact that a small but seemingly viable native fish population, as well as areas of higher quality riverine habitat still remain, provides a baseline from which recovery can be demonstrated. This initiative aims to provide the community with a visible demonstration that the health of the river and its floodplain, and the plants and animals that depend upon these river habitats, can be rehabilitated to a better condition through coordinated actions that address the major threats.

Through adopting community engagement objectives for the site, in addition to ecological and recreational objectives, the Upper Murrumbidgee Demonstration Reach (UMDR) initiative is seeking to work with the community and involve them in project activities wherever possible.

The vision for this demonstration reach is:

**A healthier, more resilient and sustainable river reach and corridor that is appreciated and enjoyed by all communities of the national capital region.**

The initiative provides an opportunity for UMDR participants to communicate to the broader community within the region as to how the Upper Murrumbidgee can be 'cared' for by a range of committed stakeholders. Importantly the success of the initiative relies upon the interest and enthusiasm of the community

This implementation plan presents this overall vision, along with goals, objectives and guiding principles for the UMDR initiative. It reviews the natural assets of the site, and the threats they face, or may face in coming years; then sets out integrated actions to be taken in response to those threats.

It is recognised that the Upper Murrumbidgee Demonstration Reach Implementation Plan needs to complement existing documents such as the: *Murrumbidgee River Corridor Management Plan* (ACT Government 1998), the *ACT Aquatic Species and Riparian Zone Conservation Strategy* (ACT Government 2007), the *National Capital Plan* (National Capital Authority 2010) and the *Murrumbidgee Catchment Action Plan* (Murrumbidgee CMA 2008). The implementation plan should also aim to draw into a cohesive framework those activities that are ongoing within the area under other programs and initiatives.

This implementation plan should be considered in conjunction with its companion plans for:

- monitoring and evaluation
- communication, education, participation and awareness
- carp reduction.



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## Abbreviations

ACT	Australian Capital Territory
CEPA	communication, education and public and awareness raising
CMA	Catchment Management Authority
DECCW	Department of the Environment, Climate Change, and Water
EPBC	Environmental Protection and Biodiversity Conservation Act
IBRA	Interim Biogeographical Regionalisation of Australia
M&E	monitoring and evaluation
ML	megalitres
ML/d	megalitres per day
MRC	Murrumbidgee River Corridor
NFS	Native Fish Strategy
NGO	non-government organisation
NRM	natural resource management
NSW	New South Wales
TAMS	ACT Department of Territory and Municipal Services
UMDR	Upper Murrumbidgee Demonstration Reach
WAE	(surface and ground) water access entitlements



# 1. Introduction

The Upper Murrumbidgee River Demonstration Reach is approximately 100 km in length, stretching from the rural township of Bredbo in south-east New South Wales downstream to Casuarina Sands in the Australian Capital Territory (see Figure 1).

A demonstration reach is a large (typically between 20 and 100 km in length) and prominent (for example, close to a large human population centre) river reach in which a number of management interventions are applied to showcase to the community the cumulative benefits of river rehabilitation (MDBC 2004) (see Section 1.1).

The Upper Murrumbidgee River is an ideal site for a demonstration reach as it is a high conservation value ecosystem containing the critical aquatic habitats of several nationally listed threatened species (notably trout cod, Murray cod and Macquarie perch).

The Upper Murrumbidgee aquatic ecosystems are threatened by:

- reduced water quality from urban and rural pollution
- water extraction
- excessive sediment deposition
- introduced fish and other fauna
- loss of riparian vegetation
- the spread of weeds of national significance
- barriers to fish movement that fragment threatened fish populations.

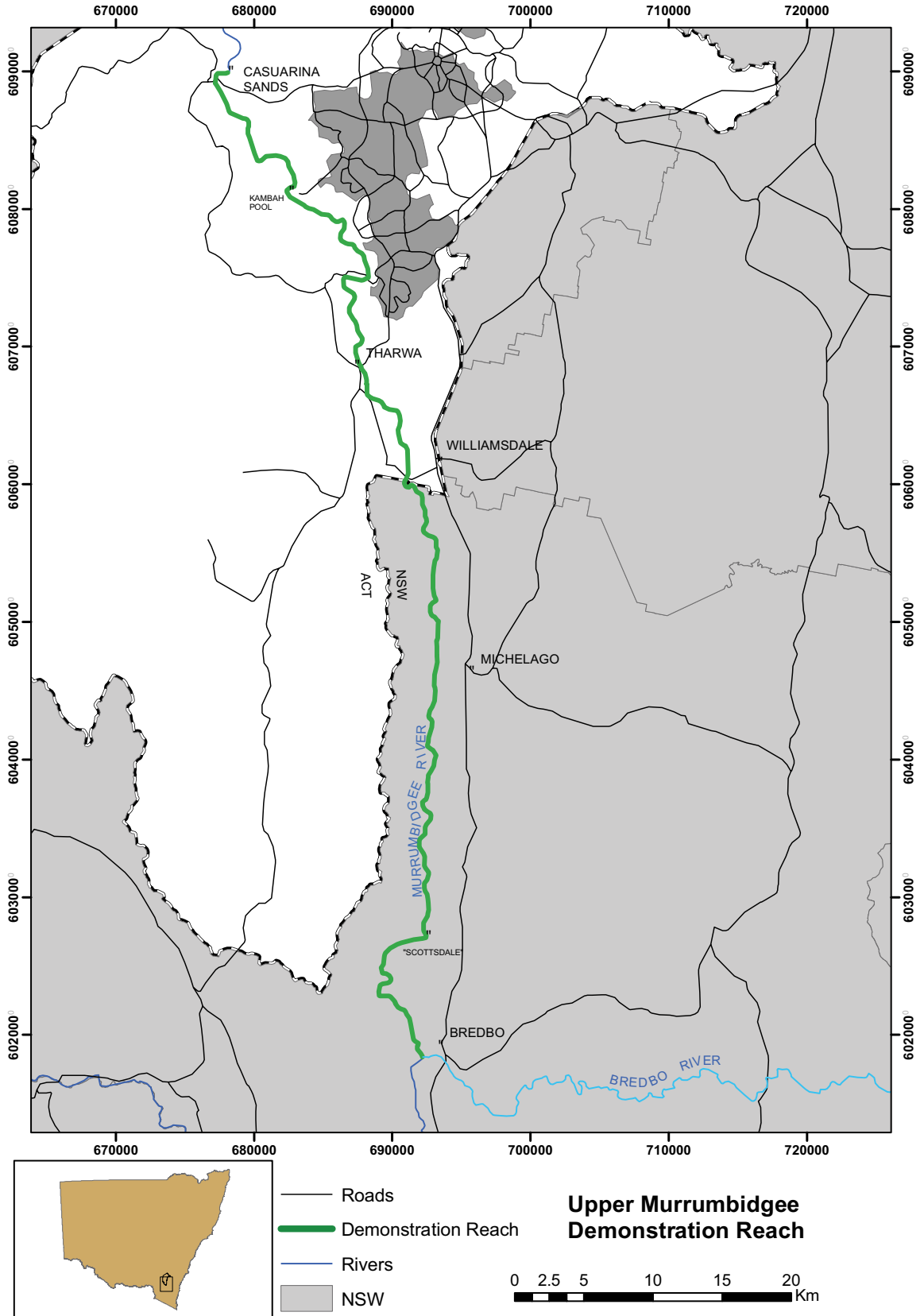
The demonstration reach framework provides a cohesive and inter-disciplinary way to achieve large-scale and significant environmental outcomes for the Upper Murrumbidgee River in both New South Wales (NSW) and the Australian Capital Territory (ACT). In particular, it will improve ecosystem resilience and ability to cope with future change by directly increasing the connectivity and condition of critical aquatic habitats within the reach.

The initiative also aims to help in the further development of cross-jurisdictional links for catchment management between the ACT and NSW, and foster improved partnerships and links between terrestrial and aquatic natural resource management groups, including government, community and industry. More than ten groups are already partners for the Upper Murrumbidgee Demonstration Reach (see section 1.3).

Strong links and diverse partnerships will ensure that the Upper Murrumbidgee Demonstration Reach:

- connects with all levels of government, from local to state/territory to national
- encourages community involvement and input at all stages of development
- develops a firm regional commitment to its longevity beyond initial short-term funding cycles
- explores novel ways to leverage corporate sponsorship
- achieves ecological, economic and social outcomes desired by all stakeholders
- recognises the importance of the river to the wellbeing of the people dependant on it including long-term Aboriginal occupation.

Figure 1: Location of the Upper Murrumbidgee Demonstration Reach





## 1.1 The demonstration reach concept

In May 2003 the Murray–Darling Basin Ministerial Council approved the Native Fish Strategy (NFS) for the Murray–Darling Basin. The strategy has a theme of rehabilitating aquatic habitats and ecological processes in the Murray–Darling Basin through management actions designed to restore healthy native fish communities. The strategy is based around several key issues:

- that the decline of native fish populations in the Murray–Darling Basin has been caused by a combination of threatening processes, not one single process
- in order to achieve the strategy's overall goal (rehabilitation of native fish populations back to 60% of the pre-European situation after 50 years of implementation), several key management interventions need to occur simultaneously and in an integrated and holistic manner
- rehabilitation should be based on ecosystem management, with emphasis on ecological communities rather than single species
- the concept of a demonstration reach is a positive way to engage the public and learn from practical examples of rehabilitation.

The purpose of demonstration reaches is to show, by example, how river and floodplain rehabilitation can be achieved by well-integrated actions such as riparian zone rehabilitation; improvements to in-stream habitat such as improving fish passage, re-snagging and enhancing aquatic vegetation; management of introduced species; improving water quality; and providing direction on environmental flows.

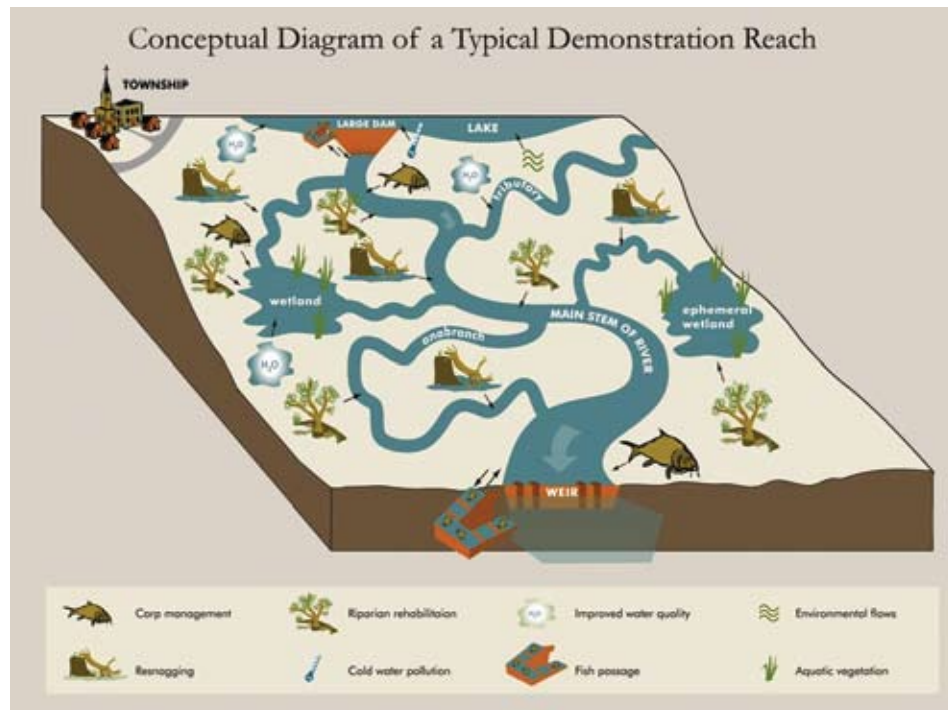
The successful rehabilitation of a reach or floodplain (see Figure 2 for conceptual diagram) is designed to enhance community awareness, support and involvement in management and provide models that can be used elsewhere. It is also hoped that such rehabilitation will attract the attention of funding agencies and boost scientific knowledge.

One fundamental premise of a demonstration reach is to enhance community awareness and support. Engagement of both Aboriginal and non-Aboriginal community members is therefore essential to success. A range of individuals and community groups are expected to be involved. These individuals or groups may have either an interest in a demonstration reach (e.g. fishing, educational, environmental) or a right (e.g. property or custodial) linked to the land and/or water resources.

A demonstration reach needs a considered approach to engaging with this variety of individuals and groups, and needs to be cognisant of the different ways in which individuals and groups receive, respond to, and can contribute to planning and management processes.

The establishment of a demonstration reach is consistent with the initiatives of the former Murray–Darling Basin Commission to involve Aboriginal people in management of the basin and incorporate consideration of Aboriginal cultural heritage into decision making (MDBC 2003). Aboriginal people have ownership and custodial responsibilities over waterways and fish as well as important traditional knowledge. Aboriginal rights to fish in the Murray–Darling Basin are recognised by the *Native Title Act 1994* (Cwlth). The MDBC Aboriginal Action Plan aimed to support a co-management approach to natural resources that could be linked with a demonstration reach initiative. This would allow for the meaningful involvement of Aboriginal people in decision making and management aimed at rehabilitating native fish populations and fish habitats. The area encompassed by the UMDR is commonly recognised as crossing lands occupied by both Ngarigo and Nggunawal Aboriginal Peoples who utilised the Murrumbidgee River for a range of traditional activities. It is anticipated that where possible, outcomes concerning the development of this initiative will involve representatives of these groups.

Figure 2: Conceptual diagram of a typical demonstration reach



## 1.2 Why the Upper Murrumbidgee River was chosen as a demonstration reach

The Murrumbidgee is the largest river flowing through the ACT and surrounding NSW region. The significance of the upper reaches of the river were recognised when approximately 400 km were placed on the Register of the National Estate, extending from Tantangara Dam to the mouth of Oaky Creek, 300 m south-west of Yeumburra Homestead and about 20 km north of the northern border of the ACT, including 20 m on either side of the river from bank-full discharge level.

Along its length within the ACT the river is protected to some degree by the presence of the Murrumbidgee River Corridor reserves. However, critical aquatic habitats cannot be managed successfully by adhering only to jurisdictional boundaries, and consequently more effective and direct links need to be established with the upstream catchment in NSW.

Native fish communities have undergone significant declines across the whole of the catchment, with the Murrumbidgee River fish community (as it existed in 2004) being classified as severely degraded (Gilligan 2005). A report card on the ecosystem health of the upland and montane zones of the Murrumbidgee River revealed them as being in very poor condition, with the fish community component rated as being poor to extremely poor (MDBC 2008a).



The Upper Murrumbidgee River is a critical aquatic habitat for several nationally threatened species (Lintermans 2002; MDBC 2008b). Nine native fish species have been recorded in this reach of the Murrumbidgee (Lintermans 2002). The list includes nationally listed threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (Trout cod, Macquarie perch, Murray cod), three ACT listed threatened species including one crayfish (Murray River crayfish, Silver perch, Two-spined blackfish) and four other species (Golden perch, Mountain galaxias, Western carp gudgeon and Australian smelt). Two species from the UMDR are also listed as endangered under the *Fisheries Management Act 1994* (NSW), namely, Trout cod and Macquarie perch.

Macquarie perch have been detected at several sites in recent sampling along the UMDR, including at Angle Crossing near the southern ACT border and Collinton Gorge near Michelago (ACT Government unpubl data 2010, MDBA SRA unpubl data 2010). Conservation stockings of Trout cod continue at key locations within the reach. Studies show that there is still an ecological community present that is capable of responding to rehabilitation of the river (ACT Government unpubl data 2010). Intervention is urgently required to mitigate the diverse array of cross-border threats that impact on this stretch of river and to rebuild ecosystem resilience.

This demonstration reach initiative will contribute to environmental outcomes of national significance through:

- preservation and/or enhancement of in-stream habitat condition.
- seeking the removal of artificial barriers to fish passage in order to increase aquatic ecosystem connectivity and maintain and improve threatened native fish populations
- participating in the establishment of enhanced environmental flows to maintain biodiversity and critical ecosystem processes
- seeking solutions to introduced pest fish management
- improving water quality in the Upper Murrumbidgee River through addressing rural and urban pollution sources
- improving the extent, condition and biodiversity of riparian zones
- reducing the impact of nationally significant weed species such as willows and blackberries
- encouraging greater community empathy, education and understanding of aquatic issues
- strengthening community collaborations and ownership of natural resource management issues
- committing to rigorous monitoring and evaluation by both scientists and local community groups.

This demonstration reach will also contribute to achieving water quality and biodiversity targets in the ACT Natural Resource Management Plan and the Murrumbidgee Catchment Action Plan.





### 1.3 Who is involved?

The Upper Murrumbidgee Demonstration Reach creates a cohesive framework for the activities of the many different natural resource management agencies and organisations in the ACT and NSW region. The initiative currently includes the following partners:

- Murray-Darling Basin Authority
- Murrumbidgee Catchment Management Authority
- ACT Natural Resource Management Council
- ACT Territory and Municipal Services
- ACT Waterwatch
- Industry and Investment NSW
- Greening Australia Capital Region
- Bush Heritage Australia
- RiverSmart Australia
- ACTEW AGL
- ACTEW Corporation
- Upper Murrumbidgee Catchment Coordinating Committee
- University of Canberra
- Australian National University

Actively linking to a wide range of organisational partners greatly enhances the promotion and likely success of the initiative, and develops a firm regional commitment to its longevity beyond initial short-term funding cycles.

All partners, as well as representatives of other community organisations have contributed towards the development of this ten-year integrated strategic plan for natural resource management in the Upper Murrumbidgee River.

### 1.4 Purpose of this implementation plan

This implementation plan has been prepared to set out a common vision and to justify, integrate and document the actions to be undertaken. These actions seek to further the management goals of an existing range of related plans (see Section 1.8), while also seeking to improve the condition of the reach and reduce impacts on the health of the site, and the ecological communities it supports.

This plan will be an evolving document. It is anticipated that elements of the plan may be modified, based on the results of the ongoing monitoring of the site. This is consistent with the adaptive management approach being used (see Guiding Principles – Section 1.7).

While some studies within the Upper Murrumbidgee Demonstration Reach area have been completed (see Sections 2 and 4 especially), there are some significant gaps in knowledge. As such, this first implementation plan applies a conservative approach based on the threats identified at present (see Section 4). When new information becomes available, or areas of uncertainty are confronted, every effort will be made to address these information gaps as soon as possible and the implementation plan adjusted accordingly.

This implementation plan should also be considered in conjunction with its companion plans for:

- monitoring and evaluation (M&E)
- communication, education, participation and awareness (CEPA) and
- carp reduction.



## 1.5 Vision and goals for the Upper Murrumbidgee Demonstration Reach initiative

**Vision: A healthier, more resilient and sustainable river reach and corridor that is appreciated and enjoyed by all communities of the national capital region.**

Goals help to articulate this vision of the initiative and indicate the aspirations for the UMDR

1. Through the activities proposed in this plan, the desire is to stop further degradation of the demonstration reach and see it become healthier through actions such as:
  - improving the health of in-stream and riparian habitats
  - increasing native fish populations, especially those of threatened species
  - removing or modifying barriers to native fish movements
  - improving water quality, particularly reducing sediment and nutrient inputs
  - making best use of available surface water and environmental flows to improve the health of the reach
  - reducing the spread and impacts of woody weeds; most notably blackberries, and willows and other deciduous trees
  - seeking solutions to reduce populations of introduced pests including European carp, *Gambusia*, Redfin perch, rabbits, pigs and deer
  - improving the health of native plant communities – particularly the health status and recruitment of riparian trees and associated understorey
  - Seeking advice on, and incorporating, traditional ecological knowledge with modern contemporary management techniques.
2. This initiative is also about demonstrating what is possible through strategic, coordinated interventions involving government and non-government organisations, and leaseholders and landholders influencing the Murrumbidgee working together
3. This initiative will also be used to strengthen community interest and engagement in working to restore the health of our rivers, and in this case a portion of the Upper Murrumbidgee River. Opportunities to engage and support community river health improvement and monitoring initiatives to benefit the rehabilitation of the UMDR will be valued. Opportunities to assist traditional owners involvement in the initiative, such as through the integration of traditional ecological knowledge and respect for cultural values and heritage, are important to the vision of the successful UMDR.

## 1.6 Objectives of the Upper Murrumbidgee River Demonstration Reach initiative

Implementation plans specify the objectives for the management efforts they seek to guide and mobilise. Such objectives encompass the broad range of social, economic, cultural and environmental implications for river management. Importantly, plan objectives can help to further define the 'vision' for the site (see Section 1.5).



### 1.6.1 Long-term objective

The long-term objective of this initiative is to develop a demonstration reach of approximately 100 km in length, stretching from the township of Bredbo in NSW downstream to Casuarina Sands to the west of the Canberra suburban area.

If this proposed core demonstration reach area proves successful, there is the potential to extend the demonstration reach in stages to cover other areas of the ACT, as well as further upstream and downstream into NSW between Tantangara and Burrinjuck reservoirs.

### 1.6.2 Short to medium-term objectives

**Environment:** The primary objective is to enhance the ecological condition of the site by:

1. improving the connectivity along the river, both in-stream and along the riparian corridor, as well as laterally into the surrounding landscapes
2. providing input to flow management improvements to revitalise in-stream, riparian and floodplain environments
3. reducing water pollution in particular sediment and nutrients
4. increasing the populations and abundance of native aquatic and terrestrial flora and fauna, especially threatened species
5. reducing the impacts of introduced plant and animal species.

**Community:** Community engagement objectives aim to ensure the community is engaged and aware of project activities by:

1. increasing awareness of activities – what is happening and what is planned in the project
2. improving community capacity to assist with management of the reach
3. demonstrating, through education, best practice techniques for environmental rehabilitation and water use
4. improving the understanding of river ecology and fish management through communication with the community
5. developing a better understanding of the links between traditional culture and the ecology of the river and its floodplain
6. using the site as a demonstration of river rehabilitation to the broad community so that they can learn from it in undertaking their own initiatives.

**Recreation:** Recreational objectives aim to ensure the Upper Murrumbidgee River continues to be enjoyed by visitors, by:

1. promoting sustainable recreational use on public lands through asset improvement and education
2. promoting recognition of the reach as an important natural, cultural and economic asset in the region, and promoting this initiative as a model for other river communities to follow.

**Governance:** Governance objectives aim to achieve a high level of integration between those involved with the management of the reach focused on the objectives above, by:

1. promoting collaboration between management agencies, landholders and other stakeholder parties to achieve the agreed vision for this initiative
2. pursuing the intent of the Murray–Darling Basin Authority's Native Fish Strategy demonstration reach concept, where a number of integrated management interventions are applied to showcase the cumulative benefits of river rehabilitation



3. participating in best practice environmental rehabilitation and promote community awareness and involvement in riverine restoration activities
4. supporting environmental education and training related to issues of conservation and sustainable resource use
5. developing active participation by local communities, all levels of government, private groups and organisations to bring resources and expertise to achieve project outcomes.

## 1.7 Guiding principles

Guiding principles are the agreed *modus operandi* or 'ways we will operate' statements on which implementation of this plan rests. The following principles are applicable to the Upper Murrumbidgee Demonstration Reach initiative:

1. Adaptive management will be applied. This requires ongoing monitoring of system responses to management actions to help inform those co-ordinating implementation so that, as necessary, these actions can be adjusted or fine tuned.
2. The precautionary approach will be applied. This states *where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation* (Rio Declaration, Principle 15) (UNEP 1972) (see Appendix A).
3. Through the steering group (see Section 3.3.1), open, transparent and consultative decision making will apply to implementation of this plan.
4. Consultations will be held with those responsible for managing ecologically or hydrologically linked areas where activities may result in a potential risk to the environmental, social, cultural or economic values of the Upper Murrumbidgee Demonstration Reach. Where such risks are identified, solutions to mitigate or minimise these risks will be sought.
5. Respect will be shown for the Aboriginal and European cultural heritage values of the site. These are important in community links to the site.
6. Recognition will be given to regional, as well as broader NSW/ACT and Murray–Darling Basin policies, initiatives and obligations, especially in relation to water management, salinity and environmental flows.
7. The availability of resources, both human and financial, may limit the pursuit of the vision and implementation of this plan, and, where necessary, management actions will be prioritised to match available resources.

## 1.8 Links to other initiatives, existing and related plans

The Upper Murrumbidgee Demonstration Reach is located within the NSW Southern Tablelands region of the Murray–Darling Basin. The project is framed within the basin-wide Native Fish Strategy for the Murray–Darling Basin 2003–2013 (MDBC 2004). Within NSW and the ACT, several related plans, strategies and projects exist across a range of legislative frameworks.

The Murrumbidgee Catchment Action Plan (Murrumbidgee CMA 2008) includes socio-economic and environmental plans for the whole of the Murrumbidgee Catchment. In NSW the UMDR is within the Cooma–Monaro Shire for which environmental considerations are included in Local Environment Plans (LEP's) prepared under the *Environment Planning and Assessment Act 1979* (NSW). At the time of publication these include the *Cooma–Monaro Local Environmental Plan 1999—(Rural)* and the *Yarrowlumla Local Environmental Plan 2002*.



This demonstration reach initiative addresses a number of riverine issues not detailed in a *Planning Framework for Natural Ecosystems of the ACT and NSW Southern Tablelands* (Fallding 2002) that is otherwise focussed on an integrated cross-border approach to regional environmental planning issues.

In the ACT the UMDR goals accord with the policies of the *National Capital Plan* (NCA 2010) and *The Territory Plan* (ACT Government 2010a), as well as the *ACT Aquatic Species and Riparian Zone Conservation Strategy* (ACT Government 2007) and *Murrumbidgee River Corridor Plan of Management* (ACT Government 1998).

At the time of publication a number of initiatives exist within the region that have direct synergies with the UMDR project. The Molonglo River Rescue Action Plan (Bowman and Keyzer, 2010), directs a targeted river rehabilitation project along one of the major tributaries of the Upper Murrumbidgee. Relevant work being undertaken along the Queanbeyan River includes Aboriginal training and cultural interpretation, as well as willow control and related riparian works for which the Queanbeyan City Council and the Murrumbidgee Catchment Management Authority are primarily responsible in partnership with the local Aboriginal community.

At a more regional scale the Kosciuszko to Coast (K2C) initiative aims to increase regional habitat connectivity throughout the region including the UMDR. Several other organisations undertake on-ground action, planning and monitoring in the Upper Murrumbidgee Catchment, for example the Upper Murrumbidgee Landcare network, the Upper Murrumbidgee Catchment Coordinating Committee, and Upper Murrumbidgee Waterwatch and associated catchment groups centred on the Upper Murrumbidgee (NSW), southern ACT, the Molonglo River and Ginninderra Creek.



## 2. Describing the demonstration reach

### 2.1 Location and site overview

The Murrumbidgee River is one of the longest rivers in the Murray–Darling Basin, flowing some 1600 kilometres from the source to the junction with the Murray River near Balranald, NSW. The Murrumbidgee catchment covers an area of approximately 84000 square kilometres or 8.4 million hectares (Murrumbidgee CMA 2008).

The Upper Murrumbidgee Demonstration Reach is approximately 100 kilometres in length, extending across the Southern Tablelands region from Bredbo in the Monaro Plains of NSW, through to Casuarina Sands near the western suburbs of the ACT. Approximately half of the demonstration reach is within NSW and half in the ACT, crossing the border near Williamsdale (ACT) (see Figure 1).

The Upper Murrumbidgee River is considered to be in a state of decline and is described as in very poor condition along its length (MDBC 2008a). Although this is generally true of the project area, several significant areas in better ecological condition remain where steep, rocky and narrow gorges confine the channel (see Plate 1). These are broken by broad valley flats (see Plate 6) where the surrounding landscapes have been altered by rural land use and peri-urban activities.

The Murrumbidgee River is the major waterway in the ACT and region and drains all catchments of urban Canberra, the largest city in the Murray–Darling Basin, and those of surrounding rural NSW. The water in this river reach is a valuable resource for ecological, rural, urban and recreational purposes. Importantly, the Murrumbidgee River is also a key source of drinking water for the populations of Canberra and neighbouring Queanbeyan (NSW).



Plate 1: Murrumbidgee River, looking towards Gigerline Gorge – the current upstream distribution limit of lowland Murray–Darling Basin native fish community. Photo: Luke Johnston



## 2.2 Climate

The climate of the project area is characterised by hot summers and cold winters. Rainfall is distributed throughout the year, with a slight peak in spring (Bureau of Meteorology, 1968). The average annual rainfall reported in the ACT varies between 625 and 750 millimetres (NCDC 1981), with extended periods of drought known to occur between periods of more reliable rainfall such as has occurred throughout the first decade of this century.

A set of microclimates that are different to the surrounding terrain occur in the river valley, in which the deeply entrenched slopes (see Plate 2) provide protection from the wind, and shade southerly and westerly aspects. In winter the river valley is particularly frost and fog prone because of cold air drainage down the valley slopes (NCDC 1981).



Plate 2: Murrumbidgee River and the steep face of the Bullen Range between Casuarina Sands Reserve and Kambah Pool. Photo: Luke Johnston





## 2.3 Physical features

### 2.3.1 Geology and soils

The UMDR straddles the north-south trending Murrumbidgee Fault that creates a major unconformity between the granitic Murrumbidgee Batholith to the west, and the Colinton and Laidlaw volcanic suite to the east. Silurian volcanic rocks dominate most of the Murrumbidgee River channel in the project area, with rhyolitic to rhyodactic tuffs as well as significant porphyry outcrops common throughout, except for occasional areas where the river crosses into lower altitude adamellite and granodiorite outcrops to the west of the fault (Geological Society of Australia 2008; Johnston et al. 2009).

The soils in the river valley are typical of the capital region, with duplex and occasionally gradational profiles of varying depth. Where steep valley slopes occur, shallow soils are common in the form of lithosols with numerous rock particles, or as pockets of soil within outcropping rock (NCDC 1981). In this situation the narrow floodplains are dominated by solid bedrock outcrops (Johnston et al. 2009). Deeper duplex and gradational soils with typically clay-rich lower horizons occur on colluvial deposits at the foothills of broad slopes. In these situations, deep river terraces occur close to the river, associated with young, poorly developed soil profiles formed on recent stratified alluvial deposits (NCDC 1981).

### 2.3.2 Geomorphology

The underlying geology strongly correlates with the stark changes in physical landscape features throughout the demonstration reach. Over the approximately 100 river kilometres of the reach, elevation declines from 700 metres (ASL) at Bredbo, to around 470 metres at Casuarina Sands, representing an average gradient of 2.3 m per river kilometre (Google Earth® 2009).

The river valley is typically steep and dissected as it passes through a number of gorges (see Plates 1, 2 and 4) in which the channel narrows through steep-sided bedrock floodplains. In places the valley broadens where old river terraces are developed on river alluvium and hill slope derived colluvium (see Plates 3 and 6).

Frequent changes in channel and floodplain geomorphology occur, correlating with changes in the composition of rock, sand, gravel and boulders, creating a diverse mosaic throughout the project area. Through steep valley sections the river is confined to a narrow relatively straight channel and rapidly falls in level as it passes through rapids, chutes and turbulent white water conditions (see Plates 1 and 4).

Where undulating land joins the river, it meanders within the confines of a broad channel with sweeping bends. In this situation steep banks occur on the outside of bends and broad sand banks develop on the insides (NCDC 1981) (see Plate 5). In such situations high sediment loads have deposited and created 'sand slugs' that have in-filled previously deep channel pools (see Plate 3 below). Table 1 was developed by Johnston et al. (2009) during a study of the floodplain components encountered within the ACT section of the UMDR area. The river channel typically varies in relation to these landform units.

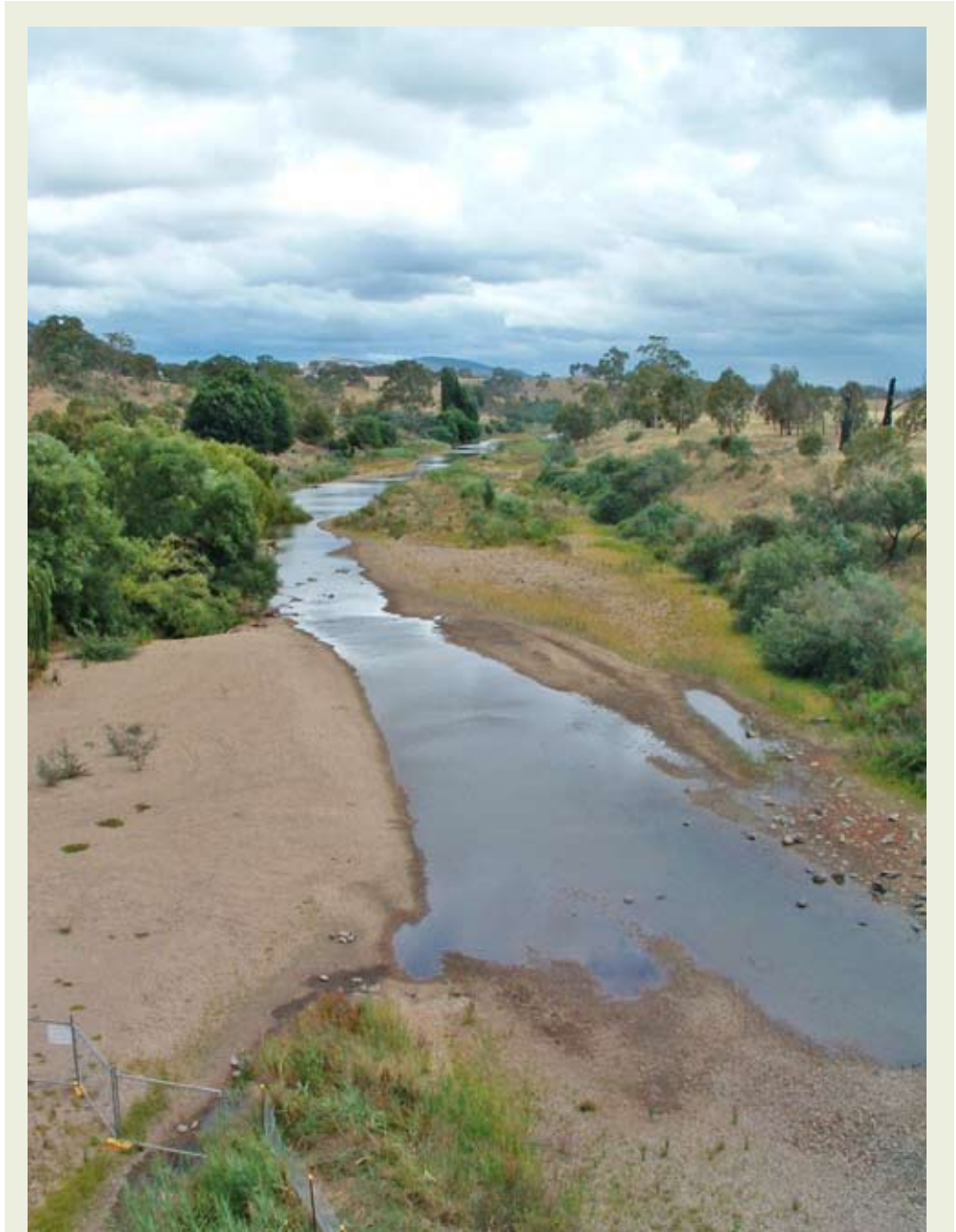


Plate 3: The Murrumbidgee River at Tharwa. Sand slugs and low flow volumes are a long-term issue along this stretch of the demonstration reach. Here the surface flow sometimes ceases during summer. Photo: Bill Phillips, RiverSmart



Plate 4: Red Rocks Gorge on the Murrumbidgee River. Photo: Luke Johnston

Plate 5: Murrumbidgee River gorge bordering Smith's Road south of the ACT border. Photo: Luke Johnston





Plate 6: Murrumbidgee River looking downstream toward Tharwa Bridge across cleared, open agricultural land. Photo: Luke Johnston.



Table 1: Floodplain geomorphic units (a) and floodplain geomorphic sub-units (b) recorded during the study of the Murrumbidgee River valley in the ACT (Johnston *et al.* 2009).

(A) BROAD GEOMORPHOLOGY	
	DESCRIPTION
Simple floodplain	Riverbank adjoining a floodplain surface with little or no variation.
Complex floodplain	Riverbank adjoining a predominantly loose earthen floodplain surface with channelled flood runners and associated wetlands and some bedrock outcrops with distinctive vegetation suites.
Bedrock floodplain	Riverbank adjoining a floodplain surface that contains a high proportion of exposed bedrock (often >50%) amongst an otherwise sandy substrate. Where bedrock outcrops, ridges often occur with channels between, often forming combination of ridges and flood runners.
Bedrock platform	Predominantly solid bedrock outcrop floodplain surface, often where river narrows through gorges. Usually well-elevated above river base flow level with steep high sided rocky banks.
Bank-slope-terrace	Riverbank adjoining valley slopes that are interrupted by elevated terraces (ancient floodplains) above the zone of regular flooding.
Bank-hill slope	Riverbank immediately adjoining river valley slope (zone where no regular flooding occurs). Often where surface bedrock precludes floodplain development. Also common at high altitudes.
Sandbank/sandbar	Emergent sand deposition zone on edge of river channel or mid-channel where stream flow is low.
Rocky island	Singular isolated emergent mid-channel rocky outcrop.
Cascade	Complex of emergent mid-channel rock outcrops.
(B) TERRESTRIAL GEOMORPHIC SUB-UNITS	
	DESCRIPTION
Riverbank	The part of the river channel immediately adjacent to the zone of permanent inundation. The riverbank is regularly inundated and usually contains a suite of hydrophilic aquatic/semi-aquatic vegetation.
Floodplain surface	Any part of the flood zone above the level of the riverbank that does not retain surface water following flood. This is the 'water-shedding' part of the flood zone.
Flood runner	A channelled part of the floodplain that contains flowing water during flood. Often evidenced by coarser grain particles that settle out following the recession of flood conditions. May contain small areas that retain water (wetlands/puddles) following the retreat of flood water.
Wetland	The part of a floodplain that retains water following flood or rain periods. Often contains fine silt / mud particulate substrate and semi-aquatic fringing vegetation. Can be ephemeral or permanent.
Bedrock outcrop	In situ bedrock outcrop. Often remains emergent during flooding of riparian areas and therefore may host flood intolerant vegetation species that are different to the surrounding floodplains.
Terrace	A mostly flat ancient floodplain surface elevated above the zone of regular flood inundation.
River valley slope	The slope above the riparian zone proper confined to the incised river valley. Never inundated during flood. Contains colluvial rather than alluvial soils.



## 2.4 Hydrology

### 2.4.1 Historical, current, and potential future surface water flow patterns

The Murrumbidgee River is the main stream within the Murrumbidgee Catchment. It starts in the Kosciuszko National Park on the Long Plain and flows 1600 kilometres westward to its confluence with the Murray River near Balranald. It has average annual flows of around 4.4 million megalitres and is the third largest river in the Murray–Darling Basin (Murrumbidgee CMA 2008).

Major tributaries within the Upper Murrumbidgee Demonstration Reach include the Bredbo, Gudgenby, Naas and Cotter Rivers, and Michelago and Tuggeranong Creeks.

Historically the natural flow regime in the Upper Murrumbidgee River was characterised by high winter and spring flows due to a predominance of rainfall in the upper catchment at that time, and snow melt from August to October bringing floods. Historic records (National Trust of Australia ACT, 1980) describe several severe floods in the 1800s that caused major changes to the river banks.

Flood levels and frequency, as well as base flows, have decreased since the construction of Tantangara Dam near the headwaters of the Murrumbidgee River, which diverts 99.6% of the average natural flow in the upper catchment to the Snowy Mountains Hydro Scheme (Pendlebury 1997).

This flow reduction equates to an approximate 40% reduction at Lobb’s Hole in the centre of the demonstration reach. Flow is occasionally released from Tantangara Dam for downstream extraction and to maintain flow at Mittagang Crossing near Cooma.

Water is extracted from the Murrumbidgee River within and above the Reach at a number of points for agricultural use and domestic consumption (see Figure 3). Table 2 shows the median, 90<sup>th</sup> and 10<sup>th</sup> percentile flow at Lobb’s Hole since 1974.

Typical surface flow patterns in the Upper Murrumbidgee River currently remain governed by seasonal climatic factors with moderate to low flows maintained throughout the year, broken occasionally by floods of varying magnitude (NCDC 1981).

**Table 2: Median, 90<sup>th</sup> and 10<sup>th</sup> percentile flow (ML/d) at Lobb’s Hole since 1974**

	MEDIAN	90TH PERCENTILE	10TH PERCENTILE
Median	261.2	33.9	1587.7
Jan	121.8	12.1	612.4
Feb	96.3	10.1	648.3
March	98.6	7.6	834.4
April	82.9	19.2	791.6
May	156.7	41.7	951.6
June	239.1	67.9	2130.4
July	382	84.5	2639.4
August	451	129.3	2229.1
September	590.8	182.5	2105.5
October	466.7	122.0	1957.7
November	345	52.3	1609.4
December	192	22.7	1380.4



Summer flows are typically low, although high rainfall in the upper catchment can provide some daily flow variability (Pendlebury 1997). However, analysis of flow duration data and flow event analysis for Mittagang Crossing (upstream of the project area) before and after the construction of Tantangara Dam showed:

- a severe reduction of seasonal base flows
- a reduction in the frequency of events across the range of event volumes
- the frequency of flow events greater than 10000 ML/d has halved
- the number of high flow events has almost halved with the average duration decreasing by about two-thirds
- reduced seasonal base flow has significantly reduced the frequency of longer duration flow events, resulting in much longer periods between such flow events (Pendlebury 1997).

At Billilिंगara (20 km upstream from the project area) recent flows in the Murrumbidgee are only 54% of the pre-Tantangara Dam flows and at Lobbs Hole, in the centre of the reach, flows are only 57% of the pre-Tantangara flows (Pendlebury 1997).

Based on long-term climate outlooks, and under current trends, it is likely that reduced flow levels will continue and that flow variability will continue to decline.

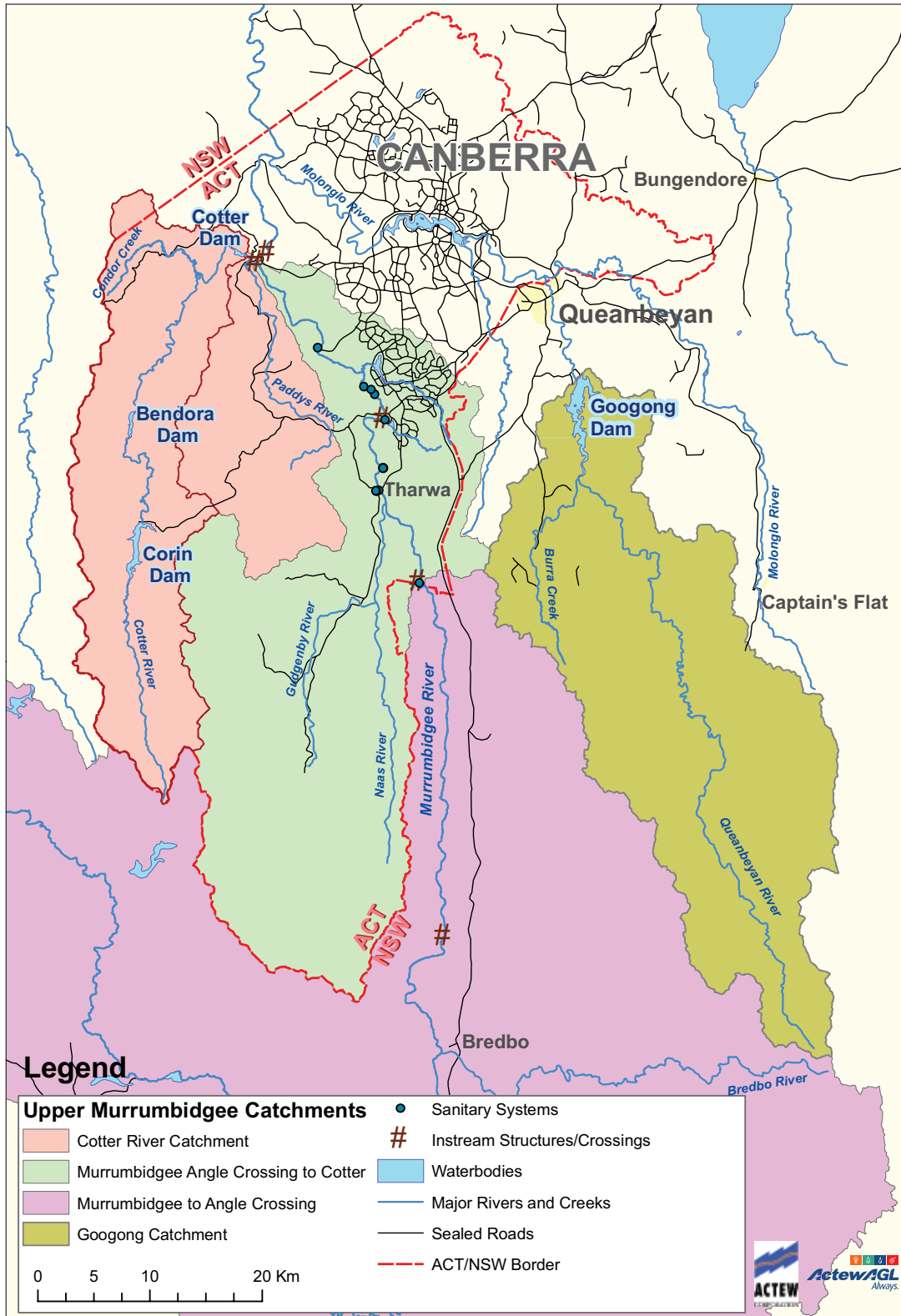
#### *2.4.2 Water management infrastructure*

The Murrumbidgee catchment is a regulated system and has 14 dams and eight large weirs. The large dams include Burrinjuck Dam near Yass, with a capacity of 1 026 million megalitres, and Blowering Dam near Tumut, holding 1 628 million megalitres. These dams control water for the Murrumbidgee Irrigation Area and the Coleambally Irrigation Area situated in the lower Murrumbidgee Catchment. More than 10000 kilometres of irrigation channels supplied from the two storages provide the irrigation areas with water (Murrumbidgee CMA 2008).

As noted in Section 2.4.1, the largest water management infrastructure currently impacting on the UMDR is Tantangara Dam near the Murrumbidgee River headwaters. At Tantangara Dam almost all of the flow (99.6%) is diverted to Lake Eucumbene for use in the Snowy Hydro Scheme. Water extraction for other purposes such as town water and agriculture occur elsewhere in the catchment, including the UMDR. These mainly impact on surface flow in the dry summer periods (Pendlebury 1997). Natural flows are impacted at the downstream end of the reach by extraction from the Cotter River and the pump within the Murrumbidgee just downstream of the Cotter River confluence, both of which supply drinking water for Canberra. A new pipeline between the Murrumbidgee River and Googong Reservoir is proposed by ACTEW. The proposed offtake from Angle Crossing at the southern ACT border is designed to increase domestic water security for the Canberra region but will affect surface flow levels in Murrumbidgee in the ACT and below. It is estimated that flow extraction for this initiative will be approximately 640 ML per month (ACTEW Corporation 2009).



Figure 3: Demonstration reach showing locations of existing water management and other instream infrastructure. Provided by ACTEW Corporation.



A small number of instream structures occur within the demonstration reach (see Figure 3), including:

- Angle Crossing low level road crossing (see Plate 7)
- Point Hut Crossing (see Plate 8)
- Casuarina Sands (with fishway) (see Plate 9)
- There is also a small regulating structure with fishway on the Cotter River just above where it joins the Murrumbidgee (see Plate 10).

Several rocky narrow gorges, as well as shallow sediment deposition zones, within the UMDR, may act as barriers to fish passage during low flow periods.



Plate 7: Low level road crossing at Angle Crossing near Williamsdale. Photo: Bill Phillips



Plate 8: Point Hut crossing. Photo: Bill Phillips



Plate 9: In-stream weir and fishway at Casuarina Sands. Photo: Bill Phillips



Plate 10: In-stream weir and fishway on the Cotter River near its junction with the Murrumbidgee River. Photo: Bill Phillips



### 2.4.3 Water quality

While most observed water quality parameters have been within acceptable limits for all uses major ongoing issues occur with sedimentation due to highly turbid flows from the Monaro Plains (T Noakes 2010 pers. comm. 17 Feb). Turbidity regularly reaches levels that are beyond guidelines for extraction to Canberra water treatment plants.

One major tributary upstream of the UMDR, the Numeralla River, has been documented as having changed significantly from being a narrow, shallow, pebble-bottomed stream with a well developed pool/riffle sequence to a broad, deeply incised, depositional stream characterised by extensive sand deposits (Starr 1995; Starr et al. 1997). Recent observation suggests that a similar pattern has occurred in other tributaries in the region, such as the Bredbo River and Michelago, Gungoandra and other small creeks (L Johnston 2010 pers. comm. 31 May). Sand deposits stemming from situations such as this are now common in the Murrumbidgee River (see Plates 11 and 12) and are having increasingly significant impacts on water quality and fish habitat (Lintermans 2000).



Plate 11: Murrumbidgee River at Bumbalong (near Bredbo) where large scale bank slumping has occurred. Photo: Luke Johnston



Plate 12: The Tharwa sand slug at Tharwa bridge during moderate flow. The benthic habitat is smothered by deep sand. Also note complete absence on the banks of ribbon gum woodland, which historically occupied the river terraces through this reach. Photo: ACT TAMS

#### 2.4.4. Groundwater

The groundwater aquifers in the ACT are limited in comparison to groundwater basins elsewhere in Australia that contain water hundreds of years old. In the ACT groundwater tends to be found in low-yield fractured rock aquifers to approximately 100 m in depth. The location of aquifers is based on surface topography and tends to discharge to streams (i.e. valley low points) providing stream base flow. The groundwater resource is small compared to surface water (Heath Chester pers comm. 2010; DECCEW 2009).

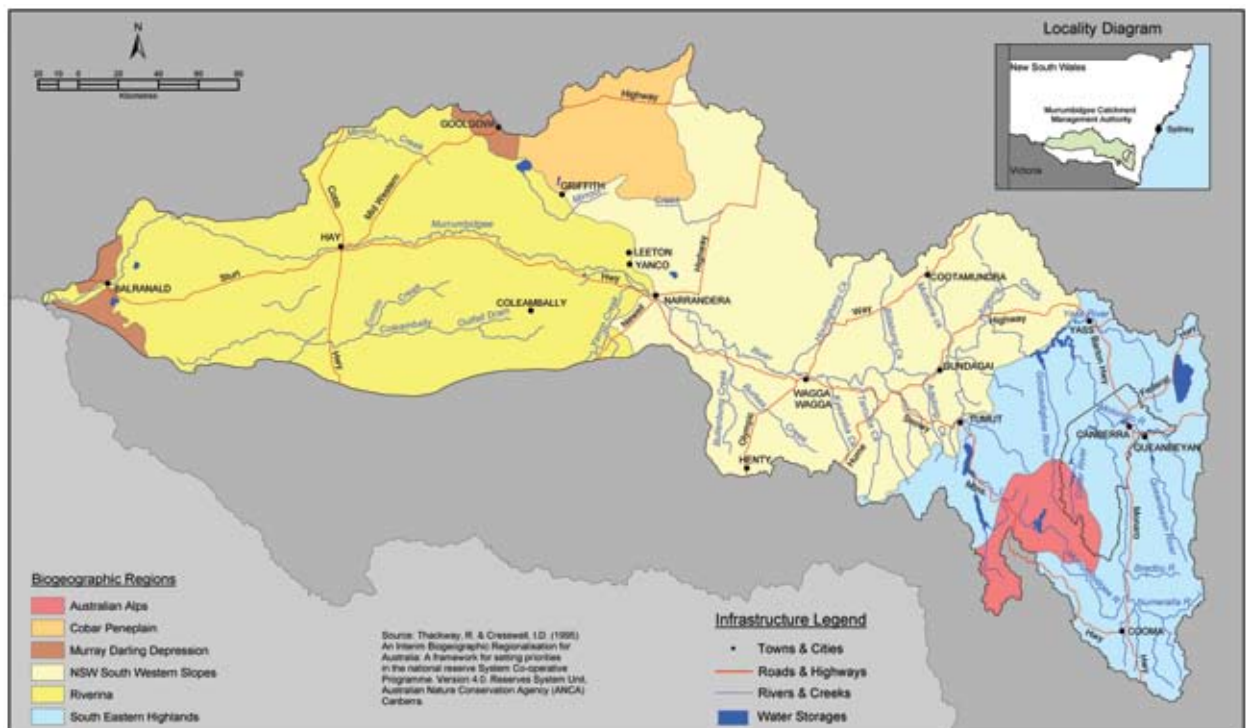
Gaining a better understanding of groundwater dynamics in the region is a recognised research priority in this plan (see Section 5).

### 2.5 Ecological features and values

Under the Interim Biogeographical Regionalisation for Australia (IBRA) the UMDR occurs within the South Eastern Highlands bioregion (see Figure 4).

Vegetation and habitat in the riparian zone of the Murrumbidgee River in the ACT has been surveyed by Johnston et al. (2009). This survey also reported on the vegetation communities of the adjacent valley slopes. The four riparian vegetation associations identified in this ACT survey are also observed upstream in the NSW portion of the demonstration reach (L Johnston 2010 pers. comm. 31 May) and are briefly described below (s. 2.5.1) and the adjoining valley slope vegetation communities are listed in s. 2.5.2.

Figure 4: Murrumbidgee catchment showing regions defined under the Interim Biogeographic Regionalisation of Australia (IBRA). Murrumbidgee CMA.



### 2.5.1 Riparian vegetation associations

Aside from where rocky substrates predominate, overall the riparian zone within the project area contains a very high cover and abundance of weed species and is a major conduit for the downstream spread of registered weeds of national significance, regionally listed exotic species and many others. Several exotic species are causing significant impacts on native biodiversity, especially willows (*Salix* spp.), African lovegrass (*Eragrostis curvula*) and blackberry (*Rubus fruticosus* agg.). Despite this, a small number of rare or uncommon species persist such as Tuggeranong lignum (*Muehlenbeckia tuggeranong*) around the Pine Island Recreation Reserve, and the Australian anchor plant (*Discaria pubescens*).

Following the conventions detailed in Johnston et al. (2009), the four dominant riparian vegetation associations occurring along the Murrumbidgee River in the project area are outlined below.

#### I. Tableland Aquatic and Fringing Vegetation Complex (Plate 13)

Dominated by emergent and submergent macrophytes, this association occurs throughout the project area in inundated, wet or moist, slow flowing environments where it provides refuge to young and small bodied aquatic fauna.



Plate 13: Emergent macrophyte component of the Tableland Aquatic and Fringing Vegetation Complex on the Murrumbidgee River in the ACT. Photo: Luke Johnston



## 2. River Bottlebrush – Burgan Tableland Shrubland (Plate 14)

Although common as narrow bands on the riverbank throughout the UMDR, the best examples of intact riparian shrubland vegetation occur within each of the river gorges where it dominates the rocky flood zone.



Plate 14: River Bottlebrush-Burgan Tableland Riparian Shrubland at the junction of Bulgar Creek with the Murrumbidgee River in the ACT. Sparse river bottlebrush (*Callistemon sieberi*) can be seen dominating a broad bedrock floodplain. Photo: Luke Johnston

### 3. Ribbon Gum Tableland Riparian Woodland (Plate 15)

This association once occurred extensively on alluvial floodplain terraces south (upstream) of Point Hut Crossing in areas where more gently undulating valley slopes meet the river edge. The sticky resin (manna) exuded from the trunks was utilised by local Aboriginal people and the canopy provided valuable shade and a food source for aquatic fauna. The ACT survey recorded less than 10% of the association's suitable habitat still containing canopy trees and those remaining are in poor condition (Johnston et al. 2009). Ribbon gum timber was used in early European settlement and the environment in which it occurs is favoured for agriculture. This community is in urgent need of protection and enhancement throughout the project area.



Plate 15: A stand of remnant trees from the former Ribbon Gum Tableland Riparian Woodland towering over a degraded understorey opposite the car park at Tharwa Sandwash. Photo: Luke Johnston



#### 4. She-oak Tableland Riparian Woodland (Plate 16)

This occurs along the river downstream (north) of Point Hut Crossing (NCDC 1981; Johnston et al. 2009). Although there are still continuous tracts of this association there has been a significant reduction of its vigour due to the effects of the high intensity bush fire of 2003. It is very likely that it has also been affected by low soil moisture from altered river flows and dry climatic conditions, which has inhibited canopy regeneration on the floodplains away from the moist riverbanks (Johnston et al. 2009).



Plate 16: Healthy She-oak Tableland Riparian Woodland on the Murrumbidgee River at McCarthy Rd crossing north of the ACT. Photo: Luke Johnston

### 2.5.2 Valley slope communities

Six main vegetation communities have been identified along the incised valley slopes of the Murrumbidgee River in the ACT and their characteristics are described in Johnston et al. (2009). The occurrence of these communities relates to landscape position and valley geomorphology. The communities are:

- Broad-leaved Peppermint–Apple Box Tableland Woodland
- Snow Gum–Candlebark Tableland Woodland
- Black Cypress Pine Tableland Woodland
- Red Stringybark–Scribbly Gum Tableland Forest
- Yellow Box–Blakely’s Red Gum Tableland Grassy Woodland
- Burgan Derived Tableland Shrubland.

The eucalypt and shrub communities are in relatively good condition given prolonged drought and the effects of the 2003 bush fire in the ACT. However, the Snow Gum – Candlebark Tableland Woodland has a restricted distribution and where it persists it is in a highly degraded state. The Black Cypress Pine Tableland Woodland that once blanketed the steep rocky slopes of the river valley has shown very patchy recovery where it was burnt in the 2003 fire (see Plate 17), and it is likely that an ecological succession to a fire tolerant eucalypt dominated canopy will occur throughout much of its range.



Plate 17: Black cypress pine (*Callitris endlicheri*) on the steep slopes of the Bullen Range was heavily impacted by the 2003 bush fire. Photo: Luke Johnston

### 2.5.3 Threatened and other notable plant species

The Murrumbidgee Catchment Action Plan (Murrumbidgee CMA 2008) indicates that there are 48 threatened plant species across the whole catchment, with 25 of these listed as endangered. Of these only two have been identified within the river valley of the project area, namely Tuggeranong lignum and pale pomaderris. Additionally the Bredbo gentian is present near Jerangle, upstream of UMDR on the Bredbo River, and Michelago parrot-pea is present approximately about 1 kilometre east of the UMDR at Michelago (see Table 3).

Table 3: Threatened flora with potential to occur in the UMDR

SPECIES		CONSERVATION STATUS		
Common name	Scientific name	Cwth	NSW	ACT
Tuggeranong lignum	<i>Muehlenbeckia tuggeranong</i>	E		E
Pale pomaderris	<i>Pomaderris pallida</i>	V	V	U
Bredbo gentian	<i>Gentiana bredboensis</i>	V	E	
Michelago parrot-pea	<i>Dillwynia glauca</i>		E	

E = Endangered, V = Vulnerable, U = Uncommon

### 2.5.4 Threatened and other notable animal species

The Murrumbidgee Catchment Action Plan (Murrumbidgee CMA 2008) indicates that 82 threatened animal species occur across the catchment, with 23 of these listed as endangered. The ACT has 23 species declared as threatened. Threatened fauna that are known from or have the potential to occur in the demonstration reach area are shown in Table 4.

Although the Upper Murrumbidgee River historically sustained large numbers of native fish (Flood 1980), there has been a substantial decline in naturally occurring populations, with alien species now comprising up to 96% numerically of the total abundance recorded in the Murrumbidgee and two of its major regional tributaries the Molonglo and Queanbeyan Rivers (Lintermans and Osborne 2002). Despite the reduced native fish abundance and decline in habitat condition within the project area, records indicate that the river still supports a diverse range of native aquatic, semi-aquatic and terrestrial fauna (Lintermans 2000; Lintermans 2002; ACT Government 2007; Johnston *et al.* 2009).

The UMDR project area is still known to maintain remnant populations of large native fish including Murray cod (*Maccullochella peelii peelii*), trout cod (*Maccullochella macquariensis*), Macquarie perch (*Macquaria australasica*) and Golden perch (*Macquaria ambigua*), with an historical record of two-spined blackfish (*Gadopsis marmoratus*) (Lintermans 2002). Silver perch were once common in the lower reach (downstream of Kambah Pool) and were recorded making spawning migrations up as far as Cooma, but this species is now rare or absent from much of the reach, and the spawning migrations no longer occur (McGovern and Lintermans 2003). Mountain galaxias, western carp gudgeon and Australian smelt are also known from the reach (Lintermans 2000, 2002). The reach has upland and lowland fish fauna populations, with the Gigerline Gorge (Plate 1) being the approximate upstream distribution limit of lowland species. Above this gorge, lowland species such as Murray cod, golden perch, western carp gudgeon and Australian smelt are rare or absent (Lintermans 2002).

Other aquatic/semi-aquatic species such as the Murray River crayfish, platypus, water rat, eastern long-necked turtle and eastern water dragon also form an important part



of the aquatic/semi-aquatic fauna community, along with a range of frogs that utilise slow flowing areas and floodplain wetlands (Lintermans and Osborne 2002).

The riverine valley supports a range of common mammals, woodland birds and reptiles. Rocky native grasslands (usually dominated by kangaroo grass) along the steep slopes continue to support the threatened Pink-tailed worm lizard (*Aprasia parapulchella*).

Shield shrimps (*Triops australiensis australiensis*) are thought to be quite common (Lintermans and Osborne 2002), and have been present since the Triassic period. They tend to occur in inland ephemeral pools, such as those that occur along Red Rocks Gorge, laying eggs in pool sediments. The eggs lie dormant for up to 25 years in dried out pools until the next rain, when they hatch.

Table 4: Threatened fauna with potential to occur in the UMDR

SPECIES		CONSERVATION STATUS		
Common name	Scientific name	Cwth	NSW	ACT
<b>Fish</b>				
Trout cod	<i>Maccullochella macquariensis</i>	E	E	E
Silver perch	<i>Bidyanus bidyanus</i>		V	E
Murray cod	<i>Maccullochella peelii peelii</i>	V		
Macquarie perch	<i>Macquaria australasica</i>	E	E	E
Two-spined blackfish	<i>Gadopsis bispinosus</i>			V
<b>Frogs</b>				
Green and golden bell frog	<i>Litoria aurea</i>	V	E	
<b>Birds</b>				
Swift parrot (ubiquitous)	<i>Lathanus discolor</i>	E	E	
Painted snipe (possible)	<i>Rostratula torquatus</i>		E	
Regent honeyeater (ubiquitous)	<i>Xanthomyza phrygia</i>	E	E	E
Australasian bittern	<i>Botaurus poiciloptilus</i>		V	
Gang-gang cockatoo	<i>Callocephalon fimbriatum</i>		V	
Glossy black-cockatoo	<i>Calyptohynchus lathami</i>		V	
Brown treecreeper (eastern subspecies)	<i>Climacteris picumnus victoriae</i>		V	V
Little eagle	<i>Hieraaetus morphnoides</i>			V
Painted honeyeater	<i>Grantiella picta</i>		V	V
Brolga (historic regional)	<i>Grus rubicundus</i>		V	
Hooded robin (south-eastern form)	<i>Melanodryas cucullate cucullata</i>		V	V
Black-chinned honeyeater	<i>Melithreptus gularis</i>		V	
Barking owl	<i>Ninox connivens</i>		V	
Powerful owl	<i>Ninox strenua</i>		V	
Blue-billed duck	<i>Oxyura australis</i>		V	
Olive whistler	<i>Pachycephala olivacea</i>		V	
Pink robin	<i>Petroica rodinogaster</i>		V	
Superb parrot	<i>Polytelis swainsonii</i>	V	V	V
Speckled warbler	<i>Pyrrholaemus saggitatus</i>		V	
Diamond firetail	<i>Stagonopleura guttata</i>		V	
Freckled duck	<i>Stictonetta naevosa</i>		V	
Masked owl	<i>Tyto novaehollandiae</i>		V	

Table 4: Threatened fauna with potential to occur in the UMDR *continued*

SPECIES		CONSERVATION STATUS		
Common name	Scientific name	Cwlth	NSW	ACT
<b>Crustaceans</b>				
Murray River crayfish	<i>Euastacus australasica</i>			V
<b>Invertebrates</b>				
Perunga grasshopper	<i>Perunga ochracea</i>			V
<b>Mammals</b>				
Eastern pygmy-possum	<i>Cercartetus nanus</i>		V	
Little pied bat	<i>Chalinolobus picatus</i>		V	
Spotted-tailed quoll	<i>Dasyurus maculatus</i>	E	V	V
Eastern false Pipistrelle	<i>Falsistrellus tasmaniensis</i>		V	
Eastern bent-wing bat	<i>Miniopterus schreibersii oceanensis</i>		V	
Large-footed Myotis	<i>Myotis adversus</i>		V	
Greater long-eared bat (south-eastern form)	<i>Nyctophilus timoriensis</i>	V	V	
Squirrel glider	<i>Petaurus norfolcensis</i>		V	
Yellow-bellied sheath-tail bat	<i>Saccolaimus flaviventris</i>		V	
Inland forest bat	<i>Vespadelus baverstocki</i>		V	
<b>Reptiles</b>				
Pink-tailed worm-lizard	<i>Aprasia parapulchella</i>		V	V
Rosenberg's goanna	<i>Varanus rosenbergi</i>		V	

E = Endangered, V = Vulnerable, U = Uncommon

Twenty-six bird species are listed as declared 'migratory species' under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act). While it is clear not all are common visitors to the UMDR, the full list provided in the Murrumbidgee Catchment Action Plan is reproduced in Table 5.



Table 5: Migratory birds of the Murrumbidgee Catchment

(Modified from Table S4.2 in the Murrumbidgee Catchment Action Plan 2008)

COMMON NAME	SCIENTIFIC NAME	INTERNATIONAL AGREEMENT	OCCURRENCE IN UMDR
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	CAMBA	Yes
Common sandpiper	<i>Actitis hypoleucos</i>	Bonn/CAMBA/JAMBA	Likely
Great egret	<i>Ardea alba</i>	CAMBA/JAMBA	Likely
Cattle egret	<i>Ardea ibis</i>	CAMBA/JAMBA	Likely
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	Bonn/CAMBA/JAMBA	Likely
Red-necked stint	<i>Calidris ruficollis</i>	Bonn/CAMBA/JAMBA	Likely
Long-toed stint	<i>Calidris subminuta</i>	Bonn/CAMBA/JAMBA	Likely
Double-banded plover	<i>Charadrius bicinctus</i>	Bonn	Likely
White-wing black tern	<i>Chlidonias leucopterus</i>	CAMBA/JAMBA	Likely
Black-tailed godwit	<i>Limosa limosa</i>	Bonn/CAMBA/JAMBA	Likely
Latham's snipe	<i>Gallinago hardwickii</i>	Bonn/CAMBA/JAMBA	Likely
Glossy ibis	<i>Plegadis falcinellus</i>	Bonn/CAMBA	Likely
Painted snipe	<i>Rostratula benghalensis</i>	CAMBA	Likely
Caspian tern	<i>Sterna caspia</i>	CAMBA/JAMBA	Likely
Curlew sandpiper	<i>Calidris ferruginea</i>	Bonn/CAMBA/JAMBA	Potential
Pectoral sandpiper	<i>Calidris melanotos</i>	Bonn/JAMBA	Potential
Bar-tailed godwit	<i>Limosa lapponica</i>	Bonn/CAMBA/JAMBA	Potential
Little curlew	<i>Numenius minutes</i>	Bonn/CAMBA/JAMBA	Potential
Ruff	<i>Philomachus pugnax</i>	Bonn/CAMBA/JAMBA	Potential
Pacific golden plover	<i>Pluvialis fulva</i>	Bonn/CAMBA/JAMBA	Potential
Wood sandpiper	<i>Tringa glareola</i>	Bonn/CAMBA/JAMBA	Potential
Common greenshank	<i>Tringa nebularia</i>	Bonn/CAMBA/JAMBA	Potential
Marsh sandpiper	<i>Tringa stagnatilis</i>	Bonn/CAMBA/JAMBA	Potential
Ruddy turnstone	<i>Arenaria interpres</i>	Bonn/CAMBA/JAMBA	No
Red knot	<i>Calidris canutus</i>	Bonn/CAMBA/JAMBA	No

Key:

- JAMBA Japan-Australia Migratory Bird Agreement
- CAMBA China-Australia Migratory Bird Agreement
- Bonn the working name of the Convention on Migratory Species
- Yes likely to be regularly recorded in the UMDR
- Likely likely to be occasionally recorded in the UMDR
- Potential UMDR is within range of a species which generally uses floodplain wetlands and coastal swamps but not necessarily rivers
- No marine species which would only appear in the UMDR as a vagrant





Plate 18: Listed species with known or potential distribution within the Upper Murrumbidgee Demonstration Reach. (a) Murray Cod (Photo: Gunther Schmida) (b) Trout Cod (Photo: Esther Beaton) (c) Hooded Robin with chick (Photo: Graham Stephinson) (d) Green and Golden bell Frog (Photo: <http://en.wikipedia.org/wiki/User:LiquidGhoul>) (e) Tuggeranong lignum flower (Photo: Luke Johnston) and (f) Tuggeranong lignum at Pine Island reserve ACT (Photo: Luke Johnston).



## 2.6 Economic, social and cultural features

The following extracts from Murrumbidgee Catchment Action Plan (Murrumbidgee CMA 2008) indicate key aspects of the economic, social and cultural features of the whole catchment:

*Tourism in the Murrumbidgee is valued at \$500 million per annum.*

*Private landholders manage approximately 85% of the Murrumbidgee Catchment. These holdings consist of corporate farms, family managed farms, private enterprise and rural and urban residential blocks. Family-owned and operated farms remain the dominant farming operators in Australia. Large numbers of corporate farms operate in the Murrumbidgee Catchment with extensive interests in irrigated agriculture. There is a growing number of small lifestyle or 'hobby farms', especially in the upper catchment near the ACT and around larger rural centres such as Wagga Wagga.*

*The Murrumbidgee River is a regulated system and has 14 dams and 8 large weirs. These dams control water for the Snowy Hydro-Electric Scheme and Murrumbidgee Irrigation Area and the Coleambally Irrigation Area situated in the lower Murrumbidgee Catchment. More than 10,000 kilometres of irrigation channels supplied by the two storages provide the irrigation areas with our most valuable resource - water.*

*Approximately 15% of the Murrumbidgee Catchment area is managed publicly (including national parks and wildlife service estate, state forests and crown lands, such as the travelling stock routes).*

*Agricultural production in the Murrumbidgee Catchment is worth in excess of \$1.9 billion annually. This amounts to 25% of NSW's fruit and vegetable production, 42% of the state's grapes and 50% of Australia's rice production.*

*Irrigated agriculture across the catchment produces approximately \$200 million worth of rice annually, \$60 million worth of vegetables, \$80 million worth of grapes, \$150 million worth of fruit and \$10 million worth of dairy products.*

*Dryland agricultural industries of livestock and cropping are major contributors to the catchment's economy. Sheep meat sales (without taking into account store sheep transactions) total \$110 million, wool \$240 million, beef \$273 million and cropping \$790 million. Softwood plantations are valued at \$550 million.*

Within the ACT-controlled portion of the UMDR (not including the Cotter pump station), there are 36 current surface and groundwater access entitlements with a total annual entitlement of 1893 ML (DECCEW 2009). Within the ACT tributaries, there are an additional 20 water access entitlements (not including the Cotter River) with a total entitlement of 987 ML (DECCEW 2009). ACTEW harvests water through three water access entitlements on the Cotter River (totalling 58000 ML) and the Murrumbidgee River at Cotter pump station.

The ACT portion of the reach lies within the Murrumbidgee River Corridor which is a series of linear reserves defined as Public Land under the *Planning and Development 2007* (ACT). The corridor is popular for recreational activities such as walking, swimming, camping and fishing. Plates 17 and 18 below are extracts from the information brochure on the corridor. The reach has cultural assets including early European cultural heritage areas relating mostly to the first farming communities that settled along this part of the Murrumbidgee (see Section 4.1).

The Murrumbidgee River corridor is believed to have been a major focal point for the Aboriginal people of the Southern Tablelands prior to European settlement. Archaeological evidence indicates occupation of the area during the last glacial maximum more than 20000 years ago when the tablelands would have been an inhospitable, sparsely populated upland landscape (Mulvaney and Kamminga 1999). The oldest published record is for Birrigai rock shelter (Tidbinbilla) around 21 000 years before present (BP) with a low intensity of occupation continuing through to 3000 BP (Flood et al. 1987).

At around 3000 BP the archaeological record indicates that occupation intensity increased and continued to increase until the early 1800s when European settlement caused major impacts on the Aboriginal population. Aboriginal economy and society in the ACT region have been documented by Flood (1973, 1980) and a wide range of surveys undertaken, only some of which are published. For example, Barz and Winston-Gregson (1981, 1982) surveyed a 100 square kilometre section of the Murrumbidgee, from Angle Crossing to the northern ACT/NSW border. This resulted in the location of 145 artefact scatters, most of which were within 150 metres of the river and on terraces, spurs and saddles. More recently a comprehensive archaeological survey of the nearby Jedbinbilla area at Tidbinbilla has provided evidence for a high density of settlement there (ACT Government 2010b; Barber et al. 2004). The local rivers were an important source of food and some riverine areas were documented gathering places (e.g. Pialligo on the Molonglo River). A canoe scar tree at Lanyon Homestead near Tharwa (ACT) provides a standing reminder of the use of the Upper Murrumbidgee.

Aboriginal associations with the Murrumbidgee River are recognised in the registration of Aboriginal sites along the Murrumbidgee River Corridor. The social and spiritual significance of the river to Aboriginal people today is also important and further research on these aspects is necessary to fully understand the river corridor as a cultural landscape.



### Ranger Guided Activities

Ranger guided activities are conducted for the public during school holidays and for school and community groups on request. For more information, phone (02) 6207 2900.

### Watch Out for River Wildlife

More than 200 different plant species occur along the banks, flood plains and dry upper slopes of the Murrumbidgee valley, including some that are threatened nationally such as Australiadsia, Theuma aurea and Anchor Plant. *Dicellaea pumilio*.

The river corridor also provides wonderful opportunities for seeing birds, including migrating honeyeaters, honeyeater birds of prey and yellow bellied Black Godwits. *Calystrotachyus fulvifrons* enjoying their winter roosting areas.

Less often seen are the mammals, reptiles and amphibians that also live here. But the signs are clear—wombat burrows are common along sandy river banks, while almost invisible platypus burrows occur right at the water's edge.

### Respecting Our Heritage

Please remember that all plants, animals, rocks, live wood, fallen timber and Aboriginal or other historic artefacts are protected by law. Respecting the natural and cultural environment will help keep the Murrumbidgee River Corridor a place for everyone to enjoy.

### Further Information

Murrumbidgee River Corridor: (02) 6207 2425  
 Canberra Connect: 13 22 81  
 Website: [www.tams.act.gov.au](http://www.tams.act.gov.au)

Produced by Parks, Conservation and Lands (PCL), Department of Environment and Natural Services, PCL Vision Statement: Integrated land management creates a sustainable and supports an enjoyable, healthy and sustainable lifestyle.

## Guide to Facilities and Activities

MHC Recreation Areas	FACILITIES										ACTIVITIES						
	Wheelchair access	Toilets	BIBS/E/G in Barriers/On W in Ward	Playground	Drinking water	Shelter	Hours parking areas	Ranger depot	Campground	Picnic tables	Dog exercise even field	Day exercise off road	Fishing	Swimming/walking/parrelling	Horse at area	Walking Tracks	Canoe entry points
Uriarra West	✓	✓	W														
Uriarra East		✓	W														
Swamp Creek		✓	W														
Casuarina Sands	✓	✓	E/G														
Cotter Avenue	✓	✓	E/G														
Cotter Bend	✓	✓	E/G														
Cotter Campground	✓	✓	E/W														
Murray's Corner		✓	G														
Kambah Pool		✓															
Pine Island	✓	✓	E/G														
Point Hut	✓	✓															
Tharwa Bridge	✓	✓															
Tharwa Sandwash	✓	✓															
Angle Crossing	✓	✓															

**Murrumbidgee River Corridor**

Map and Guide

Healthy Parks Healthy People

Plate 19: Extract from the Murrumbidgee River Corridor Information Brochure (ACT).

### MURRUMBIDGE RIVER CORRIDOR—Reserves

Please stay on walking tracks while walking through rural leasehold land. Check walking times and distances before setting off.

#### URIARRA CROSSING & SHEPHERD'S LOOKOUT

#### COTTER & CASUARINA SANDS

#### KAMBAH POOL

#### PINE ISLAND & POINT HUT CROSSING

#### MURRAY'S CORNER

#### ANGLE CROSSING

#### THARWA BRIDGE & THARWA SANDWASH

Plate 20: Extract from the Murrumbidgee River Corridor Information Brochure (ACT). Source: ACT TAMS

## 3. Land tenure, stakeholders and implementation arrangements

### 3.1 Tenure and jurisdiction

The upper half of the UMDR is located in the Cooma–Monaro Shire (NSW) and is fronted mostly by private landholders. In places the private land tenure and occasional crown lease extend to either centre stream or high water (top of bank). In the ACT, the river and floodplains are contained within the Murrumbidgee River Corridor (MRC), management of which is guided by the *Murrumbidgee River Corridor Plan of Management* (ACT Government 1998). This includes a collection of nature reserves, special purpose reserves, a European heritage conservation zone and a number of rural leases.

### 3.2 The 'stakeholders'

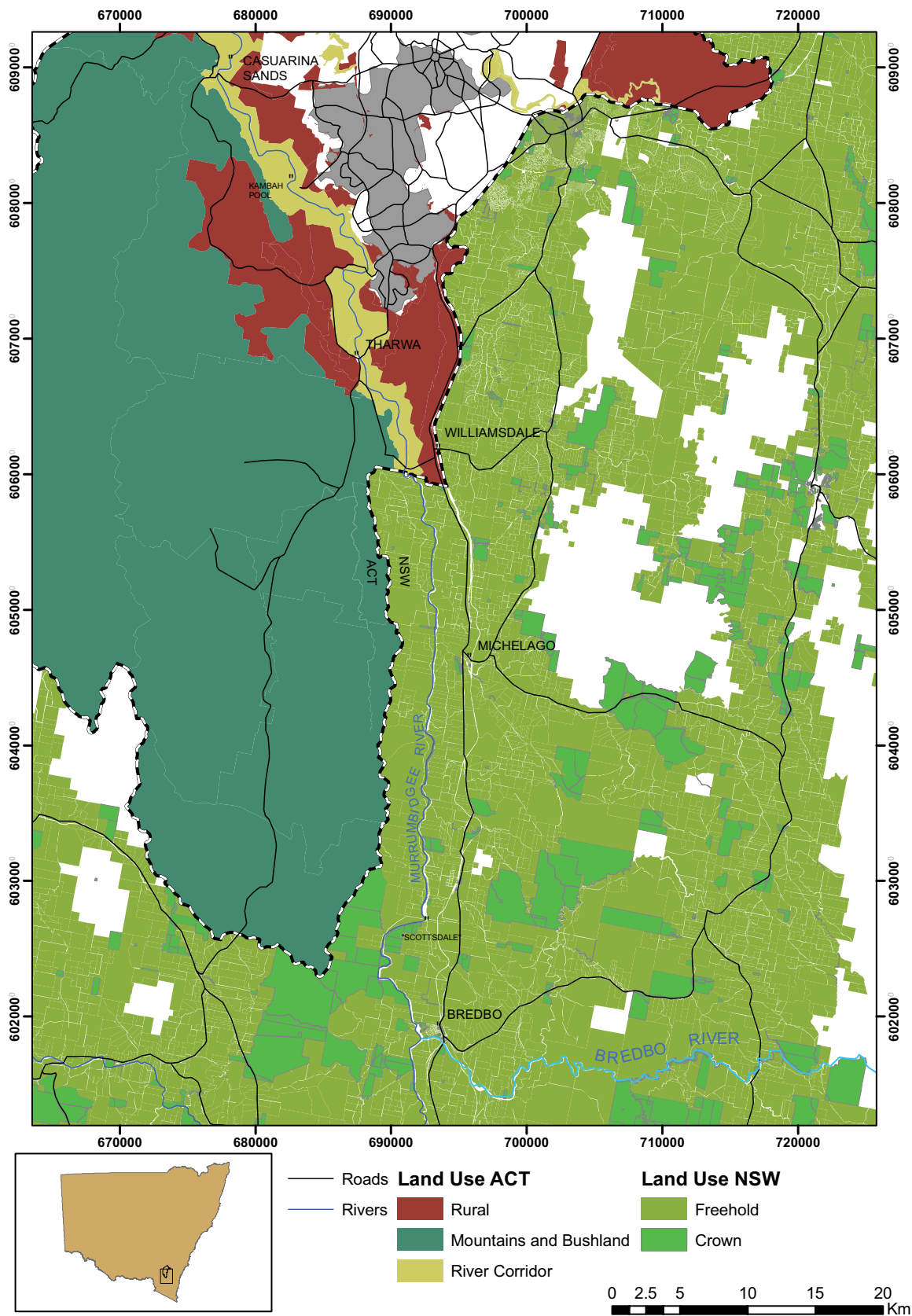
A large number of organisations, groups and individuals are stakeholders in the successful implementation of this initiative. The Murrumbidgee River is a key asset within the Murray–Darling Basin and as such the Commonwealth Government is a key stakeholder through the Murray–Darling Basin Authority from which the demonstration reach concept has evolved.

On a regional level the Upper Murrumbidgee River is the major drainage line of a large proportion of southern NSW and the Australian Capital Territory. In this sense the water and the environs drained by it both within and downstream of the project area form a valuable resource affecting a large number of stakeholders across government, private enterprise and community. The Murrumbidgee Catchment Management Authority (Murrumbidgee CMA) is responsible for natural resource management in the natural drainage basin of the Murrumbidgee River.

- NSW and ACT government agencies are important stakeholders and administer a range of legislation relevant to the management of the river and the riparian zone. Some examples from NSW are:
- Murrumbidgee CMA (Catchment Management Authorities Act 2003)
- Department of the Environment, Climate Change, and Water (DECCW) (*Native Vegetation Act 2003, Water Management Act 2000*)
- Industry and Investment NSW (*Fisheries Management Act 1994*).
- The ACT Department of Territory and Municipal Services oversees management of the river and its surrounding lands in the ACT, mainly through the ACT Department of Territory and Municipal Services.
- All users and suppliers of water in the project region hold a stake in the health of the project area. The river provides valuable water supply for a rural purposes as well as domestic supply to regional towns such as Bredbo and Michelago (NSW), and Tharwa (ACT).
- ACTEW Corporation supplies potable water from the river to residents of Canberra and Queanbeyan.
- Various community sectors hold a stake in the UMDR through recreational, heritage and cultural interests and activities. Recreational anglers have demonstrated a particular interest.



Figure 5: Broad land tenure throughout UMDR project area. Note different categorisation occurs in NSW and ACT. However it can clearly be seen that the majority of lands adjoining the Murrumbidgee River in NSW are 'freehold' whilst throughout the ACT the river is protected within the Murrumbidgee River Corridor.





### 3.3 Implementation arrangements

#### 3.3.1 *Steering committee*

A steering committee has been established comprising existing UMDR partners who were committed to the initial funding component. It is presumed that this committee will evolve over time to undertake specific roles in the planning, reporting and evaluation processes of the initiative.

Two separate technical reference groups will be established with additional expertise in:

- scientific monitoring and evaluation of river rehabilitation projects (s 3.3.2)
- implementation of natural resource management and community engagement activities associated with river rehabilitation and aquatic ecological issues (s 3.3.3).

#### 3.3.2 *Monitoring and evaluation group*

A scientific monitoring and evaluation group will be established to provide expert scientific advice as to how the UMDR project should be monitored and evaluated. The following aims have been developed for this group:

- identification of criteria, and development of methods, for monitoring and evaluation to measure the progress of the UMDR project in accordance with Native Fish Strategy (NFS) guidelines
- review of the progress of monitoring and evaluation and recommendations for improvements
- linking the results of monitoring and evaluation to on-ground rehabilitation activities and proposed future work under the UMDR project
- review and comment on outcomes of the project and presentation of results of monitoring and evaluation.

#### 3.3.3 *Working group*

A working group will be formed to address the planning and implementation of on-ground activities within the project area. It will consist mainly of existing project partners or potential project partners with specific interests in planning or implementing on-ground works. Other stakeholders who can contribute information to assist the planning or implementation of on-ground works and community engagement may be identified. The following aims have been developed for this group:

- facilitation and exchange of knowledge and information that is relevant to the development and implementation of on-ground works and community engagement for the UMDR project
- assistance with the planning, co-ordination and implementation of on-ground works and community engagement
- exchange of information related to:
  - past, current and future activities that have/may have an impact on the UMDR project area or its catchment
  - riverine management issues within the project area
  - establishing priorities for dealing with riverine management issues in the project area
  - community engagement activities related to the project – as outlined in the Community Education and Public Awareness Plan.

#### 3.3.4 *Community advisory group*

It is proposed to form a community advisory group comprised of individuals and representatives from community organisations that have a close interest in the project and its intended outcomes. It is anticipated that this group will provide a valuable link between UMDR partners and the wide community. It will be a valuable medium to inform the steering group of community priorities and concern within the UMDR and allow progress to be guided as such.



## 4. Priority assets and threats

### 4.1 Priority 'assets' and their status

In the consultation process for the development of this plan, the following 'key assets' were identified for the demonstration reach:

- Native fish community (including threatened species)
- Water
- Aquatic and in-stream habitats
- Riparian floodplain vegetation communities
- Threatened and migratory species (other than native fish)
- Iconic species
- Protected areas
- Aboriginal cultural heritage assets
- Social and other cultural assets

The key assets comprise natural, cultural and social attributes. The remaining part of this chapter briefly outlines each of these assets and the threats to them. Chapter 5 details management objectives, actions and targets in relation to the assets and the threats that they face. The order in which the key assets appear does not indicate their relative priority or importance.

**Asset 1: Native fish community (including threatened species)****DESCRIPTION OF ASSET**

Nine native fish species, along with the Murray River crayfish, have been recorded in this reach of the Murrumbidgee River within the last 80 years (Lintermans 2002) (see Section 2.5.4 for details of threatened and other notable fauna including aquatic species of the UMDR). Interestingly these comprise both typically upland and lowland species. The upper distribution limit for the lowland Murray–Darling Basin fish species occurs near the middle of the reach at Gigerline Gorge (between Angle Crossing and Tharwa, ACT (see Plate 1).

The following native fish species occur, or are recorded from the reach:

- Trout cod (listed threatened under Cwlth, ACT,NSW legislation)
- Macquarie perch (listed threatened under Cwlth, ACT,NSW legislation)
- Murray cod (listed threatened under Cwlth and NSW legislation)
- Silver perch (listed threatened under Cwlth, ACT,NSW legislation)
- Golden perch
- Mountain galaxias
- Western carp gudgeon
- Australian smelt
- Blackfish (historic record only, presumably two-spined blackfish)

Additionally the reach is habitat of Murray River crayfish (listed threatened in ACT) and a range of other aquatic macro-invertebrates.

**STATUS OF ASSET**

The health of the local fish community has significantly declined in recent decades with native fish now comprising as little as 4% of the total fish abundance during monitoring surveys in the project area (Lintermans and Osborne 2002).

Macquarie perch have been detected at some sites in recent sampling (ACT Govt unpublished data 2010, unpublished data MDBA SRA 2010) and conservation stockings of trout cod continue at key locations. Silver perch are no longer recorded in or above ACT waters.

**PRIMARY THREATS**

- Loss of natural flow regime.
- Loss of instream and riparian habitat complexity (reduced amounts of large woody debris, and increased sediment input from upland tributaries).
- Competition, predation and disease from alien fish - carp, eastern gambusia and redfin perch.
- Poor water quality.
- Barriers to fish passage resulting in fragmentation of population and loss of genetic diversity.
- Loss of aquatic vegetation.
- Overfishing

Asset 1: Native fish community (including threatened species)



Murray cod (L) Photo: Gunther Schmida



Trout cod (U, L) Photo: Esther Beaton



Golden perch (L)  
Photo: Gunther Shmida



Macquarie perch (U)  
Photo: Esther Beaton



Silver perch (L) Photo: Guntha Schmida



Two-spined blackfish (U)  
Photo: Mark Lintermans



Western carp gudgeon (L)  
Photo: ACT Gov Archive



Australian smelt (L)  
Photo: Gunther Shmida



Mountain galaxias (U, L)  
Photo: Guntha Schmida



Murray River crayfish (U, L)  
Photo: Mark Lintermans

*In UMDR: (U) = Typically upland species, (L) = Typically lowland species*

## Asset 2: Water

### DESCRIPTION OF ASSET

The Murrumbidgee River and tributaries are the major water source in the region. Water from the catchment provides for the needs of Canberra, the largest inland city in the Murray–Darling Basin, and surrounding lands.

Irrigated and dryland farming are the dominant land uses away from the urban area. In the Canberra region, especially, there is significant growth in the number of 'hobby farmers' on the peri-urban fringe.

The Murrumbidgee River has a total of 14 dams and eight large weirs regulating flows along its entire length. Water is currently extracted from the Murrumbidgee River within and above the demonstration reach at a number of points for agricultural use and human consumption (see Figure 3). The current largest major water management infrastructure impacting on the UMDR is Tantangara Dam near the headwaters of the Murrumbidgee River in NSW. At Tantangara Dam 99.6% of the Murrumbidgee flow (at that point) is diverted to Lake Eucumbene for use in the Snowy Hydro Scheme (see Section 2.4.1).

### STATUS OF ASSET

Water availability and flow patterns

Historically the Upper Murrumbidgee River yielded high winter and spring flows due to higher rainfalls in the upper catchment at that time, and snow melt from August to October bringing floods.

Flood levels and frequency, as well as base flows, have decreased since the construction of Tantangara Dam (see below). Typical surface flow patterns in the Upper Murrumbidgee River currently remain governed by seasonal climatic factors with moderate to low flows maintained throughout the year, broken occasionally by floods of varying magnitude (NCDC 1981).

Summer flows are typically low, although high rainfall events in the mountain ranges of the upper catchment can provide some daily flow variability (Pendlebury 1997). However, analysis of flow duration data and flow event analysis for Mittagang Crossing (upstream of the project area) before and after the construction of Tantangara Dam has shown:

- a severe reduction of seasonal base flows
- reduction in the frequency of events across the range of event volumes
- halving of the frequency of flow events greater than 10000 ML/d
- halving of the number of high flow events, with the average duration decreasing by about two thirds
- significant reduction in the frequency of longer duration flow events as a result of the reduced seasonal base flow so that much longer periods occur between such flow events (Pendlebury 1997).

At Billilingara (20 km upstream of the demonstration reach) recent flows in the Murrumbidgee are only 54% of the historic pre-Tantangara Dam flows and at Lobbs Hole, in the centre of the reach, only 57% (Pendlebury 1997).

Based on long-term climate outlooks, and under current trends, it is likely that these reduced flow levels and flow variability will continue. Further, the proposed Murrumbidgee to Googong Dam Pipeline, designed to increase domestic water security for the Canberra region, will further decrease surface water levels through the ACT section of the demonstration reach (ACTEW Corporation 2009). Flow extraction for this initiative is currently estimated to be approximately 640 ML per month.

Thirty-six surface and groundwater access entitlements (WAE) are current within the ACT-controlled portion of the reach (not including the Cotter Pump station). These have a total annual entitlement of 1893 ML (DECCEW 2009). An additional 20 WAEs (not including the Cotter River) with a total entitlement of 987 ML (DECCEW 2009) occur within the ACT tributaries. ACTEW currently extract water through three WAEs on the Cotter River (totalling 58000 ML) and the Murrumbidgee River at Cotter Pump Station.

**Asset 2: Water**

**WATER QUALITY**

While more data gathering is recommended, it appears that most water quality parameters along the UMDR are within acceptable limits for all uses. One of the major ongoing issues is sedimentation from the upstream portions of the Murrumbidgee River as it passes through the Cooma–Monaro Plains. Turbidity regularly reaches levels that are beyond recommended guidelines for extraction.

Sediment deposits stemming from sources such as the Numeralla and Bredbo River catchments are now common in the Upper Murrumbidgee River (see Plates 11 and 12) and are having increasingly significant impacts on water quality and fish habitat (Lintermans 2000).

**GROUNDWATER**

In the ACT groundwater tends to be found in low-yield fractured rock aquifers to approximately 100 m depth. The location of aquifers is based on topography and they tend to discharge to streams (i.e. valley low points) providing stream base flow. The groundwater resource is small compared to surface water. (Heath Chester pers comm. 2010; DECCEW 2009).

**PRIMARY THREATS**

- Lack of suitable environmental flow allocation
- Further flow diversions to support Canberra’s growing population.
- Drought conditions, climate change and reduced yields.
- Pollution of waterways from urban areas and rural activities (riparian erosion especially).
- Unsustainable use of surface and groundwater.
- Farm dams may pose a significant threat to overland flows to streams as their number continues to grow.



(a)



(b)



(c)



(d)

Contrasting surface flow.  
 Top: Murrumbidgee River looking upstream at Tharwa Sandwash recreation reserve during (a) high and (b) typical low discharge.  
 Bottom: View downstream from Tharwa Bridge during (c) high and (d) extreme low discharge.  
 Photos: (a-c) Luke Johnston, (d) Bill Phillips.



### Asset 3: Aquatic and in-stream habitats

#### DESCRIPTION OF ASSET

Within the UMDR the river has many different forms, flowing through steep sided gorges to broad open slopes, all of which provide a diversity of habitats. Among these are:

- upland pool–riffle–run sequences
- drought refuge pools
- complex benthic substrates such as cobble, pebble and varied bedrock surfaces
- in-stream (macrophytes) and overhanging vegetation
- large woody debris (snags)
- off-stream wetlands.

#### STATUS OF ASSET

Approximately 400 km of the Upper Murrumbidgee River is listed as a natural place on the Register of the National Estate, extending from Tantangara Dam to the mouth of Oaky Creek, 300m south-west of Yeumburra Homestead and about 20km north of the northern border of the ACT, including 20m on either side of the river from bank full discharge level.

Within the UMDR, the river tends to be in relatively good condition through gorge sections largely because of inaccessibility and higher velocity scouring flows (see Plates 1, 4, 5 and below). These sections can pose a potential impediment to movement for some species at low flow levels and this impediment may be exacerbated by increased water extraction.

Shallow sandy substrates are common throughout the wider slower flowing sections. These areas have been significantly affected by sediment deposition and sand slugs where habitat diversity has been dramatically reduced since widespread landclearing took place in the catchment.

Off-channel riparian wetlands that contain stable wetland habitat features are known to exist particularly where bedrock comprises a large proportion of the floodplain.

In-stream infrastructure includes water off-take points, bridges and one fish weir at the downstream end of the reach. Connectivity between habitats is at present impacted by two low-level road crossings within the ACT.

#### PRIMARY THREATS

- Sediment input and reworking of existing bed load from upstream and tributaries.
- Main channel bed and bank erosion.
- Altered natural flow regimes and flow reduction caused by extraction for urban water supply, agricultural, stock and domestic use and of tributary and overland flow (farm dams) (See Asset 2).
- Clearing of riparian zones (reduced input of large woody debris, shading and leaf fall, grazing, fire, reduced buffering of sediment run-off).
- River crossings, roadway construction.
- Aquatic and riparian weed incursions.

Asset 3: Aquatic and in-stream habitats



(a)



(b)



(c)



(d)



(e)



(f)

A range of aquatic habitats occur in the UMDR project area.

(a) Deep pool in Black Rock Gorge at Scottsdale Bush Heritage property

(b) Rocky cascade in Black Rock Gorge

(c) Shallow sandy reach at Tharwa ACT

(d) Shallow rocky reach at Lobbs Hole near the southern ACT border

(e) Emergent macrophytes (*Phragmites australis*) occur in slower sections

(f) Refuges for fauna may be found within small off-stream wetlands such this one in Gigerline Gorge.

Photos (a) Mark Jakobsons and (b-f) Luke Johnston

## Asset 4: Riparian floodplain vegetation communities

### DESCRIPTION OF ASSET

Riparian floodplains are highly variable throughout the UMDR (Johnston et al. 2009; L Johnston pers. comm. 2010). They range from wide (greater than fifty metres) cobble and sand plains, to elevated sand and clay terraces, to less than one metre wide solid bedrock banks beside steep gorge walls. This diversity of floodplain creates diversity at both large and small scales among the riparian vegetation communities within the reach. As with the fish community there is also an upland to lowland gradation in the riparian vegetation, particularly the floodplain woodlands that are dominated by ribbon gum (*E. viminalis*) in the upper part, and river she-oak (*Casuarina cunninghamiana*) in the lower part of the UMDR. In conditions unfavourable to woodland development, river shrublands dominate. Instream and fringing vegetation occurs throughout the project area.

**Floodplain woodlands** (from Johnston et al. 2009). Riparian floodplain sections of the reach with an alluvium or soil substrate are associated with floodplain tableland woodlands. Upstream from Point Hut Crossing in the ACT these floodplains were once dominated by Ribbon Gum (*Eucalyptus viminalis*) Tableland Riparian Woodland. Downstream of Point Hut Crossing the floodplains contain extensive tracts of mixed quality River She-oak (*Casuarina cunninghamiana*) Riparian Tableland Woodland (see Section 2.5.1, Plates 15 and 16).

**Floodplain shrublands** (from Johnston et al. 2009). High quality Riparian Tableland Shrublands are associated with bedrock-dominated floodplains, within the narrow steep-walled gorge sections and on river inner meander bends also. These predominantly contain river bottlebrush (*Callistemon sieberi*), river tea-tree (*Leptospermum obovatum*) and to varying extents burgan (*Kunzea ericoides*). Occasional small perched wetlands contain uncommon fringing species in the area such as the quillwort (*Isoetes muelleri* and *Isolepis inundata*). (see Section 2.5.1, Plates 13 and 14).

### STATUS OF ASSET

The **floodplain woodlands** of the Upper Murrumbidgee have been heavily impacted by previous land use and fire. Less than 10% of the Ribbon Gum Tableland Riparian Woodland occurs in the ACT section of the UMDR and is in a state of decline (Johnston et al. 2009).

The She-oak Tableland Riparian Woodland has been heavily fire impacted within the reach and is recovering slowly and less vigorously than expected (see below). Recovery has been primarily restricted to wetter margins of the floodplain and riverbank (Johnston et al. 2009).

In nearly all situations in the gorge **floodplain shrublands** are in very good condition. The bedrock upon which they are established provides protection from weed invasion and within the gorges they are relatively protected from unfavourable growing conditions (Johnston et al. 2009).

The riparian zone in NSW is also in good condition through the extensive gorges where it is relatively inaccessible. Other large tracts that were previously cleared are now degraded and often dominated by willow and African lovegrass (L Johnston pers comm 2010).

### PRIMARY THREATS

- Reduced occurrence of floods (see Asset 2).
- Weed invasion.
- Disturbance by feral animals.
- Overgrazing and bank disturbance.
- Clearing of riparian margins.

Asset 4: Riparian floodplain vegetation communities



(a)



(b)



(c)



(d)



(e)



(f)

Floodplain riparian vegetation communities of the Upper Murrumbidgee Demonstration Reach:

- (a) good quality river valley vegetation near Michelago with floodplain shrubland in the foreground in front of one of the few intact Ribbon Gum Riparian Woodlands;
- (b) a small isolated remnant of ribbon gum (large dark trees on the opposite riverbank), at Tharwa Sandwash;
- (c) healthy recovery of fire impacted river she-oak on the riverbank where soil moisture is high;
- (d) fire impacted river she-oak on the rearward edge of the floodplain being colonised by young dryland apple box eucalypt (*Eucalyptus bridgesiana*);
- (e) sparse bedrock floodplain shrubland at Red Rocks Gorge;
- (f) instream riparian fringing cumbungi (*Typha orientalis*) persisting in an off-stream perched wetland in Red Rocks Gorge.



## Asset 5: Threatened and migratory species (other than native fish)

### DESCRIPTION OF ASSET

Sections 2.5.3 and 2.5.4 provide the full lists of those plant and animal species found within the UMDR that are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) and/or NSW and ACT legislation. See Table 3 (for plant species) and Table 4 (for animal species). Table 5 lists those bird species classified as 'migratory' under the EPBC Act and which have been identified as potentially occurring within the UMDR.

Apart from the threatened native fish (see Asset 1) other species that have been identified occurring within the project area and warranting special attention through this plan are:

**Murray River crayfish** (*Euastacus armatus*) is listed as vulnerable under the *Nature Conservation ACT 1980* (ACT). The species inhabits the main channel of faster flowing cool waters. It uses the spaces between boulders and cobbles on the river bed for shelter.

**Pink-tailed worm lizard** (*Aprasia parapulchella*) (see below) occurs on rocky grassland slopes. The species is listed as vulnerable and has 'special protection status' under the *Nature Conservation ACT 1980* (ACT) and is listed as vulnerable under the EPBC Act and *Threatened Species Conservation Act 1995* (NSW).

**Tuggeranong lignum** (*Muehlenbeckia tuggeranong*) (see below) occurs at a small number of locations and is listed as endangered, both under the *Nature Conservation ACT 1980* (ACT) and the EPBC Act.

Many other uncommon vegetation species occur within the river corridor, including the Australian anchor plant (*Discaria pubescens*), pale pomaderris (*Pomaderris pallida*) (vulnerable (Cwlth, NSW) and austral toadflax (*Thesium australe*) (vulnerable Cwlth, NSW).

### STATUS OF ASSET

The pink-tailed worm lizard is thought to be uncommon as it is restricted to specific rocky grassland sites in the region. Current research is being undertaken to improve the knowledge base for this unique reptile.

The Murray River crayfish is considered to be in a serious state of decline (ACT Govt 2007). A favourite edible species it is presumed that it has suffered from high levels of exploitation throughout its range; however, actual quantification of population status is difficult.

Tuggeranong lignum occurs within the reach in the vicinity of Pine Island Recreation Reserve in the ACT. There is a small *ex-situ* population at the Australian National Botanic Gardens.



**Asset 5: Threatened and migratory species (other than native fish)**

**PRIMARY THREATS**

**Murray River crayfish**  
 The major threats to the continued survival of this species are habitat alteration, overfishing and possibly interactions with introduced fish species.

**Pink-tailed worm lizard**  
 Habitat loss and fragmentation; removal of rocks; stock and rabbit grazing; stock trampling; invasion of habitat by weeds; inappropriate grass slashing for hazard reduction; habitat modification through tree-planting in native grasslands; altered fire regimes.

**Tuggeranong lignum**  
 The main threat to survival of the Tuggeranong lignum population and therefore the species is likely to be deliberate or unintended actions associated with visitor and/or land management activities in the local area. The population consists of only eight individuals of which only one is female and therefore is also under threat due to lack of reproduction.



Murray River crayfish (*Euastacus armatus*) from Red Rocks Gorge.  
 Photo: Mark Jekabsons



Pink-tailed worm lizard (*Aprasia parapulchella*) Photo: ACT TAMS



Tuggeranong lignum (*Muehlenbeckia tuggeranong*) Photo: Luke Johnston

## Asset 6: Iconic species

### DESCRIPTION OF ASSET

As part of seeking to increase community engagement in this initiative, it is proposed that several species be promoted as 'icons' around which some activities (e.g. survey and monitoring or education and awareness raising activities might be focused). While other species may emerge as implementation commences (see accompanying Communication, Education and Public and Awareness Plan) initially the following have been proposed as iconic species.

- **Trout cod** (see Asset 1) are an iconic representative of the site, and are a good fish species to highlight as efforts are ongoing to rehabilitate populations of the species within the reach.
- **Platypus** occur throughout the project area, although little is known of its population health. Platypus has the ability to inspire a large community interest in the project and generate public relations and media opportunities.
- **Ribbon gum** (see Asset 4) are attractive large trees to 45 metres with long bark ribbons hanging in the forks and branches. The floodplain woodland community dominated by this species has been heavily impacted by past agricultural activities and now by reduced river flows and weeds. The remnant large trees along the project area are a symbol of upland riparian habitats that, with some effort, can be rehabilitated.

### STATUS OF ASSETS

**Trout cod** are listed as endangered in Commonwealth, NSW and the ACT legislation. The species has suffered a major reduction in distribution and population.

**Platypus** are presently described as being common, but vulnerable (Carrick et al. 2008) because of the very specialised niche which the species occupies. Platypus are common throughout the UMDR but the density of individuals and population dynamics that more accurately indicate population health is unknown (L. Johnston pers comm., 2010).

Ribbon gum now occupies less than 10% of the habitat considered to have been suitable for it prior to European settlement. The floodplain community formed by ribbon gum is at threat of extinction. Possible review may provide Ribbon Gum Tableland Woodland with increased protection status.

### PRIMARY THREATS

As with all aquatic species, reduction in habitat quality, alteration to flow regimes and competition from introduced species and fishing pressures continue to impact both trout cod and platypus. Furthermore, individual platypus are often tangled in litter and drowned in various types of nets and traps. Of note, opera-house nets, which kill platypus, are legally sold throughout the platypus range. Fyke or eel nets illegally set within rivers have been known to kill numerous individuals before being removed. The use of gill, mesh and trammel nets in both commercial and research fisheries is also a problem.

Ribbon Gum Tableland Riparian Woodland has historically suffered from land clearing as it occurs where the river valleys are more open and suitable for agricultural activities. It is now mostly under threat from lack of recruitment due in part to floodplain weed infestations and possibly reduced overbank flood events.

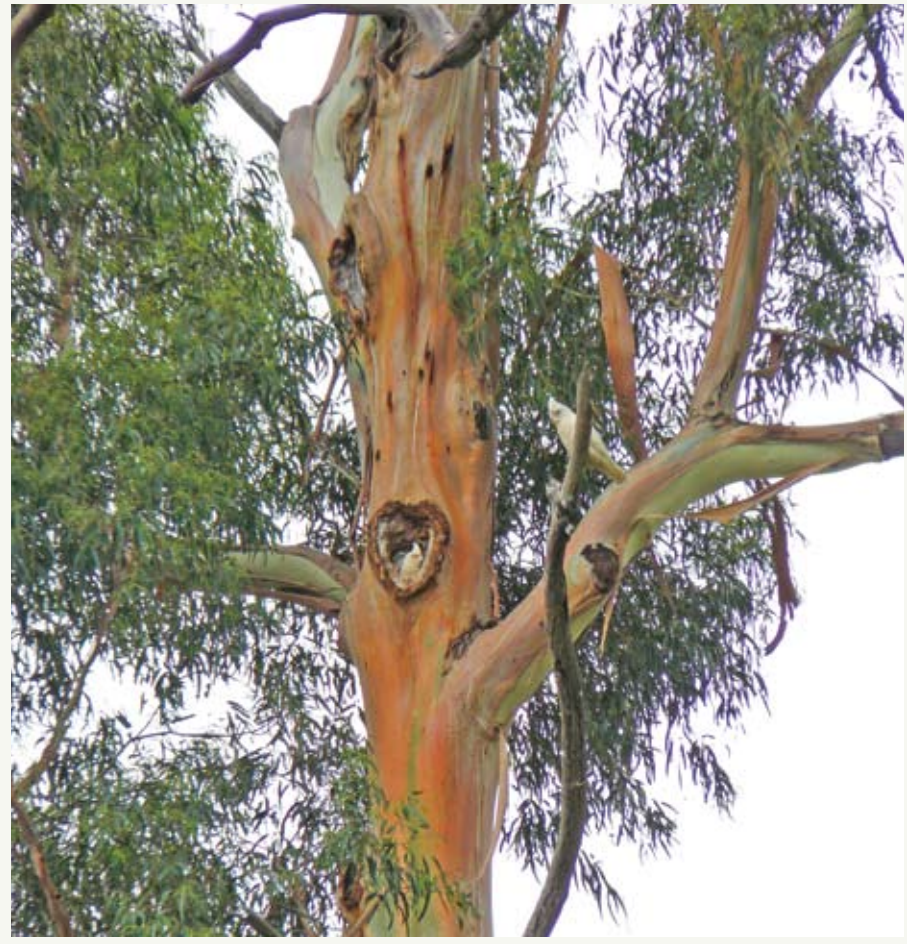
Asset 6: Iconic species



Trout Cod. Photo: Esther Beaton



Platypus. Photo: Kathryn Black



Ribbon gum with corellas using tree hollow and limb at Tharwa Sandwash.  
Photo: Luke Johnston

## Asset 7: Protected areas

### DESCRIPTION OF ASSETS

**Scottsdale Reserve** covers 1328 hectares and is located near Bredbo in NSW with frontage to the Murrumbidgee River. It is the first property to be purchased as part of a landscape reconnection project entitled 'Kosciuszko to Coast' (K2C) that has a vision of re-establishing a network of habitats between the Australian Alps and the Great Escarpment of Eastern Australia. The property was purchased by Bush Heritage Australia, a major partner in K2C.

Scottsdale protects endangered grassy box gum woodland that is home to many rare birds and reptiles along with threatened springs, bogs and temperate grasslands. It has one of the last intact ecosystems on the Murrumbidgee River.

The **Murrumbidgee River Corridor** is a government protected and managed strip of land and water up to 4 km wide along the full length of the ACT section of the Murrumbidgee River. It encompasses the entire land and river channel along the UMDR area downstream of the ACT border. The corridor contains and protects important aquatic ecosystems and many significant natural and cultural features

### STATUS OF ASSETS

Scottsdale Reserve: Bush Heritage Australia's website notes:

*By acquiring Scottsdale we have removed the main threats to the property: rural subdivision, agricultural intensification and further weed encroachment. In particular we have thwarted further attempts to 'improve' the productivity of this country through the introduction of additional exotic pasture species and crops.*

<[www.bushheritage.org.au/our\\_reserves/state\\_new\\_south\\_wales/scottsdale](http://www.bushheritage.org.au/our_reserves/state_new_south_wales/scottsdale)>

The Murrumbidgee River Corridor (MRC) within the demonstration reach includes three designated nature reserves: Gigerline, Bullen Range and Stony Creek. The corridor comprises nature reserves, low-impact recreation areas, cultural heritage places, community uses, and some rural land use. The MRC is managed in accordance with the Murrumbidgee River Corridor Management Plan (ACT Govt 1998).

### PRIMARY THREATS

**Scottsdale Reserve:** Bush Heritage Australia website states:

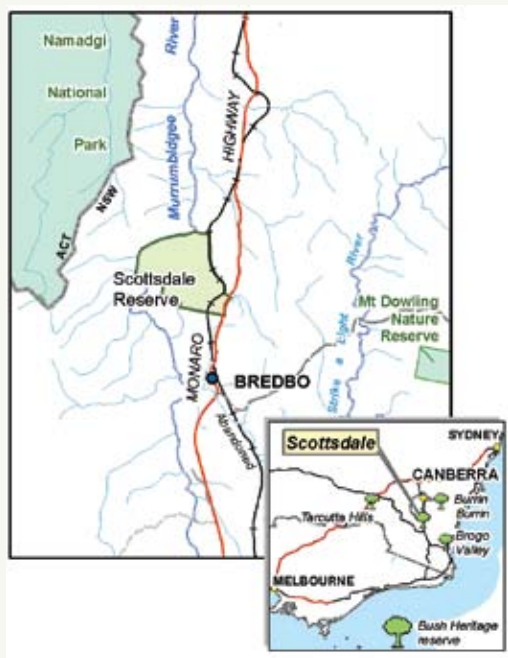
*The key management issue is weeds, particularly African lovegrass. Effective weed control and rehabilitation of the grasslands on parts of the property are likely to be costly, but there is strong support from a range of groups and agencies to set up a regional demonstration site at Scottsdale for the control of the significant weeds of the region.*

Within the river at Scottsdale, although the aquatic habitat is in good condition, recent fish monitoring for the UMDR detected 100% carp within the lower Black Rock Gorge fronting Scottsdale (ACT TAMS unpublished data 2010).

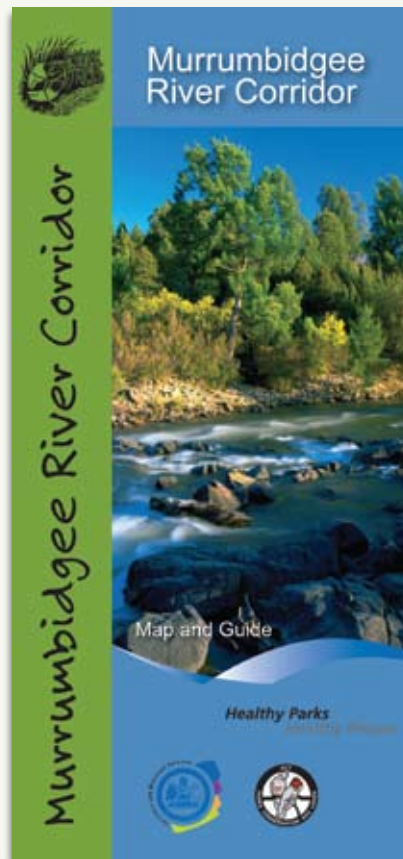
Threats to the **Murrumbidgee River Corridor** are essentially those outlined in Section 4.2. Because the MRC is so close to Canberra's expanding urban areas, threats from recreational uses, water pollution and soil erosion originating upstream are major issues. Controlling woody weeds and introduced fish (carp especially) are the other major challenges.



Asset 7: Protected areas



Above, location of Scottsdale and a photo of the Murrumbidgee River at that location (courtesy Bush Heritage Australia website).



Murrumbidgee River Corridor information leaflet (see Section 2.6)



## Asset 8: Aboriginal cultural heritage assets

### DESCRIPTION OF ASSET

The Murrumbidgee River itself is part of Aboriginal Dreaming. Likewise Murray cod, which are found within the Murrumbidgee, are a recognised part of the Dreaming. For ten's of thousands of years Aboriginal people sustainably occupied and managed the Murrumbidgee and its ecological resources using traditional ecological knowledge that ensured a healthy environment that supported its occupation.

Evidence suggests that the Murrumbidgee was certainly a major focal point of Aboriginal activity prior to European settlement that was occupied by the Ngunnawal and Ngarigo language groups. These Aboriginal peoples found food and shelter, produced tools and held gatherings associated with the collection of large numbers of Bogong moths over the summer period (Flood 1980; NSW Heritage Office and Dept Urban Affairs and Planning 1996). The river corridor and archaeological sites identified along the river continue to have cultural significance to Aboriginal people today.

Surveys such as that by Barz and Winston-Gregson (1981, 1982) and many other surveys and studies have well documented much of the Aboriginal cultural heritage of the riverine area. One well-known publically listed Aboriginal heritage site in the project area is the Lanyon Canoe Tree, 450 m north-north west of the historic Lanyon Homestead (See Asset 9).

### STATUS OF ASSET

The traditional owners that occupied the Murrumbidgee River valley were heavily impacted by the colonising European settlers. Present day Aboriginal people descended from the traditional owners remain within the Murrumbidgee region, as well as Aboriginal peoples from nations around the country who have settled in the ACT region. Many are passionate to have cultural and spiritual connections to the land and waterways recognised, and to contribute to the development both an enhanced understanding of the importance of the Murrumbidgee and its country to Aboriginal people.. Traditional ecological knowledge of sustainable land and water management still exists and could be an asset incorporated into contemporary natural resource management of the Murrumbidgee. Ongoing dialogue with Aboriginal representatives in NSW and the ACT will ensure that the understanding and protection of these Aboriginal values and cultural assets continues in the upper Murrumbidgee region.

Aboriginal sites identified by Barz and Winston-Gregson (1981, 1982) along the Murrumbidgee River Corridor are listed on the ACT Heritage Register.



**Asset 8: Aboriginal cultural heritage assets**

**PRIMARY THREATS**

- Accidental or intentional damage to Aboriginal sites.
- Lack of awareness about the cultural values of the Murrumbidgee River corridor and their continued conservation and management.
- Lack of engagement with Aboriginal people into decision making about natural resource management in the region.
- Lanyon Canoe Tree is healthy and is protected by a small fence. Its main threat is damage by bush fire. Interpretation is needed.



Canoe Tree at Lanyon. Photo: Luke Johnston

## Asset 9: Other cultural assets

### DESCRIPTION OF ASSET

The Murrumbidgee and surrounding lands have an ongoing significance to all people of the region, historically, at the present day and into the future. The Murrumbidgee River environs are generally recognised as a scenic and recreational resource within the capital region. The river gorges and steep valleys have spectacular scenery, some of which can be readily accessed along well maintained walking trails in the ACT, for example, Red Rocks Gorge only a few kilometres from the southern suburbs of Canberra.

In contrast rural land adjoining the river is often less dramatic having easier access to the river and containing a range of sites of cultural heritage interest such as the Lanyon Homestead within the Lanyon Landscape Conservation area.

There are no established recreation sites within the NSW section of the UMDR; however, within the Murrumbidgee River Corridor in the ACT (see Asset 7 above) government maintained public sites include Angle Crossing, Tharwa Sandwash, Point Hut, Pine Island, Kambah Pool and Casuarina Sands.

Recreational use within the UMDR is mainly oriented toward maintained picnic sites and activities such as swimming, walking, sightseeing, children's play activity, rock climbing, boating and canoeing, and fishing.

European registered heritage sites listed under the ACT Heritage list and/or Register of the National Estate (see Status of Assets below) within the ACT portion of the project area include:

- Tharwa village (nominated)
- Tharwa bridge
- Tharwa primary school
- Tharwa general cemetery
- St Edmunds Anglican Church
- De Sallis cemetery
- De Sallis memorial cairn
- Cuppacumbalong homestead precinct
- Cuppacumbalong cemetery and avenue of elms
- Cuppacumbalong garden
- Cuppacumbalong woolshed
- Lanyon Bowl
- Lanyon homestead
- Lambrigg homestead, wheat paddock & Farrer gravesite
- Cotter pumping station precinct, Cotter pumping station and electricity substation
- Cotter bridge
- Tuggeranong boundary wall



### Asset 9: Other cultural assets

Items of heritage significance listed under the NSW Heritage list and/or Register of the National Estate within the NSW UMDR region include:

- Bredbo cemetery
- Bredbo Inn
- Bredbo River rail bridge
- Bredbo school
- Bredbo Station
- Cappawidgee Eucalyptus pulverulenta site
- St Bartholomew's Anglican Church
- Ingalara railway bridge SHR: Michelago rail bridge over Ingalara Creek
- Micalago gardens

### STATUS OF ASSETS

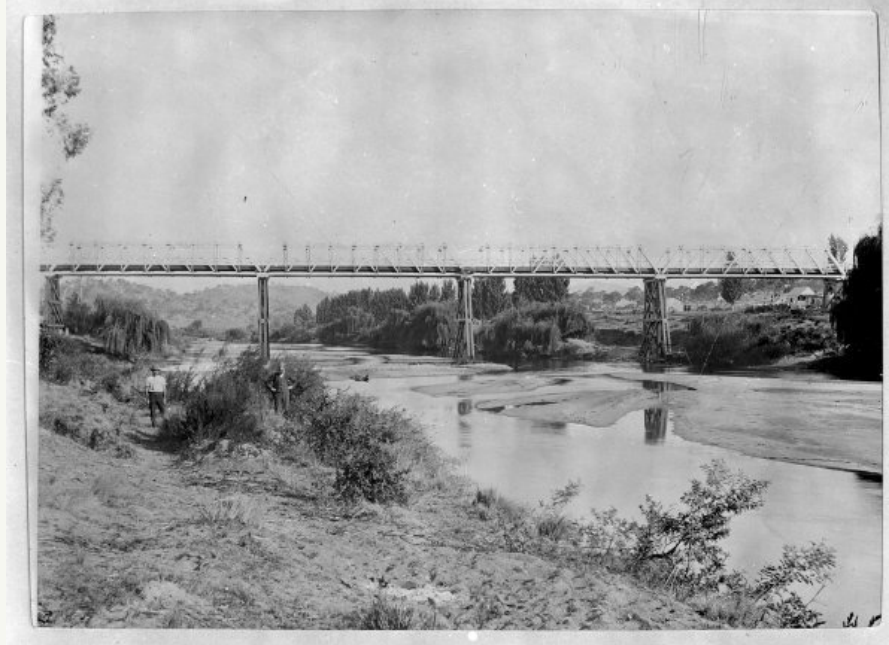
The specific sites noted above are listed on, and therefore protected under, the ACT Heritage Register under the *Heritage Act 2004* and/or the NSW State Heritage Register under the *Environmental Planning and Assessment Act 1979*.

NOTE: A new national heritage system under the *Environment Protection and Biodiversity Conservation Act 1999* commenced on 1 January 2004 under which the former national system based on the Register of the National Estate will cease to have a statutory basis from February 2012. This transition period is to allow time to transfer places on the Register of the National Estate to other local, state, territory and Australian Government registers. More information can be obtained at <http://www.environment.gov.au/heritage/places/rne/index.html>.

### PRIMARY THREATS

Threats to all heritage sites include inadequate protection, damage by natural events or vandalism, and lack of awareness or interpretation.

Asset 9: Other cultural assets



Tharwa Bridge (c.1895). Photo: courtesy National Library Australia



Cotter Pumping Station. Photo: Luke Johnston





## 4.2 Threatening processes impacting on the priority 'assets'

### 4.2.1 Changes to surface water flows and seasonal patterns

Reduced in-stream flows are due to several factors including extractions from Tantangara Reservoir, interceptions by farm dams, and agricultural and domestic extraction. Low rainfall during the first decade of this century has caused further reductions. The possible impact of the proposed water extraction from the Murrumbidgee River at Angle Crossing as part of the ACTEW Murrumbidgee to Googong Reservoir water transfer is still under consideration.

Some of the specific threats from changes to surface water flows and seasonal patterns include:

- a reduced incidence of medium-high flood events
- impacts of the timing of reduced flow events on critical life history stages of fish and other biota
- reduced fish community connectivity and increased obstruction to fish passage through shallow zones (e.g. Angle and Point Hut road crossings, Tharwa Sandwash, and the several narrow gorges) during periods of low flow.

### 4.2.2 Reduced water quality

For the UMDR the greatest water pollution threats are from high sediment loads and associated pathogens, nutrient enrichment from run-off, and point source and gross pollution from urban areas.

High sediment loads from the upper catchment accumulate at depositional zones (Bredbo, Bumbalong, Angle Crossing and Tharwa area), filling in deep habitat pools and creating uniform sand-dominated substrate zones. The estimated annual bed material transport rate is between 30 000 and 60 000 m<sup>3</sup> (Lintermans 2004a).

### 4.2.3 Groundwater depletion

Little is known at present about groundwater interactions across the region. This knowledge gap is a high priority for further investigation.

### 4.2.4 Climate change impacts on water availability

The possible medium to long term impacts of climate change on water availability in the demonstration reach are another knowledge gap and could be a high priority for further investigation.

### 4.2.5 Physical disturbances

Physical disturbances can take many forms and hence impacts on the river vary. Most common among these threats are:

- sand and gravel extraction
- land clearing
- farm dam construction
- road, bridge or river crossing construction
- urban and rural building construction.
- extreme flood events

#### *4.2.6 Loss of in-stream habitat connectivity (impediments to fish passage) and complexity*

The loss of in-stream connectivity (impeding fish passage) can result from several factors acting together or in isolation from one another. These factors include low river flows (especially at critical life cycle stages), in-stream structures such as weirs and low level crossings, and the accumulation of impassable sediment slugs.

Loss of habitat complexity can result from:

- sedimentation
- degradation of riparian margins
- bank or river bed degradation or erosion
- low flows
- reduced variability of flows
- infilling of in-stream habitats by sediment slugs and similar.

#### *4.2.7 Loss of riparian habitat connectivity and biodiversity*

Several factors can contribute to loss of riparian habitat connectivity and biodiversity including clearing of riparian, floodplain and surrounding woodland vegetation, and unregulated access of grazing stock to riparian zones (see Section 4.2.10). As well as fragmenting habitats, these can exacerbate the spread of woody weed species.

#### *4.2.8 Introduced plant species*

For the UMDR the primary introduced plant threats include:

- willows
- blackberries
- serrated tussock
- African love grass
- poplars
- Chilean needle grass.

While control measures for all of these are already underway, increased effort and resources are needed, especially in areas identified as priority habitats. It is noted that willows and blackberries do provide some habitat values for nesting waterbirds and small woodland birds, respectively, in the absence of the former tree and shrub cover.

#### *4.2.9 Introduced animal species*

Introduced animal species of primary concern are as follows.

##### **Alien fish species**

Seven alien fish species are recorded from the UMDR (Lintermans 2002):

- carp: known to comprise up to 96% of fish biomass within the project area and some of its tributaries (Lintermans 1998; Lintermans et al. 2001; Lintermans unpublished data; Jakobsons and Lintermans 2006)
- goldfish: widespread and common throughout the UMDR
- oriental weatherloach: common and widespread at and below Angle Crossing; not as common upstream
- redfin perch: common in the river below the Gigerline Gorge. Species is capable of spreading the EHN virus



- eastern Gambusia: widespread with no current control methods known
- rainbow trout: formerly more common than at present
- brown trout: formerly more common than at present

Note: Rainbow trout and brown trout are recreational species that are currently managed in NSW under the *Fisheries Management Act* (1994)

### Mammals

- Rabbits: The abundance of rabbits varies greatly, depending on factors that include disease status (myxomatosis, rabbit haemorrhagic disease), fox abundance and control history. The power of uncontrolled rabbit populations to alter the landscape is illustrated by the rate of sediment accumulation in Burrinjuck Reservoir (and other impoundments) that slowed sharply after the spread of the myxomatosis virus in 1951. Thus, rabbits can be regarded as a factor potentially affecting water quality.
- Deer: These are a newly emerging pest species requiring control (ACT CSE 2008). Three deer species occur in the ACT: sambar, fallow and red deer. The abundance of all three seems to be increasing (Lintermans, 2010, pers. comm.). Monitoring of the population is needed to track population growth, identify potential impacts and develop control methods.
- Foxes: Generally fox numbers are highest in sheep-raising areas and the first two kilometres of bushland. Foxes have widespread impacts on native fauna, (ACT CSE 2008). Fox control should be integrated with rabbit control to avoid outbreaks of the latter.
- Feral cats: The impact of feral cats has not been quantified in this region to date. There are no practical methods of control at present.
- Feral pigs: These are a potentially important agricultural pest in the UMDR and can have conservation impacts also. Effective control of pig impacts depends on co-ordination at sufficient geographic scale, and effective methods; poisoning being more efficient than trapping or shooting.
- Feral goats: These are present on the surrounding ranges, but abundance is too low at present to be associated with significant impacts due to previous shooting efforts and dingo predation.

#### 4.2.10 Rural land use practices

Land use practices can have a major impact on water quality and in-stream habitats. Grazing practices may result in loss of groundcover, increased soil erosion and in-stream sedimentation. Likewise, stock can trample or consume riparian regrowth or directly impact on bank areas along the river, therefore accelerating sedimentation. Gully erosion, if uncontrolled causes similar problems. Exposed areas may be colonised by introduced plant and weed species that can spread downstream.

Access tracks, construction works or the emplacement of river or creek crossings can have negative downstream impacts and reduce in-stream connectivity. Interception of run-off by farm dams is having a generalised impact across the catchment by reducing in-stream flows. Improving on-farm irrigation efficiency will also help to keep the river healthy. The uses of chemicals, fertilisers and sprays on rural land also needs to be managed carefully to avoid damage to the river system.

As well as traditional rural land users, it is important to draw 'hobby farmers' into education and awareness raising programs associated with the UMDR project.

#### 4.2.11 *Urban activities*

The urban areas provide their own range of threatening processes. Stormwater run-off can be laden with various pollutants. Domestic householders continue to use their stormwater drains as disposal points for many unwanted waste products that are hazardous to river life. Nutrient-enriched run-off (from fertilisers in the main) remains a problem. Pollution of the river from users of recreational areas along the Murrumbidgee River Corridor in the ACT (Angle Crossing, Tharwa Sandwash, Point Hut, Pine Island; Kambah Pool; Casuarina Sands) is a constant challenge for managers.

Urban areas are also the origin of uncontrolled domestic pets that may kill small birds and reptiles along the river corridor. There are also garden plant escapees and these can make their way to the river by run-off or illegal dumping. Likewise the disposal of unwanted aquarium fish in rivers, streams, creeks and lakes is an ongoing problem. The introduction of oriental weatherloach in the ACT is thought to have originated from this source.

Construction works (buildings and roads) in Canberra's rapidly expanding rural–urban fringe can also result in impacts on the Murrumbidgee River, especially through sedimentation.

#### 4.2.12 *Recreational activities*

Illegal fishing activities can have a direct impact on native fish or platypus populations either through direct or delayed mortality from capture, and through the human-assisted dispersal of alien fish species (Lintermans 2004b). Use of bait fish also warrants further investigation.

#### 4.2.13 *Threats to cultural heritage assets*

A range of cultural heritage assets, both Aboriginal and early European, are found within the UMDR. Direct threats to these include:

- vandalism
- accidental damage or destruction during construction works
- natural disasters
- degradation resulting from surrounding land uses
- lack of understanding among the general public around the concept of 'cultural significance'.

#### 4.2.14 *Changes to fire regime*

Fire can have a major impact on river health. Run-off immediately following fires in the catchment can have a serious negative impact on water quality. A series of fish kills in the Murrumbidgee River followed the 2003 bushfire affecting Murray cod, Macquarie perch and golden perch. A single post-2003 fire rainfall event is estimated to have deposited more than 8000 tons of sediment into the Cotter River, a major tributary of the lower UMDR.

Changes to fire regime itself alter the levels of intensity and frequency at which fire events occur. This can have impacts on not only in-stream river health but also the composition and structure of the vegetation in the river corridor.

With predictions of hotter, drier summers under climate change scenarios this threat is one of concern to management of the riverine ecosystem.



#### *4.2.15 Lack of understanding and appreciation*

Although there are several groups within the community who have a great knowledge and connection to the river, it is seen as a high priority to overcome a lack of understanding and appreciation of the values and assets of the river among many of those who live around and along the demonstration reach. A priority is to undertake a range of actions to encourage people take on a stewardship and caretaker role. Landholders along the river are a primary target group as their land use practices can have immediate and direct negative impacts of river health (see the separate Communications, Education, Participation and Awareness Plan).



### 4.3 Analysis of threats

ASSETS	Native fish community (including threatened species)	Water	Aquatic and in-stream habitats	Riparian and floodplain vegetation communities	Iconic species (such as platypus)	Rare, threatened or endangered species and ecological communities (other than native fish)	Protected areas	Aboriginal cultural heritage assets	Social and cultural assets
<b>THREATS</b>									
Changes to surface water flows and seasonal patterns	High	High	High	Medium	High	Medium	Low	Low	Medium
Reduced water quality	High	High	High	Medium	High	Low	Low	Low	Medium
Groundwater depletion	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Climate change	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Physical disturbances	Medium	Medium	Medium	Medium	High	Low	Low	High	High
Loss of in-stream habitat connectivity and complexity	High	-	High	-	High	Low	High	-	Medium
Loss of riparian habitat, connectivity and biodiversity	Medium	Low	Medium	High	Medium	Medium	Medium	Low	Low
Introduced plant species	Medium	Low	Medium	High	High	Medium	High	Unknown	Medium
Introduced animal species	High	Medium	High	Medium	High	Medium	High	Unknown	Medium
Rural land use practices	High	High	High	High	Medium	Medium	Medium	Unknown	Low
Urban activities	Medium	Medium	Medium	Low	Medium	Medium	Medium	Unknown	High
Recreational activities	Low	-	Low	Low	Medium	Low	Medium	Unknown	High
Threats to cultural heritage assets	-	-	-	-	-	-	Low	High	Medium
Changes to fire regime	Low	Low	Low	High	Low	Medium	High	Unknown	High
Lack of understanding and appreciation	Medium	Low	Medium	Low	Medium	Low	Low	High	High



## 5. Management objectives, actions and targets

The following tables detail proposed actions that contribute the long-term objectives of the UMDR. Many of the actions listed require the financial and in-kind assistance of existing project partners and additional stakeholders. Some of these actions are existing, and future, core business of partners that will contribute to the improvement of the Upper Murrumbidgee Demonstration Reach. Other project specific actions require targeted investment and support that will be proposed and managed by the UMDR project team (denoted ‘\*’ in tables below). It will be the role of the UMDR project officer and members of the steering committee, to encourage support for priority actions to be undertaken in the Upper Murrumbidgee Demonstration Reach, whilst pursuing and encouraging linkages between the project and other related catchment initiatives.

## 5.1 Improving the management of surface water flows

Management objective: Flows are managed to maximise river health within the UMDR, especially for threatened native fish, other biota and ecological communities

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
1. Contribute to the review of existing ACT environmental flow guidelines	H	Improved E-flow guidelines	River flows that can support environmental values	2011	ACT Government agencies, local research institutions
2. Investigate environmental flow requirements of the UMDR to assist it meeting its vision	H	Improved E flow guidelines	E-flow guidelines that better address Murrumbidgee River needs and that are complementary between NSW and ACT	2011	Murrumbidgee CMA, ACT Government agencies, local research institutions, Industry and Investment (NSW) and other NSW Government agencies
3. Review potential impacts from the proposed ACTEW 'Murrumbidgee to Googong water transfer scheme' on the UMDR's priority 'assets'	H	Input into planning process	Impacts reduced as much as possible Identify potential offsets	2011	ACTEW, ACTPLA, Dept Industry and Investment (NSW) and other ACT and NSW government agencies
4. Environmental flow managers in NSW and the ACT establish ongoing collaboration	H	Collaborative mechanism or forum created	E-flow decisions being made collaboratively between NSW and ACT managers	2010	Murrumbidgee CMA, ACTEW, ACTPLA and other ACT and NSW government agencies
5. Collate details of licensed water extractors and their allowed take in NSW and the ACT Assess their impact on flows within the Upper Murrumbidgee River and the UMDR's priority 'assets' in particular	M	Extraction volumes and points known Real and potential impacts documented	Better knowledge of overall water 'budget' for the Upper Murrumbidgee, with opportunities for improving flows identified	2012	Murrumbidgee CMA, ACTEW, ACTPLA and other ACT and NSW government agencies
6. Document potential low-flow barriers to fish migration in NSW and the ACT portions of the Upper Murrumbidgee	H	Barriers identified, need for rectification prioritised and quantified as to when they become low flow impediments	Ability to recommend minimum flows required at critical times of the year, for example at times of native fish migration	Determined by availability of funds	Murrumbidgee CMA, relevant ACT Government agencies, research institutions, ACTEW, Industry and Investment NSW and other NSW Government agencies
7. Conduct an inventory of farm dams in the catchment and establish their role in affecting in-stream flows	M	Inventory completed	Appropriate actions taken to address impacts of farm dams on the UMDR, if required	2011	Murrumbidgee CMA, ACT and NSW Government agencies
8. Investigate groundwater-surface water interactions across the regions and for the river system especially	L	Groundwater systems across the region documented, including rates of extraction, and interactions with surface water bodies	Understanding of groundwater dynamics reflected in future UMDR planning and actions	Determined by availability of funds	Murrumbidgee CMA, CSIRO, ACT Government agencies, research institutions, ACTEW, Industry and Investment NSW and other NSW Government agencies
9. Document the expected impacts of climate change on flow patterns through the Upper Murrumbidgee over the coming 50 years	L	Broad predictions based on existing research for Australia	Predictions helping to forward plan within the context of the UMDR	Determined by availability of funds	Murrumbidgee CMA, relevant ACT Government agencies, research institutions, ACTEW, Industry and Investment NSW and other NSW Government agencies

## 5.2 Improving water quality

Management objective: Water quality 'hot spots' are addressed and broader, non-point source pollution reduced through behavioural changes by the community and stakeholders

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
1. Review and map major sediment and pollution input sources within the catchment of the Upper Murrumbidgee (where feasible) Collaborate with CSIRO (Sednet program) where appropriate	H	Ongoing monitoring at key sites along the UMDR and its tributaries	Improved understanding and targeting of sediment input sites	Ongoing	Waterwatch, Industry and Investment NSW and other NSW Government agencies, ACTEW
2. Identify sites in the catchment where remediation actions to address long-term sediment inputs are likely to be effective	H	Ongoing monitoring at key sites along the UMDR and its tributaries Prioritisation of sites for remediation	Targeted and strategic remediation of sedimentation input site	Ongoing	Murrumbidgee CMA, NSW DII, Waterwatch, ACTEW, ACT Government
3. Develop and implement a plan to address high impact pollution sources	M	Production of plan documenting alleviation of high impact pollution sources	Reduced pollution input to the UMDR	2015	ACTEW, ACT and NSW Government agencies, WaterWatch, ACTEW
4. Identify and rehabilitate high priority riparian sites in the UMDR and tributaries to protect water quality as well as conferring other benefits	H	Establishment of riparian assessment sites and photo points	Better understanding of the effectiveness of remediation works and areas of high value Prioritisation of sites for remediation	Ongoing	Waterwatch, Greening Australia, MCMA, Industry and Investment NSW and other NSW and ACT Government agencies
5. Continue to monitor water quality and flow levels through existing initiatives being taken by ACTEW, ACT and NSW governments, Waterwatch.		See separate M&E Plan			



### 5.3 Improving fish passage

Management objective: To allow native fish passage along the whole length of the demonstration reach

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
1. Review effectiveness of existing fishways (Casuarina Sands and Lower Cotter River) and modify as required. Consider the feasibility of carp trapping as part of these designs if recommended by the Carp Management Plan (see below)	H	Modification of existing fishways and incorporation of carp trapping capacity, where indicated	Fishways functional Improved fish passage Potential actions related to Carp Management Plan	2013	ACT Government agencies, ACTEW, MDBA, fishway designer, Industry and Investment NSW and other NSW Government agencies
2. Document, and prioritise for attention, other in-stream structures and other impediments to native fish passage	H	Prioritisation report	Reach-wide plan for fish passage	2010-11	MDBA, Industry and Investment NSW
3. Design appropriate fish passage remediation solutions for high priority barriers. Consider the inclusion of carp trapping as part of these designs if recommended by the Carp Management Plan (see below)	H	5-6 concept designs, including carp separation technology, if appropriate	Construction of 5-6 priority fishways, with carp traps as appropriate	2011 for concept designs	MDBA, Industry and Investment NSW and other NSW Government agencies, ACT Government
4. Liaise with relevant management authorities to facilitate the incorporation of fish passage considerations into maintenance or upgrade programs for existing instream infrastructure such as road crossings and weirs (Already done in the ACT)	M	Potential sites for amelioration identified Education of management authorities for use of fish-friendly river crossings when infrastructure is updated	Improved knowledge of fish passage issues by management authorities Fish-friendly river crossings used as standard within the reach	2011	MDBA, Industry and Investment NSW, Cooma Shire, ACT Govt
5. Determine the swimming ability of high priority native fish species within the project area to pass existing barriers at a range of water depths and velocities	M	Report on swimming capacities for priority native species, and barrier characterisation at priority barriers	Identification of priority barriers for remediation	Mid-2012	ANU, ACTEW and Industry and Investment NSW
6. Recommend flow regimes to overcome low-flow impediments to native fish passage – see flows objective above	M	Low-flow impediments identified Hydrological and geomorphic modelling conducted Swimming abilities of fish known (see above)	Flow targets recommended for all barriers	2015	Universities, research funding bodies, ACTEW, Industry and Investment NSW, ACT Govt
7. Monitor effectiveness of improved passage opportunities once installed or provided (See separate Monitoring and Evaluation Plan)	H	Fishway effectiveness monitored	Information for adaptive management available	As barriers are addressed	Australian National University, University of Canberra, Industry and Investment NSW, ACT TAMS



## 5.4 Improving the condition of in-stream habitats

Management objectives: To gain an understanding of where high value habitats for native fish and other aquatic fauna are located and maintain these and improve other sites to extend habitat availability

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
* 1. Survey and map the distribution and condition of in-stream habitats, identifying those of greatest importance to native fish and other aquatic fauna (see Action 5.5.2 also)	H	Inventory of habitat extent and condition Determination of what habitats are most important	Knowledge of where to focus protection or remediation efforts	2015	ACT TAMS, Industry and Investment NSW, MDBA, universities
* 2. Investigate status and effectiveness of existing habitat rehabilitation measures (groynes) at Tharwa	M	Report on status and effectiveness of groynes	Knowledge on whether to expand existing measures or to use at other sites	Mid-2011	ACT TAMS, University of Canberra, consultant engaged to recommend sand slug mitigation measures, Industry and Investment NSW
* 3. Investigate the cost-benefit and feasibility of installing in-stream structures (jams and groynes) to restore deep pools	M	Report identifying potential sites and feasibility	Information for targeted interventions at high priority sites	Mid-2011	ACT TAMS, Industry and Investment NSW, consultant
* 4. Investigate cost-benefit and feasibility of ecological mitigation to improve native fish habitat at sediment deposition sites	H	Feasibility investigated	Knowledge of whether mitigation for conservation purposes is feasible	End 2010/11	MDBA, ACT TAMS
* 5. Investigate potential for income generated from ecological mitigation to be returned to aquatic habitat restoration activities	H	Feasibility investigated	Funding generated	Late-2010	ACT TAMS, Industry and Investment NSW
* 6. Establish monitoring of identified key habitats and locations where interventions are undertaken to help improve habitat availability and connectivity		See separate M&E Plan			ACT TAMS, Industry and Investment NSW

\* Project specific actions, refer page 67



## 5.5 Supporting the recovery of threatened native fish and 'icon' species

Management objectives: Threatened native fish species and selected 'icon' species (see Asset 5 in Section 4) of this reach are secure and provided with opportunities to increase and expand their geographical coverage

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
* 1. Contribute to the collection of baseline and ongoing data on fish communities in the ACT portion of the UMDR, and seek to see this undertaken in the adjoining NSW portions	H	Ongoing fish monitoring	Information available for management of fish populations	Ongoing	ACT TAMS, ACTEW, Industry and Investment NSW, Murrumbidgee CMA
* 2. Compile an inventory of critical habitats for threatened species and their locations, and prioritise for management actions (see Action 5.4.1 also)	H	Inventory of critical habitats	Information for priority instigation of management action	2012	ACT TAMS, Industry and Investment NSW, University of Canberra
3. Undertake targeted threatened species recovery actions, including monitoring and stocking, according to national and jurisdictional guidelines and recovery plans, and inventory of critical habitats below Actions here to be considered in terms of native fish populations above and below Gigerline Gorge	H	Specific recovery actions completed for priority species	Improved conservation status for threatened native fish species	As resources can be allocated	ACT TAMS, ACTEW, Industry and Investment NSW, Murrumbidgee CMA
4. Protect and/or help restore critical fish habitats associated with threatened species (for example riffles or critical pools for Macquarie perch)	H	Plans for site remediation or protection	Priority habitats protected or restored	As resources can be allocated	ACT TAMS, Industry and Investment NSW
* 5. Ecological mitigation to improve native fish habitat at high priority sites (see 5.3 also)	M	Ecological mitigation at priority sites	Improved availability and stability of aquatic habitats	As resources can be allocated	ACT TAMS, Industry and Investment NSW, private industry
* 6. Promote actions designed to increase and secure populations of the selected 'icon' species	M	Specific actions completed for 'icon' species	Improved conservation status for 'icon' species	As resources can be allocated	ACT TAMS, ACTEW, Industry and Investment NSW, Murrumbidgee CMA, non-government organisations and community groups

\* Project specific actions, refer page 67

## 5.6 Improving riparian habitat condition and connectivity

Management objective: Riparian health and habitat connectivity are returned along the river corridor and laterally into surrounding landscapes

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
* 1. Survey and map the distribution and condition of riparian vegetation and habitat in the NSW parts of the UMDR to complement work already completed in the ACT	H	Distribution and condition maps for the full UMDR	Improved knowledge of vegetation and habitats	Funding dependant	Murrumbidgee CMA, ACT TAMS, ACTEW
* 2. Identify priority areas and opportunities to re-establish riparian corridors and vegetated links into the surrounding landscapes	M	ACT working from south to north from border to border 100,000 number of trees planted Database of species mix	Connectivity, remnant enhancements, reduced sediment and nutrient input, stabilisation	ACT section complete in five years under the One Million Trees project	ACT TAMS, Greening Australia, Parkcare, Outward Bound, CVA, Industry and Investment NSW
3. Review existing schemes that encourage landholders along the river corridor to undertake restorative works such as stock exclusions, weed control, re-plantings and seek ways to focus these, or establish new schemes (such as River Tender) to see the works undertaken	H	Improve on current schemes available Encourage landholder participation	Improved water and vegetation quality Increased knowledge among landholders	Continual	Greening Australia
* 4. Support the work of non-government organisations(NGOs) keen to assist landholders undertake riparian habitat rehabilitation	H	Wider group of NGOs involved	Increased knowledge among participants	Continual	Broad across community facilitated by UMDR project officer, GA, MCMA

\* Project specific actions, refer page 67



## 5.7 Reducing the impacts of introduced plants

Management objective: The distribution and abundance of introduced plant species within the UMDR and surrounding areas is reduced and control measures are maintained to prevent re-invasions

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
* 1. See Action 5.6.1 above Survey and map the distribution of introduced plants species in the NSW parts of the UMDR to complement work already completed in the ACT	H	Distribution maps of weeds for the full UMDR	Plans for future coordinated control works	Depends on resource availability	Murrumbidgee CMA, ACT Research and Planning from Territory and Municipal Services (TAMS)
* 2. Support, encourage or assist targeted, ongoing willow, blackberry and poplar control efforts	H	Reduced invasive weed cover	Native plant regeneration	Ongoing due to the need for follow-up control works	Landholders, Murrumbidgee CMA, ACT Research and Planning staff from TAMS
3. Continue to monitor the impact of sawfly larvae on willow populations	M	Better understanding of impact	Localised impacts only so direct control still required	Ongoing	CSIRO
4. Where appropriate, contribute to ongoing forum and research into the control and adaptive management related to African lovegrass	M	Reduced African lovegrass cover	Native grass and wildflower regeneration	Ongoing	Upper Murrumbidgee Catchment Coordinating Committee, MCMA, NSW DII, ACT TAMS, K2C, Landcare
5. Investigate, through collaboration with existing programs, opportunities to control serrated tussock	H	Reduced serrated tussock cover	Native grass and wildflower regeneration	Ongoing	Leaseholders
6. Encourage community-based monitoring and involvement (where feasible) in the control of weed species	M	See separate M&E and CEPA Plans			

\* Project specific actions, refer page 67

## 5.8 Reducing the impacts of introduced animals

Management objective: The impacts of introduced animals (carp and redfin perch especially) on the assets of the UMDR are reduced

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
1. Develop a carp management plan for the project area	H	See separate regional carp plan	Improved river health, including habitat for native species, following sustained carp control	Completed	MDBA, RiverSmart, ACT TAMS, UCan
* 2. Implement the carp management plan, including community engagement activities (see separate CEPA Plan also; see also 5.3 in relation to improving fish passage)	H	On-ground implementation of activities identified in regional carp plan	Improved river health, including habitat for native species, following sustained carp control	2012	MDBA, Industry and Investment NSW, Canberra & SE Region Environment Council, local fishing groups, WaterWatch, ACT TAMS
3. Develop and prioritise strategies to identify and address other priority fish pest species within the reach and adjoining regions	M	Specific actions for control of high priority species	Pest fish plan for the UMDR	2012	MDBA, Industry and Investment NSW
4. Support educational programs to raise awareness of the threats posed by live bait fishing, ill-advised fish stocking, disposal of unwanted aquarium fish and illegal fishing practices	M	See separate CEPA Plan			
5. Support ongoing pest animal control programs targeting rabbits, deer, foxes and feral cats, and where possible encourage stronger landholder uptake	M	On-ground implementation of activities designed to reduce terrestrial feral pests	Reductions in the incidence and abundance of terrestrial feral pests	Ongoing	ACT TAMS, Leaseholders/landholders
6. Promote education of urban dwellers of the threat posed to wildlife from uncontrolled domestic cats and dogs	L	See separate CEPA Plan			

\* Project specific actions, refer page 67





## 5.9 Enhancing understanding and appreciation of Aboriginal cultural heritage assets

Management objectives: To gain a better understanding of the Aboriginal cultural heritage values of the reach and incorporate consideration of these values into management of the reach

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
1. Support documentation of the Aboriginal culture and cultural heritage values of this reach by the local Aboriginal community, in order to guide future management actions	H	A GIS map showing sites of particular importance to the Aboriginal community	Aboriginal communities are better engaged in the project and sites of value are protected	To determined by availability of funding	ACT NRM Council, TAMS, Murrumbidgee CMA, Heritage ACT
2. Incorporate Aboriginal cultural heritage sites (where appropriate) into the UMDR Plan for integration of natural and cultural heritage management	H	Sites are listed and mapped in the relevant heritage management plans/legislation are considered in future management decisions	Natural and cultural heritage values are better integrated to result in improved overall management of the demonstration reach	To determined by availability of funding	TAMS, Project Officer, ACT Heritage & DECCW, Heritage ACT
3. Actively engage Aboriginal people in the development of all aspects of the UMDR to ensure where suitable that all interest and concerns are given appropriate outlets within the initiative	H	Where possible, Aboriginal input to the development of all aspects of the UMDR	Where possible, Aboriginal input to the development of all aspects of the UMDR	Ongoing	ACT NRM Council, United Ngunawal Elders Council, Dept Housing and Community Services (ACT), Ngarigo peoples, Mogo Aboriginal Land Council, Wagonga Aboriginal Land Council
4. As part of the CEPA Plan for the UMDR ensure that Aboriginal culture (including language and art) and cultural heritage are highlighted and included in on-site signage and educational materials	H	See separate CEPA Plan			

## 5.10 Enhancing understanding and appreciation of European cultural heritage and recreational values

Management objective: To gain a full appreciation of European cultural heritage and recreational values of the UMDR and incorporate consideration of these values into management of the reach

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
1. Document European cultural heritage values and recreational values of the UMDR in order to include their appreciation and management into this plan	M	Report with stock-takes and updates of existing and new information	Improved understanding of current condition, management of assets, etc.	2015	Heritage ACT, Heritage Council of NSW
2. Incorporate listings of European cultural heritage sites and recreational assets into the demonstration reach plan for integration of natural and cultural heritage management	M	Definitive list of assets and their management requirements	Improved understanding of European cultural significance along the reach	Ongoing	Heritage ACT, Heritage Council of NSW
3. As part of the CEPA Plan for the UMDR ensure that European cultural heritage assets are highlighted and included in on-site signage and educational materials.	H	See separate CEPA Plan			



### 5.11 Ensuring sound governance and maximising funding opportunities

Management objective: The UMDR project is undertaken according to expected procedures and processes for accountability and transparency, and through an open and consultative process

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
* 1. Demonstration reach plan developed to integrate and guide future investment, on-ground works, monitoring and community consultation needs of the reach	H	Published report available online as a downloadable PDF Consultative meetings with at least ten ACT and NSW community groups and organisations	Strategic cross-border planning approach to catchment management Framework from which to undertake high priority on-ground works at key sites Model to encourage further investment, particularly co-investment by the corporate sector Clear strategy for the project's connection and promotion to the broader community Collaborative partnerships developed and enhanced with a range of ACT and NSW government and community organisations	Mid-2010	All project partners with RiverSmart Australia having a facilitation role for initial planning and community consultation
* 2. Development of a rigorous M&E program to support the demonstration reach plan, aligned with the Commonwealth's NRM monitoring, evaluation, reporting and continuous improvement framework and including the recommendation of Boys et al. 2008	H	Establishment of an M&E committee with membership from key aquatic and terrestrial scientists Reviewed and published monitoring framework available online as a downloadable PDF	Scientifically rigorous monitoring framework to guide assessment of the effectiveness of on-ground activities Quantified river health improvements that can be publicised to the broader community and contribute towards national accounting and reporting targets	2010	All project partners

ACTIONS	PRIORITY	KEY OUTPUTS ANTICIPATED	ANTICIPATED OUTCOMES	TIMEFRAME FOR COMPLETION	POTENTIAL LEAD ORGANISATIONS
* 3. Establish a project officer (or other arrangement) to effectively link project partners, with an active role in communicating and consulting with the community	H	Actively linking and communicating with the project partners, demonstration reach plan, monitoring program, community field days, community meetings, development of project extension material, and project media releases	Facilitate strengthened collaborations between ACT and NSW organisations, community groups and individuals	Ongoing	ACT TAMS will host and supervise this position
* 4. Undertake all aspects of contract management, funds administration and accountability for the project to high standards	H	A steering committee made up of all project partners	Project accountability and clearly identified means of liaising with the Commonwealth Government on behalf of the project and its partners Coordination of project delivery and communication of project outcomes Project well linked with other regional NRM projects and meeting the targets of ACT and Murrumbidgee's NRM plans		ACT NRM Council (CFOC grant), ACT TAMS (MDBA grant)
* 5. Continually investigate investment and partnership opportunities in the demonstration reach and implement strategies to encourage ongoing investment in the project	H	A strategy developed to target partnership investment opportunities with governments; industry and corporations	A demonstration reach project with high profile and financial stability		ACT NRM Council; Project Officer, RiverSmart and Industry and Investment NSW

\* Project specific actions, refer page 67



## 6. Monitoring asset condition and impact of actions

A technical reference group will be formed under this project (see Section 3.3.2) to develop and guide the implementation of a monitoring and evaluation (M&E) plan.

A fundamental requirement of a demonstration reach is the need to measure ecosystem condition before and after interventions, in order to demonstrate changes to river health as a result of works carried out (MDBC 2004). Consequently a robust M&E plan will be developed to underpin the on-ground activities carried out as part of the Upper Murrumbidgee Demonstration Reach that will align with the national natural resource management Monitoring, Evaluation, Reporting and Improvement (MERI) framework. The proposed M&E plan will also incorporate recommendations from a report on the monitoring and evaluation of demonstration reaches, recently compiled for the Murray–Darling Basin Commission (Boys et al. 2008).

The reach is fortunate to possess almost thirty years of long-term monitoring data for ACT fish communities (Lintermans 2002). This is probably unique in Australia and provides a benchmark of condition against which to measure the success of rehabilitation measures. ACT Research and Planning (TAMS) have in-house capability to undertake aquatic ecology monitoring and links are being established with the academics and students at Canberra's universities.

The proposed technical reference group will comprise members with expertise in scientific and community based aquatic research and monitoring in order to design a monitoring program that includes both targeted and surveillance monitoring components. Targeted monitoring will evaluate the success of particular interventions such as the removal of barriers to fish passage, and surveillance monitoring will measure changes in overall ecosystem condition and resilience. Components of the monitoring program will include:

- fish passage monitoring (pre- and post-monitoring of barrier remediation works to determine the success of fish passage works)
- a commitment to ongoing fish community monitoring at long-term sites, in order to benchmark changes in overall condition
- contributions to the determination of environmental flow effectiveness through monitoring of targeted ecological processes such as native fish recruitment, maintenance of drought refuge integrity (habitat and water quality)
- river flow monitoring to assist with determination of environmental flows, including their timing and delivery (by ACTEW flow monitoring stations)
- riparian condition assessment and monitoring to link terrestrial with aquatic health indicators
- sand slug monitoring (fish passage, habitat diversity, water quality impacts, and sand deposition)
- water quality monitoring by EcoWise, Water Watch and Frogwatch. This data will be used to engage the Canberra community in monitoring the effects of urban stormwater impacts.





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## Appendix A: Precautionary approach explained

From: 'THE PRECAUTIONARY PRINCIPLE IN A THE REAL WORLD'  
By Peter Montague, Environmental Research Foundation,  
New Brunswick, New Jersey, August 27, 2005  
<[www.precaution.org/lib/pp\\_def.htm](http://www.precaution.org/lib/pp_def.htm)>.

The Wingspread Statement's definition of the precautionary principle is now widely quoted [Wisconsin, January 1998]:

When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

In this context the proponent of an activity, rather than the public, should bear the burden of proof.

The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action.

### The Essence of Precaution:

Critics say that the precautionary principle is not well-defined. However, the Science and Environmental Health Network [[www.sehn.org/](http://www.sehn.org/)] points out that, in all formulations of the precautionary principle, we find three elements:

1. When we have a reasonable suspicion of harm and
2. scientific uncertainty about cause and effect then
3. we have a duty to take action to prevent harm.

The precautionary principle does not tell us what action to take. However, proponents of a precautionary approach have suggested a series of actions:

1. Set goals
2. Examine all reasonable ways of achieving the goals, intending to adopt the least-harmful way
3. Assume that all projects or activities will be harmful, and therefore seek the least-harmful alternative. Shift the burden of proof – when consequences are uncertain, give the benefit of the doubt to nature, public health and community wellbeing. Expect responsible parties (not governments or the public) to bear the burden of producing needed information. Expect reasonable assurances of safety for products before they can be marketed – just as the food and drug administration expects reasonable assurances of safety before new pharmaceutical products can be marketed.





4. Throughout the decision-making process, honor the knowledge of those who will be affected by the decisions, and give them a real say in the outcome. This approach naturally allows issues of ethics, right-and-wrong, history, cultural appropriateness, and justice to become important in the decision.
5. Assume that humans will make mistakes and that decisions will sometimes turn out badly. Therefore, monitor results, heed early warnings, and be prepared to make mid-course corrections as needed; this implies that we will avoid irreversible decisions and irretrievable commitments.

Instead of asking the basic risk-assessment question – ‘How much harm is allowable?’ – the precautionary approach asks: ‘How little harm is possible?’

In sum: Faced with reasonable suspicion of harm, the precautionary approach urges a full evaluation of available alternatives for the purpose of preventing or minimising harm.