Australian Government

MURRAY–DARLING BASIN AUTHORITY

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Lindsay–Wallpolla Islands

Environmental Water Management Plan

February 2012

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Murray–Darling Basin Authority

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Cover image: Floodplain on Wallpolla Island

Photographer: Corey Brown © MDBA

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Contents

About this plan

This environmental water management plan consists of:

i. A long-term strategic plan, (per Clause 117 of the TLM Business Plan), which outlines the icon site's environmental water requirements and how to broadly achieve them with a combination of environmental water and works and measures.

ii. Schedules detailing operational information about the icon site such as Operating, Condition Monitoring, Risk Management and Communication Plans. These Schedules will be added to the environmental water management plan as they become available and updated to reflect learnings from the operation of works, the results of environmental waterings and the latest science.

The environmental water management plans provide context for an icon site's water planning, delivery, monitoring and consultation processes. While the environmental water management plans include proposed operating strategies, annual water planning and implementation will be responsive to changing water resource conditions, opportunities and environmental priorities throughout the season and from year to year.

This environmental water management plan and associated schedules have been prepared by TLM partner governments in consultation with the relevant stakeholders. The MDBA would like to acknowledge the significant contribution of all those involved in the development of the environmental water management plans.

Summary

The Living Murray Initiative is one of Australia's largest river restoration programs, established in 2002 following evidence of declining health in the River Murray system. The long-term goal of this program is to achieve a healthy working River Murray system for the benefit of all Australians. Since 2004, a total of $700 million has been committed to improve environmental outcomes at the six icon sites:

- Barmah–Millewa Forest
- Gunbower–Koondrook–Perricoota Forest
- Hattah Lakes
- Chowilla Floodplain and Lindsay–Wallpolla Islands
- Lower Lakes, Coorong and Murray Mouth
- River Murray Channel.

With the recovery of almost 500 gigalitres (GL) for environmental waterings, The Living Murray is in a phase of design, construction and operation of infrastructure works to facilitate environmental water delivery and maximise the associated environmental outcomes at the icon sites.

The Chowilla Floodplain and Lindsay–Wallpolla icon site spans South Australia, New South Wales and Victoria, with Chowilla in South Australia and New South Wales, and Lindsay–Wallpolla Islands in Victoria.

The icon site is important because it retains much of the area's natural character and attributes. It is typified by complex anabranch systems, including streams, billabongs and backwaters, and swamps (Victorian Department of Sustainability and Environment 2010). It has a high diversity of both terrestrial and aquatic habitats, supports populations of rare, endangered and nationally threatened species and contains heritage protected sites of cultural significance. The area is also important for its recreational and economic values.

The Lindsay–Wallpolla Islands include three separate anabranch systems within the Murray–Sunset National Park: Wallpolla Island, Mulcra Island and Lindsay Island. Wallpolla Island, Lindsay Island and Lake Wallawalla are listed in *A Directory of Important Wetlands in Australia* (Environment Australia 2001).

Environmental water management plans have been developed for each icon site with the aim of describing The Living Murray objectives and targets, water delivery arrangements and the watering regimes for each site. This document is the Lindsay–Wallpolla Environmental Water Management Plan and supersedes the Chowilla Floodplain (including Lindsay–Wallpolla Islands) Environmental Management Plan 2005–06. Although the South Australian—New South Wales (Chowilla) and Victorian components of the icon site are contiguous, separate environmental watering management plans have been prepared for each as they are managed by different jurisdictions and agencies, and have separate governance and management committee structures. Each component also has specific ecological objectives and environmental watering management options.

Altered flow regimes in the River Murray are the key threat to the values of the icon site. River regulation and water extraction have reduced the frequency and duration of natural flooding regimes across the islands, degrading flora, fauna and cultural values associated with waterways and wetlands.

A suite of works have been developed for the icon site that aims to achieve the ecological objectives set for Lindsay–Wallpolla Islands, such as increasing the diversity and abundance of wetland vegetation and maintaining the current condition and extent of river red gum (*Eucalyptus camaldulensis*) communities. These works include:

- Regulators and ancillary works on Mulcra Island that enable inundation of the floodplain when Lock 8 is raised at regulated flows. This will water 800 ha of floodplain and increase flows through 20 km of Potterwalkagee Creek.
- Regulators at Horseshoe Lagoon (Wallpolla Island) and Webster's Lagoon (Lindsay Island) that can be flooded by the weir pools of locks 9 and 6 respectively. Regulators allow annual drying phases to be introduced, as would have occurred under natural conditions. Wetlands can also be surcharged using temporary pumps to water the large fringing river red gums.
- Replacing pipe culverts on the inlet channels of Lake Wallawalla (Lindsay Island) with large regulators to allow water to be retained in the wetland when it fills from high flows in the Lindsay River. This will water fringing vegetation and provide more than 800 ha of wetland habitat. The regulators also facilitate pumping environmental water into the lake during long dry periods.

- Replacing stop banks with regulators on two Lindsay River inlets to increase flows into the upper Lindsay River. This will provide an additional 20 km of anabranch habitat when Lock 7 is raised at regulated flows. An existing fixed crest weir on the Mullaroo Creek will also be replaced with a regulator and fishway to maintain high quality habitat for Murray cod (*Maccullochella peelii).*

Together, the works will enable more natural water regimes to be reinstated across Lindsay–Wallpolla Islands, targeting over 1,800 ha of floodplain and wetlands. Operation will include maintaining base flows and providing spring freshes in anabranches on Mulcra and Lindsay islands (Potterwalkagee Creek and Lindsay River), broadscale floodplain inundation at Mulcra Island and managing the water regime of regulated wetlands (Wallpolla Horseshoe Lagoon, Mulcra Horseshoe Lagoon, Webster's Lagoon and Lake Wallawalla).

Annual ecological monitoring occurs across the icon site, through the Icon Site Condition Monitoring Program. Monitoring examines the condition of waterbird and fish populations, and vegetation communities, tracking the progress towards achieving the ecological objectives for the icon site. It is anticipated that additional monitoring will be undertaken during and following watering events, including activities such as groundwater monitoring, compliance monitoring and vegetation response (as part of the Native Vegetation Offset Management Plan).

The Environmental Water Management Plan promotes an adaptive management approach through 'learning by doing'. Ecological information collected during and after environmental watering events will be incorporated into the icon site operating strategy to ensure it remains relevant and effective.

The Environmental Water Management Plan recognises the importance of ongoing community consultation and communication in the delivery of the plan's components. Several committees have been established for Lindsay–Wallpolla Islands. These committees (together with The Living Murray Indigenous Facilitator, various project working groups, other established community groups and activities under communication plans and strategies) provide a mechanism for consulting with a range of community and agency stakeholders.

1. The Living Murray

The Living Murray (TLM) Initiative is one of Australia's most significant river restoration programs. Established in 2002, it is a partnership of the Australian Government and the governments of New South Wales, Victoria, South Australia and the Australian Capital Territory. The initiative is coordinated by the Murray–Darling Basin Authority (MDBA). The long-term goal of this program is to achieve a healthy working River Murray system for the benefit of all Australians.

The Living Murray aims to improve the environmental health of six icon sites chosen for their significant ecological, cultural, recreational, heritage and economic values:

- Barmah–Millewa Forest
- Gunbower–Koondrook–Perricoota Forest
- Hattah Lakes
- Chowilla Floodplain and Lindsay–Wallpolla Islands (including Mulcra Island)
- River Murray Channel
- Lower Lakes, Coorong and Murray Mouth.

Through its First Step water recovery initiative, TLM has acquired a water portfolio consisting of environmental water entitlements. As of May 2011, there was 478.97 gigalitres long-term Cap equivalent (LTCE), with another 7.1 GL to be recovered in 2011–12. The actual volume of water available against these entitlements depends on the allocations.

This portfolio will be used to achieve environmental objectives at the icon sites. Regulating structures, water delivery channels and fishways, known as works and measures, will deliver and manage the environmental water at the icon sites. On-ground works for each icon site were being progressively constructed from 2010 to 2012. The success of the environmental watering against the objectives is monitored using fish, birds and vegetation as an overall indicator of the icon site's health.

Once finalised, TLM will seek to align itself to the requirements of the Basin Plan Environmental Watering Plan.

Further information on TLM is available on the MDBA website at **<www.mdba.gov.au/programs/tlm>**.

Figure 1.1: Location of The Living Murray icon sites

The Living Murray icon site environmental water management plans

The Lindsay–Wallpolla Islands Environmental Water Management Plan establishes priorities for the use of TLM water within the icon site, and identifies environmental objectives and targets (where appropriate), water delivery options and regimes for the site that can use The Living Murray water portfolio.

Development of the environmental water management plans has been coordinated by MDBA in consultation with the Environmental Watering Group to ensure a consistent approach to planning and management across the icon sites.

This revision builds on previous iterations of the Lindsay–Wallpolla Islands Environmental Water Management Plan (previously known as 'environmental management plans') and incorporates consultation, research into icon site key species, learning from water behaviour modelling and outcomes from previous environmental watering.

The Lindsay–Wallpolla Islands Environmental Water Management Plan reflects the larger volume now held in The Living Murray water portfolio, and uses TLM works and measures (as construction is completed) and monitoring information gathered at the icon site.

This environmental water management plan deals specifically with the Victorian component of the Chowilla–Lindsay–Wallpolla icon site—Lindsay–Wallpolla Islands. A separate environmental water management plan for the Chowilla Floodplain has been prepared by South Australia and New South Wales.

Planning context and legislation framework

The Australian Government, Victoria, New South Wales and South Australia have comprehensive legislative frameworks addressing natural resource and environmental management. For activities associated with management of The Living Murray icon site, including construction of works under TLM, the principal pieces of legislation and planning strategies are detailed below.

Agreements

Ramsar Convention on Wetlands of International Importance

The Ramsar Convention on Wetlands of International Importance (the Ramsar Convention) is an international treaty with the broad aim of halting the worldwide loss of wetlands and to conserve, through wise use and management, those that remain. For wetlands to be listed as Ramsar wetlands, they need to be representative, rare or unique in terms of their ecological, botanical, zoological, limnological or hydrological importance. Ramsar-listed wetlands can be natural, artificial, permanent or temporary swamps, marshes, billabongs, lakes, salt marshes or mudflats classified as wetlands.

Signatories to the Ramsar Convention, including Australia, are required to formulate and implement their planning so as to promote the conservation of wetlands included in the Ramsar list, and as far as possible the wise use of all wetlands in their territory. Ramsar wetlands in Australia are protected under the *Environment Protection and Biodiversity Conservation Act 1999* as a matter of national environmental significance (Department of the Environment, Water, Heritage and the Arts 2009).

Bilateral migratory bird agreements

Over the past 30 years Australia has signed three bilateral migratory bird agreements in an effort to conserve migratory birds in the east Asian and Australian regions: China–Australia Migratory Bird Agreement (signed in 1986); Japan–Australia Migratory Bird Agreement (signed in 1974); and the Republic of Korea–Australia Migratory Bird Agreement (came into effect in 2007).

These agreements protect terrestrial, water and shorebird species that migrate from Australia to Japan or China. The Japan–Australia Migratory Bird Agreement also provides for cooperation on the conservation of threatened birds, while the Republic of Korea–Australia Migratory Bird Agreement ensures conservation of migratory birds and collaboration on the protection of migratory shorebirds and their habitat (Department of Sustainability, Environment, Water, Population and Communities, 2011a).

Murray–Darling Basin agreements

The Murray–Darling Basin Ministerial Council established The Living Murray in 2002. In 2004, the Australian Government and the governments of New South Wales, Victoria, South Australia and the Australian Capital Territory signed the Intergovernmental Agreement on Addressing Water Over-allocation and Achieving Environmental Objectives in the Murray–Darling Basin, which gave effect to a funding commitment (made in 2003) of $500 million over five years for TLM. The Living Murray program's First Step aimed to recover 500 GL of water for the River Murray and focused on improving the environment at the six icon sites. A supplementary Intergovernmental Agreement was signed in 2006 which provided increased funding of $200 million to The Living Murray.

The role of the Intergovernmental Agreement on Murray–Darling Basin Reform, signed by the Council of Australian Governments, is to:

- promote and co-ordinate effective planning and management for the equitable, efficient and sustainable use of the water and other natural resources of the Murray–Darling Basin (Council of Australian Governments 2008).

This Agreement was the foundation for the *Water Act 2007*, which established the MDBA whose role is to manage the Basin's water resources through the development of a Basin plan.

Commonwealth legislation

Water Act 2007

The Intergovernmental Agreement on Murray–Darling Basin Reform was the foundation for the *Water Act 2007*, which established the MDBA to manage the water resources of the Murray–Darling Basin in an integrated, consistent and sustainable manner. The Water Act requires MDBA to prepare and oversee a Basin Plan as a legally enforceable document that provides for the integrated and sustainable management of water resources in the Basin.

The Basin Plan's Environmental Watering Plan will provide a strategic framework for coordinated environmental water planning and environmental watering throughout the Murray–Darling Basin. In the future, TLM will align with the Environmental Watering Plan in the development of Basin states' long-term and annual environmental watering plans and through the annual environmental water prioritisation processes.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places (including natural, historic or Indigenous places) —defined in the EPBC Act as matters of national environmental significance. There are eight matters of national environmental significance to which the EPBC Act applies.

The EPBC Act aims to balance the protection of these crucial environmental and cultural values with our society's economic and social needs by creating a legal framework and decision-making process based on the guiding principles of ecologically sustainable development (Department of Sustainability, Environment, Water, Population and Communities, 2011b).

Native Title Act 1993

Section 24KA of the *Native Title Act 1993* requires that native title claimants are notified of any future act consisting of the grant of a lease, licence, permit or authority under legislation that relates to the management or regulation of surface or subterranean water.

Victorian legislation

The principal Acts listed in this section operate in conjunction with other state legislation that deals with the management and conservation of Victoria's natural resources, and outlines obligations relating to obtaining approvals for structural works within TLM icon sites.

Aboriginal Heritage Act 2006

The *Aboriginal Heritage Act 2006* provides for the protection of Indigenous Australian cultural heritage in Victoria. The Act also provides for the introduction and management of a system of Registered Aboriginal Parties that allows Indigenous groups with connection to country and others to be involved in decision-making processes around cultural heritage. Regulations enabled under this Act require a cultural heritage management plan to be prepared when undertaking high impact activities in culturally sensitive landscapes.

Figure 1.2: The white-bellied sea eagle is listed as threatened in Victoria under the Flora and Fauna Guarantee Act

Environmental Effects Act 1978

The *Environmental Effects Act 1978* aims to ensure that development occurs in an ecologically sustainable manner and provides for assessment of any project or development that could have significant effects on the environment. This Act enables the Victorian Minister for Planning to decide whether an environmental effects statement should be undertaken for proposed projects. Projects should be referred to the minister if they meet any referral criteria, as set out in ministerial guidelines (Victorian Department of Sustainability and Environment 2006). A project can be referred by the proponent, a statutory authority or any minister.

Flora and Fauna Guarantee Act 1988

The aim of the *Flora and Fauna Guarantee Act 1988* is to conserve threatened flora and fauna species and communities, and to manage potentially threatening processes. This Act provides for the establishment and maintenance of lists of threatened species, potentially threatening processes and excluded species, which are those not to be conserved because they constitute a serious threat to human welfare (i.e. human disease organisms).

The Act directs that action statements (brief management plans) are to be prepared for listed species to track the progress of management actions, and recovery plans are to be prepared for species also listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth).

Forests Act 1958

The *Forests Act 1958* governs forest management in Victoria. This Act and associated regulations are supported by Victoria's five regional forest agreements. Under the Act's provisions, detailed forest management plans are developed for each area following a complex assessment process that considers all forest values. These management plans provide for the control, maintenance, protection and taking of forest produce and fire management in state forests.

Planning and Environment Act 1987

The *Planning and Environment Act 1987* establishes a framework for planning the use, development and protection of land in Victoria in the present and long-term interests of all Victorians. Local planning schemes are enabled under this Act.

This Act enables the Gannawarra and Campaspe planning schemes. Under these schemes, planning permits are required for proposed works under The Living Murray initiative in these areas, with applications prepared and submitted to the relevant councils.

Murray–Darling Basin Act 1993

The *Murray–Darling Basin Act 1993* enables the Murray–Darling Basin Agreement 2008, which was entered into by the Australian Government and the governments of New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory with regard to the water, land and other environmental resources of the Murray–Darling Basin. This Act provides for the referral of selected powers under the Victorian Constitution that enable the Australian Government to manage specific aspects of water resource management within the Basin.

National Parks Act 1975 and Parks Victoria Act 1998

In Victoria, national parks are managed by Parks Victoria. Under the *Parks Victoria Act 1998*, Parks Victoria's responsibilities are to provide services to the state and its agencies for the management of parks, reserves and other public land. Under s. 27 of the *National Parks Act 1975*, works by a public authority within a park reserved and managed under the provisions of the Act are subject to consent by the minister. A condition of this consent is that the proposed works comply with the management objectives and strategies for the park.

Water Act 1989

The Victorian *Water Act 1989* governs the way water entitlements are issued and allocated in Victoria. The Act defines water entitlements and establishes the mechanisms for managing Victoria's water resources. Part 10 of the Water Act establishes waterway management and general river health management as the responsibility of catchment management authorities and Melbourne Water (where applicable). For TLM works, s. 67 of the Water Act identifies catchment management authorities as the responsible authorities for issuing licences for conducting works in a designated waterway.

New South Wales legislation

Crown Lands Act 1989

The *Crown Lands Act 1989* ensures that Crown land is managed for the benefit of the people of New South Wales and, in particular, provides for the management, proper development, conservation and regulation of the conditions under which Crown land is permitted to be used, or otherwise dealt with. The Land and Property Management Authority is responsible for the sustainable and commercial management of Crown land in New South Wales. A Crown land licence is a contractual agreement that grants the licensee a personal right to occupy and use Crown land for a particular purpose.

Environmental Planning and Assessment Act 1979

This Act forms the statutory framework for planning approval and environmental assessment in New South Wales. Implementation of the *Environmental Planning and Assessment Act 1979* is the responsibility of the Minister for Planning, statutory authorities and local councils. The need or otherwise for development consent is set out in environmental planning instruments — state environmental planning policies, regional environmental plans or local environmental plans.

Fisheries Management Act 1994

The *Fisheries Management Act 1994* lists threatened aquatic species, endangered populations and ecological communities, and key threatening processes. Potential impacts on species, populations and communities subject to this Act are assessed by Industry and Investment NSW.

Water Management Act 2000

The *Water Management Act 2000* provides for the sustainable and integrated management of the water sources of the state to protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality. Any activity that affects the quantity or flow of water in a water source requires consent under this Act.

Planning frameworks and strategies

Management objectives outlined in the environmental watering management plan are complementary to objectives and outcomes in Victorian regional planning strategies.

Regional catchment strategies

The Victorian *Catchment and Land Protection Act 1994* established overarching strategic documents aimed at halting biodiversity decline through the implementation of priority programs, including those that protect and manage wetlands. The catchment management authorities are responsible for coordinating the implementation of the Regional Catchment Strategy and its sub-strategies and action plans under the Water Act (Vic.).

Victorian Northern Region Sustainable Water Strategy

Regional sustainable water strategies were legislated through 2005 amendments to the Water Act (Vic.) and fulfil Victoria's commitment to the National Water Initiative to carry out open, statutory-based water planning. Sustainable water strategies take a long-term view of water resource planning and, as such, they guide the development, integration and implementation of management plans prepared by water corporations and catchment management authorities operating within each region.

Victorian River Health Strategy

The Victorian River Health Strategy was released in 2002 with the statewide objective of achieving healthy rivers, streams and floodplains that meet the environmental, economic, recreational and cultural needs of current and future generations. The strategy provides the policy direction and planning framework for communities to work in partnership with government to manage and restore Victoria's rivers over the long term.

Regional river health strategies

These strategies were established as a part of the Victorian Government's response to the Victorian River Health Strategy. They provide regional frameworks for catchment management authorities, as regional caretakers, to achieve regional river health outcomes.

Victorian Native Vegetation Management: A Framework for Action

The *Native Vegetation Management: A Framework for Action* was released in 2002. The framework establishes the strategic direction for the protection, enhancement and revegetation of native vegetation across the Victorian landscape.

Improving the quality and amount of native vegetation in Victoria is critical to maintaining land and water health. The framework's main goal is to achieve a reversal across the entire landscape of the long-term decline in the extent and quality of native vegetation, leading to a net gain.

Mallee Parks Management Plan

The Mallee Parks Management Plan 1996 sets out the broad directions for future management of Mallee Parks and provides management objectives and strategies to achieve a high standard of conservation and recreation management. One of the major directions is to restore a more natural water regime.

Governance and planning arrangements

The Living Murray is a joint initiative and is managed collaboratively by partner governments. The Murray–Darling Basin Intergovernmental Agreement on Addressing Water Overallocation and Achieving Environmental Objectives in the Murray–Darling Basin (Council of Australian Governments 2004) outlines the governance arrangement for implementing The Living Murray program. The 2004 intergovernmental agreement is complemented by The Living Murray Business Plan, which provides operational policies to guide TLM implementation.

Groups with a direct role in TLM governance are the Murray–Darling Basin Ministerial Council, MDBA, Basin Officials' Committee, The Living Murray Committee and the Environmental Watering Group (see **Figure 1.3** for The Living Murray governance structure).

While MDBA plays a key coordination role at a TLM-wide level, management and delivery of TLM activities at the icon sites are primarily undertaken by relevant agencies in the jurisdictions where the icon sites are located.

In Victoria, the Department of Sustainability and Environment coordinates TLM delivery across all Victorian icon sites. A statewide governance framework has been developed, with a state steering committee and state construction committee to ensure high-level engagement of stakeholder agencies.

The icon site manager for Lindsay–Wallpolla Islands is the chief executive officer of the Mallee Catchment Management Authority, as catchment management authorities are responsible for river health and environmental water management in Victoria. The Mallee Catchment Management Authority therefore coordinates delivery of The Living Murray program at icon site level, working in partnership with Parks Victoria (the land manager) and supported by a number of icon site-specific committees. These committees are composed of representatives from relevant agencies and communities. For more detail on the roles and responsibilities of individual committees and groups, please refer to **Appendix A**.

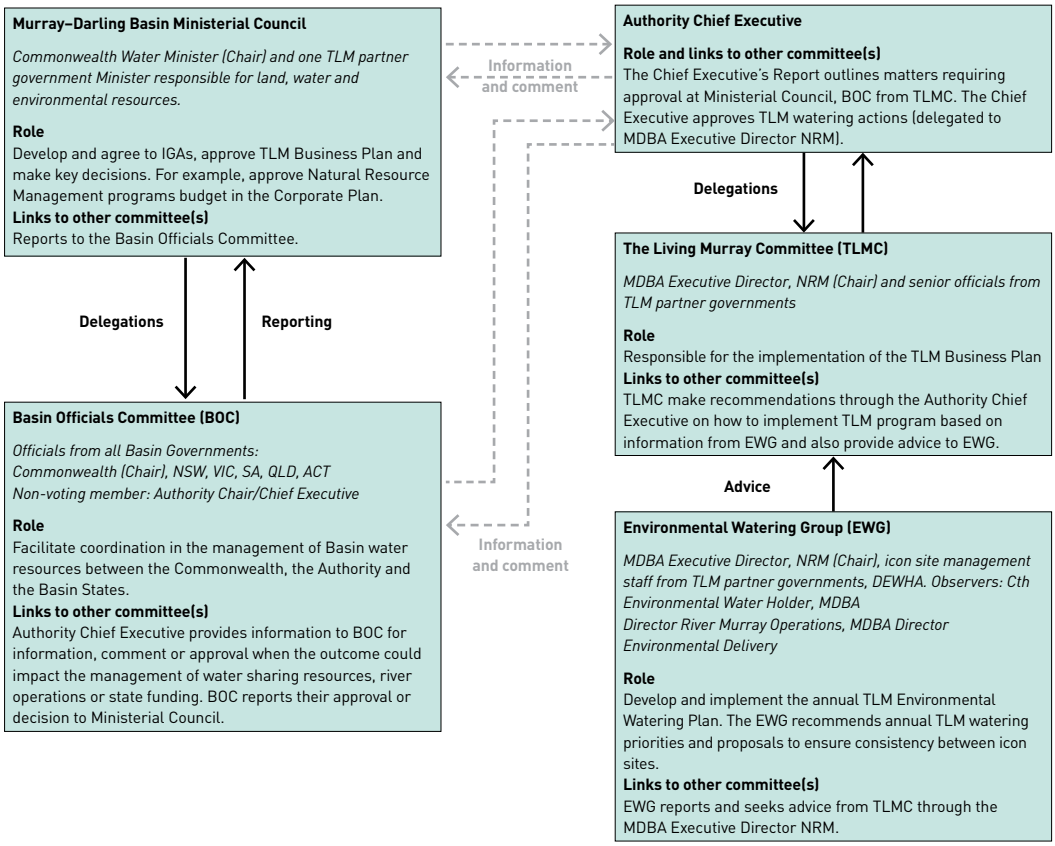

Figure 1.3: The Living Murray governance structure (MDBA)

2. Icon site description

The Chowilla–Lindsay–Wallpolla icon site is a cross-border icon site, having components in South Australia, New South Wales and Victoria (see **Figure 2.1**). The icon site covers 43,856 ha and has four main components — the Chowilla Floodplain (17,700 ha), which spans South Australia (74%) and New South Wales (26%), as well as the Lindsay, Mulcra and Wallpolla islands in north-west Victoria, which collectively cover 26,156 ha downstream of Mildura.

The Chowilla Floodplain and the Lindsay–Wallpolla Islands have specific physical differences and water delivery constraints that affect their management and the development of options for environmental watering. They lie within different states and are managed by different agencies, although consultation between icon site staff in New South Wales, South Australia and Victoria occurs regularly. While having similar values and hydrology, their geographical locations means that different water management infrastructure (e.g. River Murray weirs, small block-banks) influences the hydrology of each component. Accordingly, separate works options have been developed. However, there are clear opportunities to coordinate future operations, share technical knowledge and collaborate on monitoring and consultation activities.

Wallpolla Island is closest to Mildura and is bounded by Wallpolla Creek and the Lock 9 weir pool of the River Murray. It covers 9,000 ha and, together with Mulcra Island, was added to the Murray–Sunset National Park in June 2010. Mulcra Island covers 2,000 ha between Lindsay and Wallpolla Islands and is formed by the Potterwalkagee Creek and the weir pools at locks 7 and 8. Lindsay Island covers 15,000 ha and is bounded by the Lindsay River anabranch and both the locks 6 and 7 weir pools.

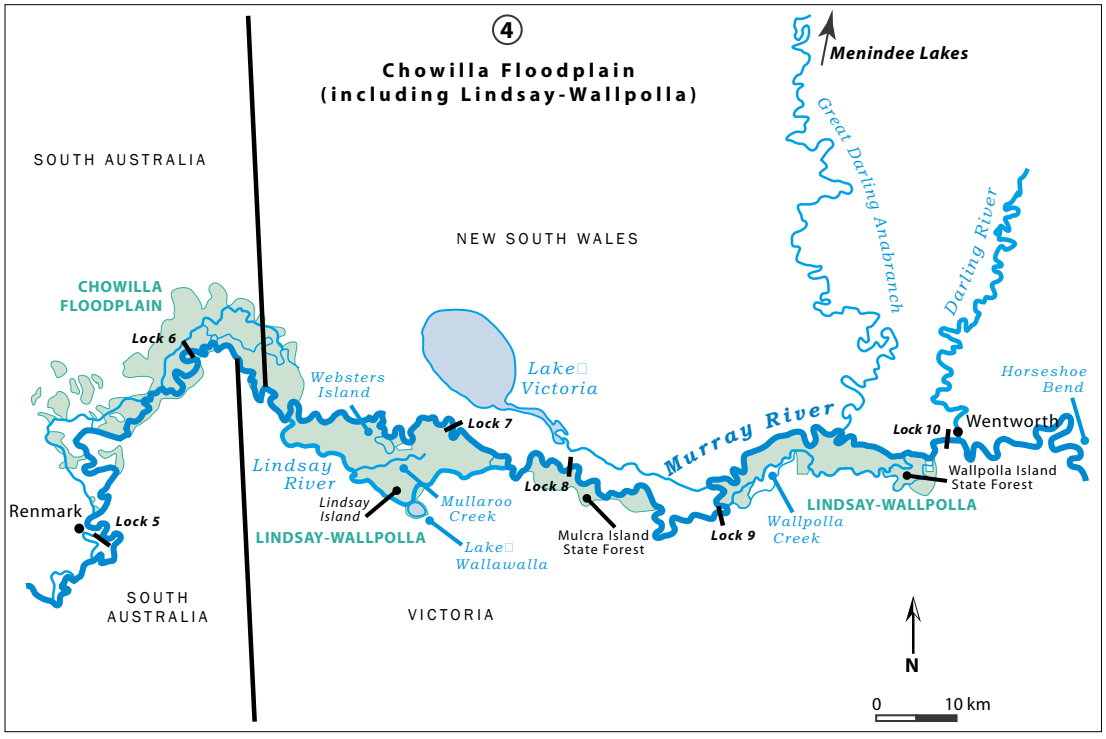

Figure 2.1: The Chowilla–Lindsay–Wallpolla icon site

The Lindsay–Wallpolla Islands lie within the Murray–Sunset National Park and are managed by Parks Victoria. Lindsay Island was included when the park was declared in 1991, with the Mulcra Island and Wallpolla Island state forests added in 2010. Ned's Corner lies to the south of Mulcra and Lindsay islands. Formerly a sheep and cattle station, this property was purchased by Trust for Nature in 2002 and is now managed for conservation.

Description of key ecological assets of the icon site

The Lindsay–Wallpolla floodplain lies within the Murray Scroll Belt bioregion, which is typified by the River Murray floodplain, oxbow lakes, ephemeral lakes, swamps and active meander belts (Victorian Department of Sustainability and Environment 2010). Here, red-brown earths, cracking clays and texture contrast soils support a range of vegetation types, including terrestrial, floodplain and aquatic ecosystems (Victorian Department of Sustainability and Environment 2010). The islands feature a number of waterways and wetlands.

This floodplain is relatively flat and is dissected by a network of anabranches, small creeks and permanent and ephemeral wetlands. Lindsay Island, Wallpolla Island and Lake Wallawalla are listed as nationally important wetlands (Environment Australia 2001).

Values of the icon site

The Lindsay–Wallpolla floodplain is an area of high ecological significance. When inundated, the waterways and wetlands of the floodplain provide refuges and resources for a range of flora and fauna, including threatened species; they also provide important waterbird breeding habitat.

Fauna

The floodplain supports diverse aquatic, wetland-dependent and terrestrial species. It provides important habitat for native fish, frogs, turtles and waterbirds, including many considered threatened at a national and state levels. Thirty-five species listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988* have been recorded there. The regent parrot (*Polytelis anthopeplus*), growling grass frog (*Litoria raniformis*)and the Murray cod are also listed as nationally threatened under the federal *Environment Protection and Biodiversity Conservation Act 1999* (Ecological Associates 2007).

Mullaroo Creek, a permanent Lindsay Island anabranch, supports one of the most significant populations of Murray cod (Figure 2.2) in the lower River Murray and Victoria, exhibiting significantly better age structure and population size than in any other Victorian system (Saddlier *et al*. 2008; Sharpe *et al*. 2009). It is the robustness of the Mullaroo Creek population that makes it of particular importance to the sustainability of broader regional populations (Sharpe *et al*. 2009). Key habitat features contributing to the viability of the population include the sustained moderate flows (e.g. >400 ML/d) and the hydraulic diversity, including sections of variable water velocity and high densities of submerged woody debris in the creek (Saddlier *et al*. 2008; Water Technology 2009).

The islands also provide resources for the growth and breeding of an additional four fish species listed under the Flora and Fauna Guarantee Act — freshwater catfish (*Tandanus tandanus*), silver perch (*Bidyanus bidyanus*), Murray–Darling rainbowfish (*Melanotaenia fluviatilis*) and unspecked hardyhead (*Craterocephalus stercusmuscarum fulvus*). Australian smelt (*Retropinna semoni*), bony bream (*Nematalosa erebi*), carp gudgeon (*Hypseleotris* spp.), dwarf flathead gudgeon (*Philypnodon macrostomus*) and flathead gudgeon (*Philypnodon grandiceps*) also occur (Mallen-Cooper *et al*. 2010).

During dry periods, floodplain wetlands (e.g. Lake Wallawalla) support terrestrial species such as small mammals and reptiles (Ecological Associates 2007). When flooded, these wetlands provide important habitat for a range of wetland-dependent species, including many waterbirds (MDBC 2006). When freshly inundated, these wetlands promote the growth of microbes, algae, macroinvertebrates, crustaceans and frogs, providing food for fish and birds such as dabbling ducks (*Anatidae* f.) and grazing waterfowl (Ecological Associates 2007).

Figure 2.2: The Murray–Darling rainbowfish was formerly widespread across the Basin but has declined in the Murray region. (Gunther Schmida © MDBA)

As the water level drops, the muddy lake bed becomes exposed, providing conditions for lakebed herbland to establish, and ideal grazing for wading birds such as the great egret (*Ardea alba*), greenshank (*Tringa nebularia*) and the red-necked stint (*Calidris ruficollis*), all of which are listed under the Japan–Australia, Republic of Korea–Australia and the China–Australia Migratory Bird agreements (Ecological Associates 2007; MDBC 2006; SKM 2003). Fish and carrion feeding birds such as the China–Australia Migratory Bird Agreement-listed white-bellied sea eagle (*Haliaeetus leucogaster*) (**Figure 1.2**) are also supported by the lake (Ecological Associates 2007).

Some 210 bird species, 49 of which are dependent upon water habitats, are known to use the Lindsay–Wallpolla floodplain for breeding, feeding and roosting. Of these bird species, 40 are considered threatened in Victoria; 24 are listed under the *Flora and Fauna Guarantee Act 1988* (Vic.) and three are listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (Ecological Associates 2007).

Flora

Together, the island floodplains support a number of plant species of national and state significance, including nine species listed as endangered under the Victorian Flora and Fauna Guarantee Act, and eight, such as bignonia emu-bush (*Eremophila bignoniiflora*), which are listed or nominated for listing (Ecological Associates 2007; MDBC 2006; SKM 2004). Plant communities on the floodplain have been mapped in detail and described by White and others (2003) as ecological vegetation classes (Ecological Associates 2007). Vegetation of the Lindsay, Mulcra and Wallpolla floodplain and wetlands consists of 21 individual ecological vegetation classes and one ecological vegetation class complex, the conservation significance of which range from 'least concern' to 'endangered' (Ecological Associates 2007; Victorian Department of Sustainability and Environment 2010).

Table 2.1: Ecological Vegetation Classes and their conservation significance: Lindsay–Wallpolla floodplain

Ecological Vegetation Class	Bioregional conservation significance
Floodplain vegetation	
Grassy riverine forest (106)	Depleted
Intermittent swampy woodland (813)	Depleted
Shrubby riverine woodland (818)	Least concern
Riverine grassy woodland (295)	Depleted
Lignum (*Muehlenbeckia florulenta*) swampy woodland (823)	Depleted
Riverine chenopod woodland (103)	Depleted
Lignum shrubland (808)	Least concern
Alluvial plains semi-arid grassland (806)	Vulnerable
Semi-arid chenopod woodland (98)	Depleted
Low chenopod shrubland (102)	Depleted
Sub-saline depression (820)	Vulnerable
Disused floodway shrubby herbland (807)	Endangered
Wetland vegetation	
Lignum swamp (104)	Vulnerable
Floodplain grassy wetland (809)	Endangered
Floodway pond herbland (810)	Depleted
Aquatic herbland	Depleted
Spike rush (*Eleocharis obicis*) wetland (819)	Vulnerable
Shallow freshwater marsh (200)	Vulnerable
Lake bed herbland (107)	Vulnerable
Ecological vegetation community complex	
Grassy riverine forest/floodway pond herbland (811)	Depleted

Source: Ecological Associates (2007); Victorian Department of Sustainability and Environment (2010).

River red gums (**Figure 2.4**) occur mainly in riparian and floodplain zones along the River Murray channel and on the edges of waterways and wetlands. These trees are an important source of habitat and a food resource for many fauna, including birds, reptiles and mammals, and are critical to the successful recruitment of many species.

Figure 2.3: River red gums occur mainly in riparian and floodplain zones along the Murray River (Corey Brown © MDBA)

River red gums also provide submerged woody habitat to anabranches through limb-drop or complete topples (Water Technology 2009; Ecological Associates 2007). Submerged woody habitat is a source of food and shelter for fish and aquatic macroinvertebrates. Similarly, limb-drop is a source of organic matter used to fuel primary productivity in the aquatic system.

In the vicinity of waterways, river red gums may be sustained by relatively fresh, shallow groundwater (Ecological Associates 2007). Over much of the floodplain, however, surface-water provided by floods is needed for these trees to survive. Under natural conditions, these areas would have been flooded for two to six years out of every 10, depending on their position on the floodplain.

Black box occurs commonly throughout the floodplain. It supports both arid and riverine bird species, and productivity and recruitment is strongly linked to flooding. Lignum is dispersed similarly to black box but is largely confined to floodplain depressions where water collects and persists after floods. When inundated, it provides habitat for both birds and fish.

Typically, arid zone floodplain wetlands are sites of high biodiversity and may support both aquatic and terrestrial plant communities, depending on inundation status (Henderson *et al*. 2009). When inundated, wetlands such as Lake Wallawalla and the Mulcra Horseshoe Lagoon host aquatic flora species grown from both dormant seeds and propagules present in the lakebed, as well as those washed in (Ecological Associates 2007). As the lake dries, aquatic vegetation will give way to wetland herb communities (Ecological Associates 2007). A total of 28 threatened wetland plant species have been reported on Lindsay Island (SKM 2003).

Anabranches dissecting the Lindsay–Wallpolla floodplain provide adverse aquatic habitats, including deep and shallow sections with varied flow velocities and both steep and sloping banks. Dense stands of aquatic macrophytes are supported and significant amounts of instream woody debris are present. The diversity of habitats within anabranches has significant potential to support fish, aquatic invertebrates, frogs and birds, including some that are threatened or uncommon.

Indigenous values

Indigenous Australian occupation across the Lindsay–Wallpolla floodplain dates back thousands of years, and was sustained by the rich productivity of the floodplain woodland and wetland systems. Historically, the islands would have been an abundant source of food and water for these communities. Today, many signs of Indigenous life still remain at the islands, including diverse archaeological site-types and complexes closely associated with floodplain features (SKM 2004). The floodplain contains many registered sites of cultural heritage, within each of which may be multiple items of significance such as burial sites, shell middens, hearths, stone artefact scatters and culturally scarred trees (Bell 2010; Kelton 1996). Under the *National Parks Act 1975* (Vic.) and the Mallee Parks Management Plan 1996, Lindsay Island is listed as a special protection zone for its many of archaeological sites.

Only a very small area of the icon site has been surveyed for areas of cultural significance, largely because of its isolation. Surveys show the area was once densely populated by Indigenous peoples, who maintained spiritual, cultural and emotional links with its land, waters and traditional resources such as native species used for food and medicine (K.Stewart, pers. comm., 2010) The land and waterways are associated with cultural learning, which is still being passed on to new generations today (NSW Department of Environment, Climate Change and Water 2010).

Culturally scarred trees are often a living remnant of traditional Indigenous life and frequently occur along the edges of waterways and wetlands. Many of these trees occur on the islands, but are often stressed because of lack of flooding and likely to die without intervention.

Social and economic values

Tourism in the Mildura region generates more than $210 million annually, and is the third-largest industry in the region (Mildura Development Corporation 2009), with tourist numbers in the tens of thousands every year (B. Rogers, pers. comm., 2010). Sites such as the Murray–Sunset National Park are major attractions contributing to the tourism industry and local economy. The island floodplains are also popular recreation sites for the local communities of Millewa and Sunraysia, Victoria and the Riverland in South Australia. Camping, canoeing, bird- and wildlife-watching, photography, fishing and four-wheel driving are all popular pursuits.

3. Ecological objectives and water requirements

Based on an understanding of the Chowilla–Lindsay–Wallpolla icon site's characteristics and ecological requirements, First Step Decision interim ecological objectives were developed and approved by Murray–Darling Basin Ministerial Council in 2003. Objectives include:

- high value wetlands maintained
- current area of river red gum maintained
- at least 20% of the original area of black box vegetation maintained.

Since these objectives were approved by Ministerial Council in 2003, jurisdictional agencies have continued to review and refine the First Step interim objectives to develop refined ecological objectives for icon sites. These refined ecological objectives reflect eight years of learning's from the delivery of environmental water, monitoring, modelling and consultation activities and scientific research, and enable a clearer, more effective, evaluation of environmental responses to environmental water delivery.

In consultation with communities, the First Step Decision objectives that relate to Victorian environmental water management plans have been extended to develop overarching objectives. These overarching objectives better reflect the specific icon site values that the environmental waterings aim to protect, as well as relevant jurisdictional management plans and obligations.

The objectives for the Lindsay–Wallpolla environmental water management plan are outlined in **Table 3.1**. In addition to the overarching objectives, more detailed objectives have been developed to guide icon site management. Targets to measure progress towards these objectives are under development for this icon site.

Table 3.1: Revised ecological objectives for the Lindsay–Wallpolla icon site

Vision: *To maintain and restore a mosaic of healthy floodplain communities across Lindsay, Mulcra and Wallpolla Islands which will ensure that indigenous plant and animal species and communities survive and flourish throughout the site*		
Icon site ecological objectives		Targets
Overarching objectives	Specific objectives	
Vegetation Increase the diversity, extent and abundance of wetland vegetation	Provide a diversity of structural aquatic habitats Increase diversity and abundance of wetland aquatic vegetation Maintain and improve the populations of threatened flora and fauna that are flow-dependent Restore productivity linkages between the river and floodplain habitats.	Targets under development
Fish Increase abundance, diversity and extent of distribution of native fish	Increase abundance, diversity and extent of distribution of native fish	Targets under development
Waterbirds Provide habitat for a range of waterbirds, including migratory species and colonial nesters	Provide occasional breeding and roosting habitat for colonial waterbirds Provide habitat suitable for migratory birds, especially species listed under the JAMBA, CAMBA and RoKAMBA	Targets under development

Recognising their different values and variable water requirements, specific objectives based on water regime classes were then developed for different wetland types and vegetation communities across the island (Ecological Vegetation Classes). These are:

- semipermanent wetlands — restore habitat and community diversity
- ephemeral wetlands — restore habitat and community diversity; reinstate the communities typical of ephemeral wetlands
- lignum — improve condition and increase extent to sustain species assemblages and processes typical of lignum communities
- open grassland — maintain habitat values and flora and fauna communities
- river red gum — maintain current condition and extent of river red gum communities to sustain species assemblages and processes typical of such woodland
- black box — improve condition to sustain species assemblages and processes typical of black box woodland.

In 2006 the Murray–Darling Basin Commission noted that the specific objectives for the Lindsay–Wallpolla component of the icon site were to be further developed (MDBC 2006). Following the completion of the *Floodplain Options Investigation: Lindsay, Mulcra and Wallpolla Islands* (Ecological Associates 2007), the objective for permanent wetlands (to restore habitat and community diversity) was removed because these do not occur naturally on the islands.

Water requirements

Ecology and hydrology

Duration, depth, frequency and timing of flooding influence plant species assemblages, their relative abundance and growth habit and the fauna communities they support. As such, plant community classifications are a useful way to directly relate water regime to flora habitat, and indirectly to fauna habitat.

Water regime classes are a spatial classification of the floodplain into areas with common water regimes and ecological characteristics. Each water regime class has its own distinct ecology and hydrologic requirements, as described in Ecological Associates (2007).

Water regime classes provide a basis to establish objectives for the location, extent and condition of components of the floodplain ecosystem and therefore to set hydrologic objectives. Water regime classes were defined using existing information that describes the vegetation and aquatic habitat values of the floodplain (Ecological Associates 2007).

The hydrological environments of Lindsay–Wallpolla Islands have been classified into water regime classes according to the vegetation communities and aquatic habitat present, their water regimes prior to river regulation and by their interpreted ecological roles (Ecological Associates 2007; see also **Table** and **figures 3.1–3.3**).

All wetland ecological vegetation classes have been classified into two water regime classes, according to water regimes, plant communities and dependent fauna (Ecological Associates 2007). All anabranch ecological vegetation classes have been grouped into water regime classes with specific water requirements based on the biota they support (Ecological Associates 2007).

The relationship between water regime classes and fauna species guilds and breeding waterbirds is outlined in Appendix B.

Table 3.2: Water regime classes and component ecological vegetation classes

Water regime class	Ecological vegetation classes
Red gum forest	Grassy riverine forest (106)
	Grassy riverine forest/floodway pond herbland complex (811)
Red gum woodland	Intermittent swampy woodland (813)
	Shrubby riverine woodland (818)
	Riverine grassy woodland (295)
	Riverine swampy woodland
Black box woodland	Lignum swampy woodland (823)
	Riverine chenopod woodland (103)
Lignum shrubland	Lignum shrubland (808)
	Lignum swamp (104)
Alluvial plains	Alluvial plains semi-arid grassland (806)
	Semi-arid chenopod shrubland (98)
	Low chenopod shrubland (102)
	Sub-saline depression (820)
	Disused floodway shrubby herbland (807)
Semipermanent wetlands	Floodplain grassy wetland (809)
	Water body—fresh
Temporary wetlands	Floodway pond herbland (810)
	Spike rush wetland (819)
	Shallow freshwater marsh (200)
	Lake bed herbland (107)
Anabranches	Ecological vegetation class mapping does not cover waterways

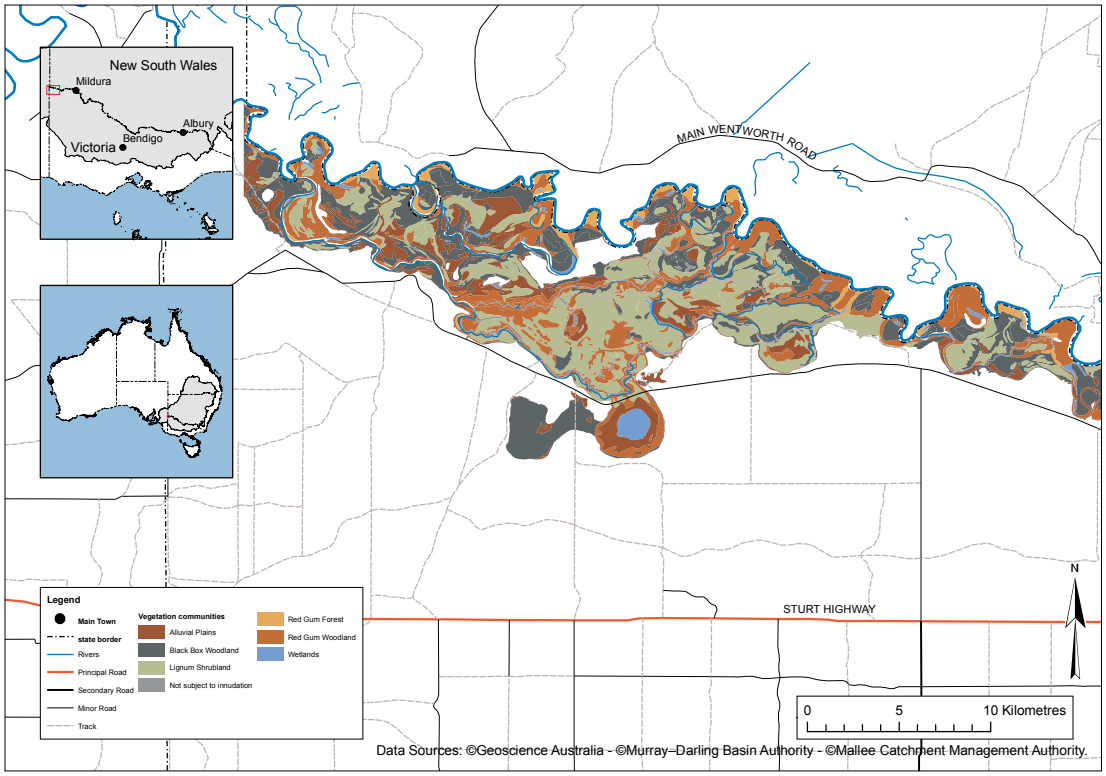

Figure 3.1: Water regime class distribution on Lindsay Island

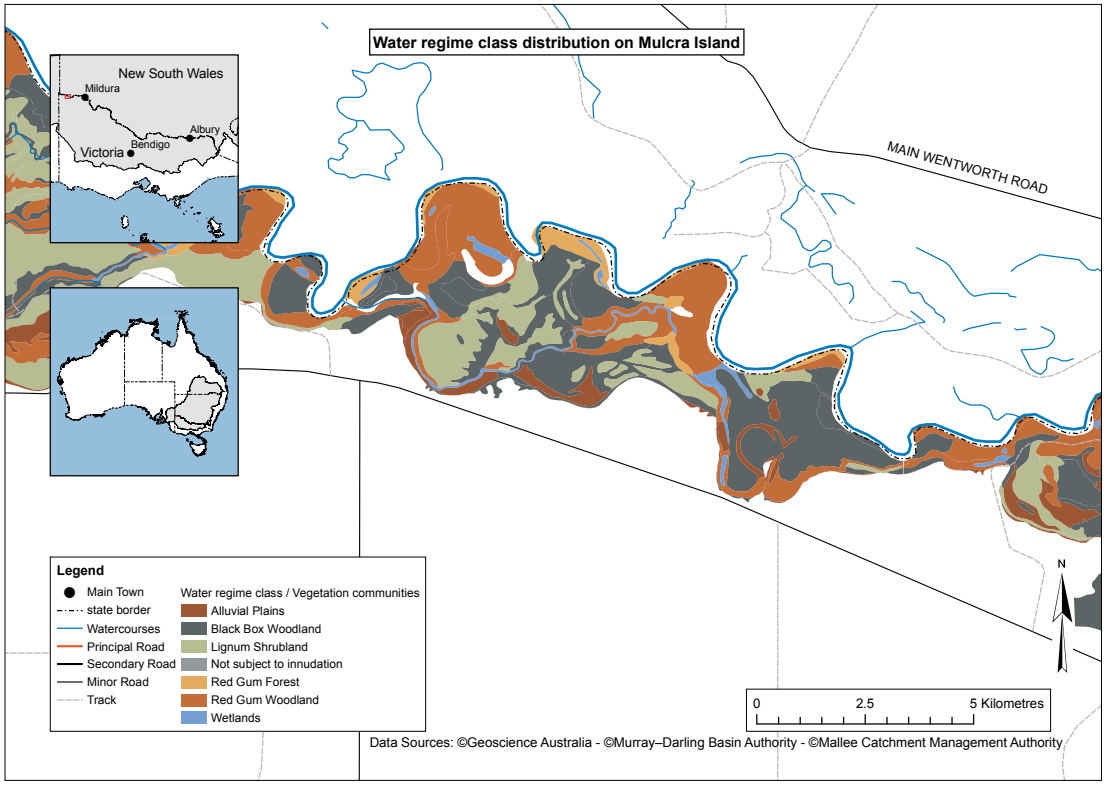

Figure 3.2: Water regime class distribution on Mulcra Island

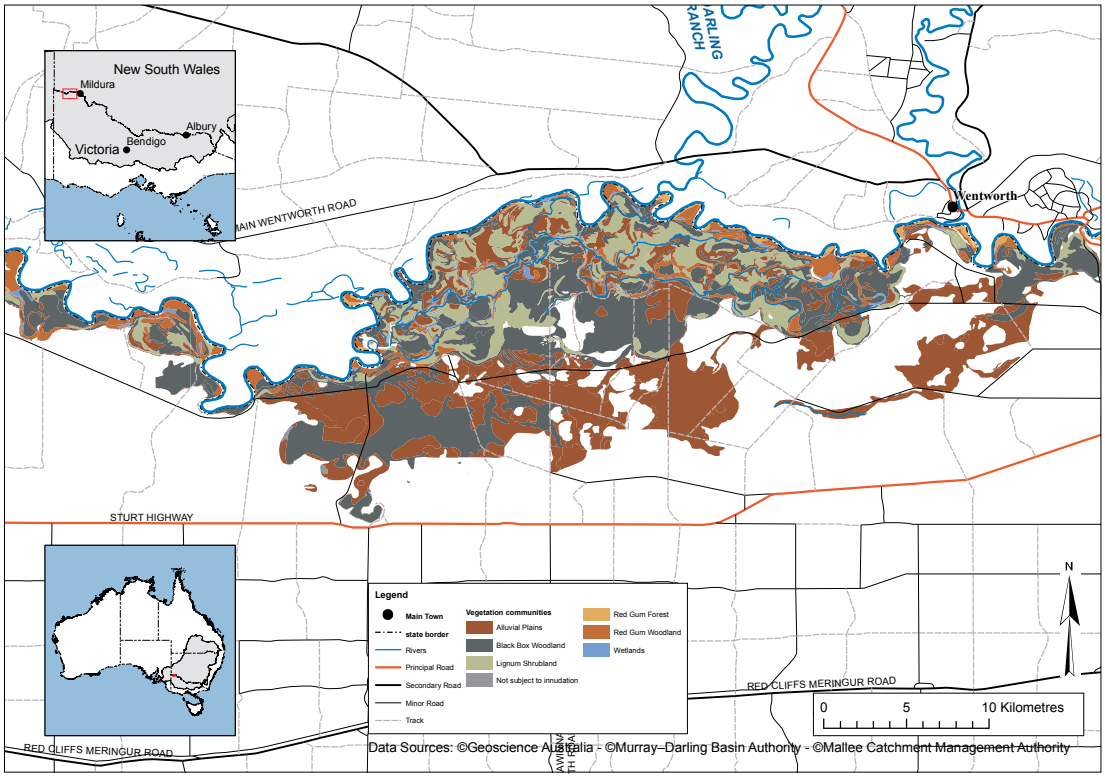

Figure 3.3: Water regime class distribution on Wallpolla Island

Table 3.3: Water requirements for the icon site environmental objectives

First Step Decision objective	Refined objectives	Vegetation community (water regime class)	River flow rate (ML/day)	Duration	Timing	Frequency (years in 10)	Maximum time between events	Works or other mechanisms to assist meeting objectives	Area flooded by works (ha)
			Required water regime						
High value wetlands maintained	Provide a diversity of structural aquatic habitats	Temporary wetlands Semipermanent wetlands	>30,000 ML/d >60,000 ML/d	2 months 1 month	Spring	2–8	4 years	Mulcra Island works Lindsay Stage 1 works Wetland regulators[a]	1,286 ha across the entire icon site[b]
	Increase diversity and extent of distribution of native fish								
	Increase diversity and abundance of wetland aquatic vegetation								
	Provide occasional breeding and roosting habitat for colonial water birds	Lignum shrubland	>50,000 ML/d	2 months	Spring	5	5 years	Mulcra Island works Lake Wallawalla regulators	161 ha on Mulcra Island[b] ~70 ha at Lake Wallawalla
	Maintain and improve the populations of threatened flora and fauna that are flow-dependent								
	Restore productivity linkages between the river and floodplain habitats	Anabranches	15,000 ML/d	14 days (3–4 freshes/y)	August–December	8	2 years	Mulcra Island works Lindsay stage 1 works	Flows improved over 20 km on Mulcra Island and 20 km on Lindsay Island
Current area of river red gum maintained	Provide occasional breeding and roosting habitat for colonial water birds	Red gum forest	>60,000 ML/day	4 months	Spring	7	4 years	Mulcra Island works	29 ha on Mulcra Island[b]
	Provide habitat suitable for migratory birds, especially species listed under the Japan–Australia and the China–Australia migratory bird agreements								
	Restore productivity linkages between the river and floodplain habitats	Red gum woodland	>80,000 ML/d	2 months	Spring	6	7 years	Mulcra Island works Wetland regulators Lake Wallawalla regulators	263 ha on Mulcra Island[b] Minor areas around wetlands ~250 ha at Lake Wallawalla
At least 20% of the original area of black box vegetation maintained	Provide habitat suitable for migratory birds, especially JAMBA- and CAMBA- listed species	Black box woodland	n/a	1 month	August–December	1–2	8 years	Mulcra Island works Lake Wallawalla regulators	45 ha on Mulcra Island[b] ~200 ha at Lake Wallawalla
	Restore productivity linkages between the river and floodplain habitats								

Notes
a Wetland regulators include those at Horseshoe Lagoon on Wallpolla Island, and Webster's Lagoon and Lake Wallawalla on Lindsay Island.
b Area flooded includes any areas in New South Wales inundated by raising Lock 8.

Climate and rainfall in the Murray–Darling Basin

Historically, the climate of the Murray–Darling Basin has been variable. Climate change science indicates a likely increase in this variability, resulting in more frequent and extreme floods and droughts (MDBA 2010a). Consequently, river storages and the use of environmental water will be managed according to these varying river flows.

Between 1996 and 2010, the Murray–Darling Basin was in a drought characterised by below-average rainfall in autumn and winter and few wet periods. This drought was significantly drier than the Federation Drought (mid-1890s to early 1900s) and the droughts of the World War II era (1937–1945).

Beginning in spring 2010, and continuing through the summer of 2010–11, widespread, above average rainfall across the Murray–Darling Basin broke the long standing drought. This rainfall was associated with the development, beginning in 2010, of a moderate to strong La Nina event making 2010 the wettest year on record for the Murray–Darling Basin.

Antecedent hydrologic conditions

Lindsay–Wallpolla Islands are located within the semi-arid Mallee region of Victoria. The climate is the hottest and driest in Victoria, with an average annual rainfall of 270 mm in Mildura. Average maximum temperatures are around 32°C in summer and 16°C in winter, with high evaporation rates throughout the year. As such, the River Murray represents an important source of water for the floodplain ecosystem.

The past 100 years has seen a vast increase in regulation and water extraction within the River Murray, resulting in reductions in the occurrence of high flows and extended periods of low flows, delays to the onset of floods and reduced frequencies and durations of floods (**Figure 3.4**)(Ecological Associates, 2007; SKM 2004). Flows are now captured in upstream storages and gradually released, resulting in relatively even flows all year round, transforming the River Murray into a deep habitat with low water velocities and stable water levels at low to moderate flows (Walker & Thoms 1993).

These changes to the flooding regime have affected the condition of the Lindsay–Wallpolla floodplain ecosystem. In recent years, the reduction in flooding caused by river regulation has been compounded by extended drought. These impacts are likely to increase under the predicted influence of climate change, however recent flooding in late 2010 and early 2011 will provide significant environmental benefits.

The widespread rainfall in spring 2010 has generated high flows throughout the Murray system. Flows downstream of Lock 9 began to rise in late August 2010, reaching 30,000 ML/d in October 2010. This inundated low lying wetlands along the river channel and generated flow through a number of anabranches across the islands. Flows have risen steadily since early November and exceeded 60,000 ML/d in mid-January 2011. This has generated flow into Lake Wallawalla and flooded most wetlands across the floodplain.

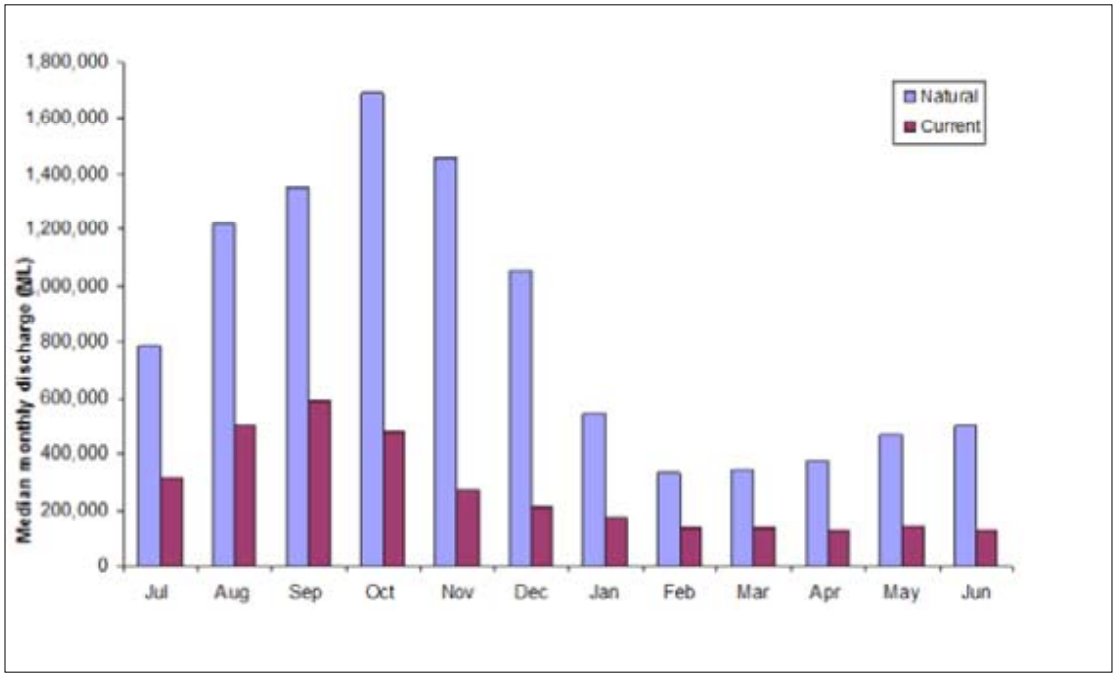

Figure 3.4: Monthly discharge at Lock 8, for modelled natural flows and modelled current system; based on 115 years of data (1894–2009) provided by MDBA

Past management actions and activities

As discussed in **Chapter 2**, Lindsay Island was made part of the Murray–Sunset National Park in 1991, with Mulcra and Wallpolla islands added in June 2010. The islands have traditionally been used for grazing, apiary, timber harvesting and water extraction, as well as broadacre and irrigated cropping.

The anabranches of Lindsay River and Wallpolla Creek are used for irrigation, stock and domestic extraction. At present, there is about 1,457 ha of irrigated horticulture at Lindsay Point, a small amount of stock and domestic extraction from Wallpolla Creek as part of Kulnine Station operations, and irrigation as part of Keera Station. Water extraction from Potterwalkagee Creek ceased when Trust for Nature purchased the adjacent property, Ned's Corner, and decommissioned the dam and channels.

4. Water delivery

Prioritisation of water requirements

The Living Murray Annual Environmental Watering Plan, developed by the Environmental Watering Group, includes a flexible decision framework to guide prioritisation of environmental watering actions. It also contains icon site environmental watering proposals, water availability forecasts and management objectives for water resource scenarios (see **Table 4.1**).

Throughout the year the Environmental Watering Group recommends environmental watering actions to the Murray–Darling Basin Authority (MDBA) for approval. These recommendations are based on the Annual Environmental Watering Plan and the volume of water available in The Living Murray's environmental water portfolio.

Local watering actions are prioritised under different water availability scenarios (see **Table 4.1**), according to the Mallee River Health Strategy (Mallee Catchment Management Authority 2006) and the Victorian Government's Northern Region Sustainable Water Strategy (Victorian Department of Sustainability and Environment 2009). Sites are chosen according to water availability and the environmental outcome achievable, as well as the ability of managers to deliver water to the site and the practicality of retaining water within the site.

Table 4.1: Objectives under different water availability scenarios

	Extreme dry	Dry	Median	Wet
Ecological watering objectives	Avoid irretrievable loss of key environmental assets	Ensure priority river reaches and wetlands have maintained their basic functions	Ecological health of priority river reaches and wetlands have been protected or improved	Improve the health and resilience of aquatic ecosystems
Management objectives	Avoid critical loss of species, communities and ecosystems Maintain key refuges Avoid irretrievable damage or catastrophic events	Maintain river functioning with reduced reproductive capacity Maintain key functions of high priority wetlands Manage within dry spell tolerances Support connectivity between sites	Enable growth, reproduction and small-scale recruitment for a diverse range of flora and fauna Promote low-lying floodplain-river connectivity Support medium flow river and floodplain functional processes	Enable growth, reproduction and large-scale recruitment for a diverse range of flora and fauna Promote higher floodplain-river connectivity Support high flow river and floodplain functional processes
Example priority locations for Lindsay–Wallpolla floodplain icon site	Base flows in Mullaroo Creek to preserve Murray cod populations	Base flows in Mullaroo Creek Base flows in Potterwalkagee Creek, Lindsay River and Wallpolla Creek Maintain priority wetlands (e.g. Webster's Lagoon)	As for Dry and: Spring pulse events in Potterwalkagee Creek and Lindsay River Inundate Mulcra floodplain Inundate Lake Wallawalla	As for Median and: Using natural flood events to inundate the broader floodplain

The Living Murray works and water modelling

Modelling

Modelling completed in 2008 found that the environmental water requirements of the floodplain icon sites (with the exception of Barmah–Millewa and the Lower Lakes, Coorong and Murray Mouth and River Murray Channel icon sites) could largely be met by a combination of the proposed TLM works, the 500 GL of recovered TLM water and 70 GL long-term Cap equivalent (LTCE) of River Murray Increased Flows.

This modelling was based on a number of assumptions including the use of unregulated flow events for environmental watering actions. It was also agreed as a modelling principle that return flows could be used to water at multiple environmental sites. There are a number of constraints to the implementation of this principle which TLM are currently working to resolve.

Further modelling is also planned to allow greater optimisation of works and measures to achieve icon site ecological objectives as we gain a greater understanding of operating scenarios.

Works

A range of water management options for Lindsay–Wallpolla Islands have been investigated under TLM. Many have been progressed to the detailed design or construction phases. Concept designs have been developed for the remaining options for further development if funding becomes available.

A brief description of priority options across Lindsay–Wallpolla Islands is provided in **Table 4.2**; see **Figure 4.1** for works locations.

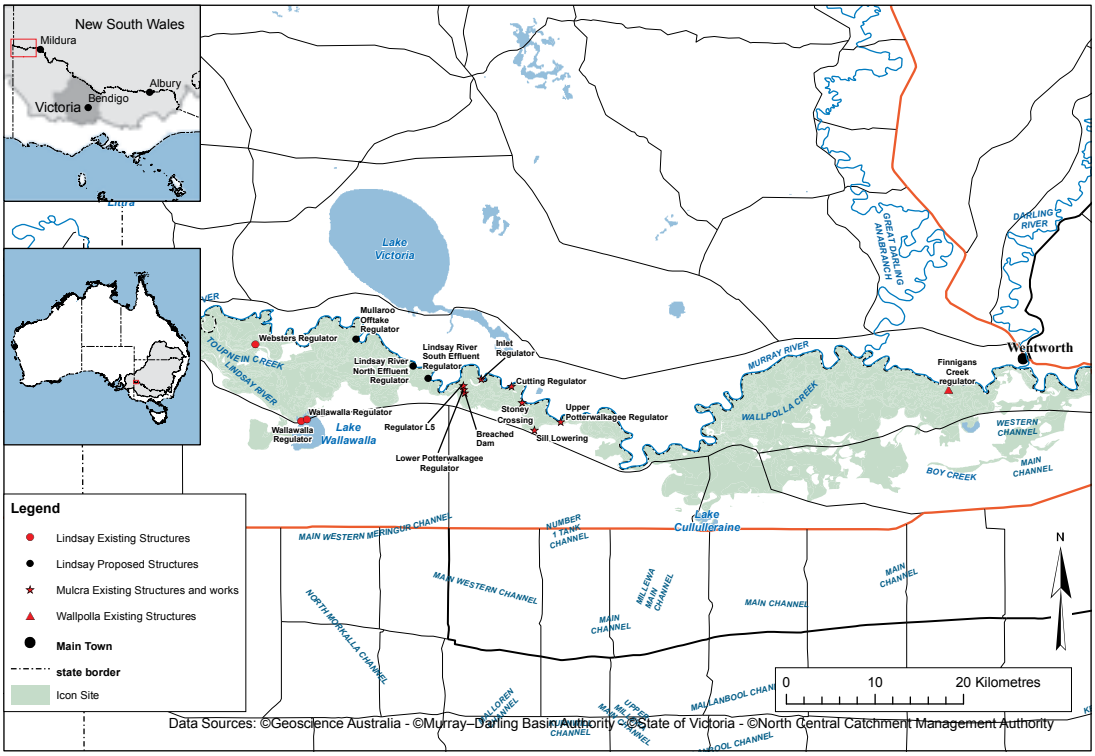

Figure 4.1: Map of existing and proposed works on Lindsay-Wallpolla Islands

Table 4.2: Completed and proposed works and their functions

Works package	Component	Function	Status
Mulcra Island	Lower Potterwalkagee regulator	Enable inundation of the Mulcra Island floodplain	Completed (2010–11)
	Lock 8 track upgrade (in Victoria and NSW)	Maintain access to Lock 8 during inundation events	
	Breached dam rehabilitation	Reinstate the natural creek alignment Remove willows and cumbungi (*Typha* species) Improve connectivity	
	'The Cutting' block bank	Prevent water draining back to the River Murray when the floodplain is inundated (maximising inundation)	
	Stoney Crossing regulator	Maximise flow capacity during inundation events and improve fish passage Enable flow management, including periodic drying of Potterwalkagee Creek	
	Upper Potterwalkagee sill lowering and regulator	Enable flow management Increase flowing habitat Improve connectivity and fish passage Inundate Snake Lagoon	
	Mulcra Horseshoe inlet regulator (L1) and L5 regulator	Enable water to be retained to desired depth and area	
	Mulcra Horseshoe pipe and channel	Deliver water from the lower Potterwalkagee Creek to the Mulcra Horseshoe wetland	
	Lock 8 track regulator (in New South Wales)	Improve connectivity between river and floodplain	
Webster's Lagoon (Lindsay Island)	Inlet regulator	Disconnect wetland from weir pool to allow for drying phase and re-instate variable water regime	Completed (2005–06)
Lake Wallawalla Regulator (Lindsay Island)	Inlet regulators (2)	Reinstate connectivity with the Lindsay River Retain inflows for desired duration Allow wetland to fully drain upon flood recession	Completed (2005–06)
	Raise Mail Road by 1 m		
Lindsay Island stage 1	Upper Lindsay River regulators (north and south inlets)	Improve flow capacity Provision of base flow to the upper Lindsay River Improve connectivity and fish passage Enable within channel spring pulse event	Detailed design (construction anticipated 2010–11)
	Mullaroo Creek regulator and fishway	Maintain fast flowing habitat for Murray cod Improve fish passage between Mullaroo Creek and River Murray	Detailed design (construction anticipated 2011–12)
Lindsay Island Stage 2	Lindsay River Weir and ancillary regulators	Enable inundation of approximately 5000 ha on Lindsay Island	Concept design
Horseshoe Lagoon (Wallpolla Island)	Inlet regulator	Disconnect wetland from weir pool to allow for drying phase and re-instate variable water regime	Completed (2005–06)
Lock 9 bypass	Bypass channel around Lock 9 and ancillary regulators	Extend and improve flowing fish habitat and connectivity Enable floodplain inundation	Concept design

Operating regimes for environmental watering actions

This section of the environmental water management plan provides a broad description of the proposed operating regimes to maximise ecological outcomes from the use of The Living Murray Water portfolio and works. To meet the proposed operating regimes a combination of unregulated and regulated environmental water may be used. While this environmental water management plan focuses on the use of environmental water from The Living Murray's Water Portfolio, there may also be other sources of environmental water available to meet the proposed regimes.

The overall aim of environmental water management across Lindsay–Wallpolla Islands is to provide a watering regime that meets the environmental water requirements of floodplain vegetation and the associated biota over the greatest area possible, taking into account recent watering events.

While the River Murray weirs (7, 8 and 9) have contributed to the changed hydrology of the islands, these structures also provide opportunities to maximise the benefits of environmental water delivery. Raising and lowering weirs can, to some extent, mimic the variable flows that would have occurred under unregulated conditions. Raising weirs under higher flows can increase the inundation of floodplain immediately upstream and also generate higher flows through upstream effluents, mimicking freshes.

The operating regimes for completed works and those in the detailed design phase (**Figure 4.2**) are outlined below, with detailed operating strategies provided in **Schedule A** (when completed). Operating strategies have not been developed for those options at concept design phase (Lindsay Island Stage 2 and Lock 9 bypass).

Opportunities exist for the coordination of operation across the Chowilla–Lindsay–Wallpolla icon site. The raising of the Lock 6 weir pool for operation of the Chowilla Floodplain TLM works potentially will require raising Lock 7, to maintain flow velocities through the Mullaroo system. This will allow operation of the Lindsay River spring pulse scenarios in conjunction with environmental watering on the Chowilla floodplain. This concept can be extended to include filling of Lake Wallawalla by pumping. Operating infrastructure to inundate Mulcra Island and Chowilla at the same time is likely to improve the ecological outcomes at both sites.

Mulcra Island

The proposed operating regime for Mulcra Island aims to maintain base flows through the system year-round, with a partial drying phase once every six to eight years to mimic natural low flow periods. Base flows are supplied under normal regulated conditions, with Lock 8 maintained at full supply level (FSL, 24.6 m Australian height datum [AHD]). This provides a permanent flow of between 50 and 100 ML/d through the new Stoney Crossing Regulator to the 10 km section of Potterwalkagee Creek downstream.

Spring freshes will be provided once every one to two years by a moderate raising of the Lock 8 weir pool (by 20 to 60 cm). Broader floodplain inundation will occur every two to three years through raising the weir pool to the top of piers (25.7 m AHD) and raising the Lower Potterwalkagee Creek regulator to pond water behind the regulator. This would mimic a 50,000 ML/d flood event and inundate about 822 ha (including 250 ha in New South Wales).

Lindsay Island — stage 1

The proposed operating strategy of the Lindsay Island stage 1 works aims to maintain existing high quality habitat for native fish, increase the extent of flowing habitat, improve fish passage and the condition of riparian vegetation. With these aims in mind, the operating regime involves provision of two key elements — low base flows and spring freshes.

Low base flows will be the normal mode of operation at the normal Lock 7 weir pool level (22.1 m AHD). At this level, the northern Lindsay regulator will be opened to allow inflows of 35 to 40 ML/d, while no flows will pass through the southern Lindsay regulator. The Mullaroo Creek regulator will be operated to pass ~700 ML/d.

Spring freshes will be provided by raising the Lock 7 weir pool to 22.6 m AHD for nine weeks, once or twice each year in years where River Murray flows of at least 17,000 ML/d have not been recorded in the previous nine months. When providing a spring fresh, both the northern and southern Lindsay regulators will be open and the Mullaroo Creek regulator will be operated to pass ~700 ML/day.

Providing spring freshes in the Lindsay River will also increase opportunities to inundate Lake Wallawalla using temporary pumps. This large wetland would normally fill via two small effluents from the middle reaches of the Lindsay River, when River Murray flows exceed 50,000 ML/d. During extended low-flow periods, as have occurred over recent years, water can be pumped from the Lindsay River into the wetland, provided that flows are high enough.

Wetland regulators

In the absence of moderate-to-high River Murray flows, regulated wetlands within the floodplain are currently prioritised and filled in accordance with the Environmental Water Group's watering criteria. These wetlands include Horseshoe Lagoon on Wallpolla Island, Lake Wallawalla and Webster's Lagoon on Lindsay Island. The specific objectives and operation of these works are outlined in **Table 4.3**.

Table 4.3: Operating regime of the regulated wetlands

Wetland (connection to River Murray)	Ecological objectives	Operation to achieve objectives
Horseshoe Lagoon–Wallpolla Island (Finnigan's Creek) Webster's Lagoon–Lindsay Island (Toupnein Creek)	Increase the area and extent vegetation in the littoral zone Provide breeding habitat for waterfowl, particularly ducks and grebes Provide habitat and promote breeding events of small fish, frogs and turtles Limit river red gum regeneration in the wet-dry littoral zone Limit cumbungi growth in the permanent pool and promote greater macrophyte diversity Reduce carp abundance	Wet the wet-dry littoral zone for 3–6 months winter/spring Filling: wetland inundated at normal weir pool levels Surcharging: regulator closed and temporary pumps used to surcharge wetland Dry the wet-dry littoral zone for 6 months summer/autumn Completely dry the permanent zone annually for 6 to 7 months Drying: regulator closed to disconnect wetland and allow drying Carp screens in operation when regulators open to allow natural inflows
Lake Wallawalla–Lindsay Island (floodrunner from Lindsay River)	Maintain lakebed herbland (supports several threatened species) Improve condition and regeneration of river red gums Provide successful waterbird breeding events Maintain populations and breeding events of small native fish Provide breeding events for golden perch (*Macquaria ambigua*) and other large floodplain fish Reduce carp abundance	Allow higher water levels to be retained in the lake and provide the opportunity to increase duration of inundation Filling: wetland filled by natural floodwaters or pumped environmental water; both regulators closed to retain water in the lake Allow complete drainage of the lake Drying: regulators fully opened Operate the structures to reduce carp access and promote movement of native fish Carp screens in operation when regulators open

Water accounting and measurement

Water accounting methodology will be developed and agreed in advance by The Living Murray Committee and the Basin Officials Committee. Consistency of water accounting methodology will be sought wherever possible. Where relevant, water accounting will be consistent with the Water Accounting Conceptual Framework and Australian Water Accounting Standards.

The best available, most appropriate and cost-effective measurement technique will be used to determine environmental water use. The appropriateness of the measurement technique is likely to differ depending on icon site and event. For example, under dry conditions, environmental water pumped into Hattah Lakes is likely to be measured using a meter while return flows are measured via a gauging station; under wet conditions, environmental water returning from Barmah–Millewa Forest will need to be modelled.

Accurate measurement of water use at Mulcra and Lindsay islands will be difficult because operating strategies involve raising locks 7 and 8. As such, modelling of the losses incurred when surcharging weir pools will be required at these sites.

Evaluation and management of risks

A number of risks are associated with using infrastructure to deliver environmental water. A risk assessment has been undertaken for the operation of the Lindsay–Wallpolla floodplain works (**Table 4.5**). Monitoring and mitigation will be carried out where possible, the results of which will be taken into consideration when implementing adaptive management principles. These risks and mitigating measures are further detailed in a detailed Risk Monitoring Plan, included at Schedule 2.

Table 4.4: Operating regimes contributing to ecological objectives

First Step Decision objectives	Vegetation community area inundated (ha)	Operating strategy	Frequency (years in 10)	Duration	Water availability scenario (range if appropriate)	Estimated volume of water required (GL)	Estimated volume of water used (GL)
Mulcra Island works							
Preferred operating scenario							
High value wetlands maintained Current area of river red gum maintained At least 20% of the original area of black box vegetation maintained	324 ha wetlands 161 ha lignum shrubland 292 ha river red gum communities 45 ha black box woodland	Maximum floodplain inundation (including Mulcra Horseshoe)	5	4 months (full operation)	Median-wet	40	5.3
		Spring fresh	5 (3–4 per year)	14 days, 7 days between pulses	All	5.5	0.5
Minimum operating scenario							
High value wetlands maintained Current area of river red gum maintained At least 20% of the original area of black box vegetation maintained	324 ha wetlands 161 ha lignum shrubland 292 ha river red gum communities 45 ha black box woodland	Maximum floodplain inundation (including Mulcra Horseshoe)	3	4 months (full operation)	Median-wet	40	5.3
		Spring fresh	8	14 days, 7 days between pulses	All	5.5	0.5
Regulated wetlands — Horseshoe Lagoon–Wallpolla Island; Webster's Lagoon–Lindsay Island							
Preferred operating scenario							
High value wetlands maintained Current area of river red gum maintained	120 ha wetlands Surrounding large old river red gum	Fill wetlands at regulated flows	9	3–6 months	All	2.7	2.7
		Surcharge wetlands using temporary pumps	5	3–4 weeks			
		Close regulators to dry	10	6 months			
Minimum operating scenario							
High value wetlands maintained Current area of river red gum maintained	120 ha wetlands Surrounding large old river red gum	Fill wetlands at regulated flows	5	3–6 months	All	2.7	2.7
		Surcharge wetlands using temporary pumps	3	3–4 weeks			
		Close regulators to dry	10	6 months			
Lindsay Stage 1 and Lake Wallawalla regulators[a]							
Preferred operating strategy							
High value wetlands maintained Current area of river red gum maintained At least 20% of the original area of black box vegetation maintained	800 ha wetlands[b] 20 km of riparian vegetation watered along watercourses	Base flows (Lindsay South)	10	Year round	All	0	0
		Spring fresh	8	14 days, 7 days between pulses	All	Minor[c]	Minor[c]
		Pumping to inundate Lake Wallawalla	(3–4 per year)	4 months (full operation)	All	12	12
Minimum operating scenario							
High value wetlands maintained Current area of river red gum maintained At least 20% of the original area of black box vegetation maintained	800 ha wetlands	Base flows (Lindsay South)	10	Year round	All	0	
		Spring fresh	5 (3–4 per year)	14 days, 7 days between pulses	All	Minor[c]	Minor[c]
		Pumping to inundate Lake Wallawalla	1	4 months (full operation)	All	12	12

Notes

a Lindsay Stage 1 works and Lake Wallawalla regulators would be operated together.

b The area of 800 ha covers fringing vegetation around Lake Wallawalla–includes river red gum woodland, black box woodland and small areas of lignum. Actual areas watered have yet to be calculated.

c Water use is yet to be calculated but is expected to be minor.

Table 4.5: Potential risks associated with TLM works on Lindsay–Wallpolla Islands

Risk	Description	Mitigation
Salinity	With any extended floodplain inundation there is a risk of mobilising salt stored within the floodplain. If operation of TLM works results in an accountable impact under the Basin Salinity Management Strategy, an entry must be made on Schedule B of the Basin Salinity Management Strategy (BSMS) Salinity Register. Victoria has conducted preliminary assessments of the impacts of proposed TLM operating strategies in line with BSMS requirements and submitted these to MDBA. These assessments suggest that salinity impacts are likely to be insignificant to minor; where accountable, provisional entries will be made on the BSMS register.	Salinity investigations and assessments guiding initial operations. Ongoing salinity monitoring. Adaptive management if necessary.
Sediment transport and erosion	Flows through waterways and into wetlands may cause erosion and contribute to sedimentation. Mobile sediment may detrimentally effect water quality and change the bed planform.	Geomorphologic investigations and assessments guiding initial operations. Ongoing geomorphologic monitoring. Adaptive management if necessary.
Water quality	Changes to water regimes risks releasing salt and nutrients from the waterway, wetland and/or groundwater, resulting in decreased water quality in the water body. They may also cause saline and black water, resulting in fish or vegetation kills. Other parameters that may affect water quality include suspended sediment loads and temperature	Water quality investigations and assessments guiding initial operations. Ongoing water quality monitoring. Adaptive management if necessary.
Pest vertebrate species	Water management actions may benefit undesirable aquatic and terrestrial pest species through provision of habitat and food resources.	Pest animal investigations and assessments guiding initial operations. Ongoing pest monitoring. Adaptive management if necessary.
Fish passage	Passing more water through anabranches and less through the main channel may reduce stimulus for fish to use the main-stem as a major migratory route.	Fish investigations and assessments guiding initial operations. Ongoing fish monitoring. Adaptive management if necessary.
Pest flora species	Increased water on the floodplains may increase the occurrence of pest plant dispersal and colonisation.	Pest plant investigations and assessments guiding initial operations. Ongoing pest plant monitoring. Adaptive management if necessary.
Cultural heritage	On-ground works may potentially disturb or damage features of cultural significance during the construction phase.	Cultural heritage investigations and assessments guiding initial operations. Ongoing cultural heritage monitoring. Adaptive management if necessary.
Further risk assessment and monitoring	Refer to Risk Management Plan (Schedule B).	–

5. Environmental monitoring

Different monitoring methods are used to assess progress toward the icon site ecological objectives. These include River Murray system-scale, icon site condition and intervention monitoring. The Living Murray (TLM) Outcomes Evaluation Framework (Murray–Darling Basin Commission 2007) outlines the rationale for these monitoring methods, which are summarised below.

River Murray system-scale monitoring

Conducted annually, River Murray system-scale monitoring and evaluation focuses on the system's ecological health, measuring improvements relating to fish, waterbirds and vegetation.

Icon site condition monitoring

Condition monitoring assesses each icon site's condition in relation to its ecological objectives. Condition monitoring is typically conducted on a medium-frequency basis (months to years), depending on the rate of change. Condition monitoring includes standard methodologies for monitoring fish, birds and vegetation, as well as icon site-specific methods for monitoring other ecological objectives (see **Schedule 3**). These monitoring activities have been classified into three categories — A, B and O.

'A' category monitoring activities are undertaken at all icon sites using agreed standardised methodologies:

- fish condition monitoring using MDBA Sustainable Rivers Audit methodology
- waterbird condition monitoring using a standard on-ground method to link with the annual aerial waterbird survey
- tree condition monitoring for river red gum and black box using on-ground assessments linked to remote-sensing data.

'B' category contains icon site-specific monitoring using locally appropriate methods. This monitoring responds to unique icon site characteristics and is less easily standardised:

- tree community distribution
- tree population structure/recruitment and relative abundance
- understorey plant assemblages, including wetland and floodplain species, and targeted surveys to assess lignum (*Muehlenbeckia florulenta*) and cumbungi (*Typha* species) condition
- additional surveys for small-bodied fish
- bush birds.

'O' category uses icon site monitoring related to objectives and is less easily linked to TLM ecological objectives.

At Chowilla–Lindsay–Wallpolla, these include threatened bird species, including regent parrot and bush stone-curlew (*Burhinus grallarius*) and frogs.

The Mallee Catchment Management Authority is responsible for all ecological monitoring under The Living Murray program at the Lindsay–Wallpolla icon site.

At present, the site specific ecological objectives for Lindsay–Wallpolla do not provide SMART (specific, measurable, achievable, realistic and time bound) targets and, as such, reporting in relation to ecological targets is generally not possible (Wallace 2009). In the interim, while site-specific ecological targets are being developed, reporting will focus on the specified ecological objectives by reporting against the variables identified in the Outcomes Evaluation Framework, e.g. species diversity; spatial distribution; relative abundance; and age structure (Wallace 2009).

More detailed monitoring may be required during the first few managed watering events following completion of the proposed works. The existing condition monitoring program should provide sufficient information about the resulting ecological outcomes, but there will also be a need for real-time monitoring of a range of parameters to identify and manage risks.

In addition, under Victoria's Native Vegetation Framework, which aims to achieve a net gain in the extent and condition of native vegetation across the state, it has been agreed that any native vegetation clearing associated with The Living Murray can be offset using the measured improvement in condition of the areas watered by the works. This policy recognises that significant biodiversity gain will occur through large-scale environmental watering, but does require implementation of a monitoring program across proposed offset sites to demonstrate the maintenance or improvement of vegetation condition.

Intervention monitoring

To improve icon site management and enhance ecological outcomes intervention monitoring investigates the links between environmental watering, infrastructure and ecological outcomes. Intervention monitoring targets environmental watering events that will inform key knowledge gaps and ecological questions. These results can be applied to other icon sites with similar ecological communities, hydrology and processes.

Groundwater monitoring

In addition to monitoring ecological outcomes and risks, groundwater and salinity monitoring will need to be undertaken, to provide information for Schedule B of the Basin Salinity Management Strategy Salinity Register. Monitoring will be undertaken according to recommendations in SKM (2009; 2010).

Risk monitoring

Risk monitoring plans have been developed (Schedule B) based on risk investigations conducted during the detail design phase of the works. These plans target monitoring efforts specifically around identified risks of the works or operations. The results from this monitoring can be used to gauge the success of the works as well as guide future management decisions.

6. Community consultation and communication

Community support for activities delivered under The Living Murray (TLM) at the Lindsay–Wallpolla icon site depends on effective engagement with a range of stakeholders.

Engagement strategies have been developed for TLM projects at Mulcra and Lindsay islands (Schedule 4), in consultation with the Icon Site Community Reference Group, the Trust for Nature and four New South Wales landholders. These groups have also provided input into the development of the Lindsay–Wallpolla Environmental Water Management Plan.

The engagement strategies focus on ensuring that the community is informed of the context, history, proposed processes, constraints and opportunities for environmental water management at the Lindsay, Mulcra and Wallpolla islands. This in turn will better enable environmental water managers to consider community values and knowledge in decision-making where possible. The Community Reference Group (see **chapter 1**), the Trust for Nature and New South Wales landholders play a key role in this process by providing advice on the most appropriate methods of engagement.

Communication and engagement activities to date have included field trips, site visits, briefings, media releases as well as events and publications for key stakeholder groups such as the Community Reference Group, local government, adjoining landholders and the local community.

Despite extended drought and low irrigation allocations, the local and wider community has been generally supportive of emergency environmental watering events at Lindsay, Mulcra and Wallpolla islands. It is understood that community opinion may shift with continued drought and that a proactive program of communication and consultation will be imperative for program success.

7. Indigenous engagement

Indigenous people have many social, cultural, customary and economic interests in the water resources of the River Murray.

The Living Murray aims to maximise ecological outcomes through the delivery of environmental water and therefore cannot provide for the commercial economic interests of any of its stakeholders. However, The Living Murray is committed to taking into account Indigenous values and objectives in its environmental water planning and management. As Indigenous communities identify objectives and strategies for achieving these Indigenous objectives they will be incorporated into environmental water management plans in the future. Indigenous consultation will be reported on in The Living Murray Annual Environmental Watering Report and The Living Murray Annual Implementation Report.

Indigenous engagement is an important aspect of managing the Lindsay–Wallpolla Islands. The Mallee Catchment Management Authority The Living Murray Indigenous Facilitator assists the project team in ensuring the local Indigenous community is fully engaged, informed and involved in the project. Involvement of the Indigenous community is critical to ensuring the success for the project, particularly as there are a number of groups involved. The Living Murray Indigenous Facilitator assists the project team in ensuring the local Indigenous community is fully informed through face-to-face and community meetings, a quarterly newsletter, fact sheets and Mallee Catchment Management Authority website updates.

The Living Murray Indigenous Partnerships Project

Murray Lower Darling River Indigenous Nations successfully negotiated the Indigenous Partnerships Project under The Living Murray Initiative. The project employs an Indigenous facilitator and establishes an Indigenous working party at each of the icon sites.

This will enable the drafting of cultural maps that will be owned by the Indigenous nations and used in the asset management plans and significant ecological asset environmental watering plans. These maps will ensure that any proposed works will not negatively impact on Indigenous sites—such as hunting sites, native fauna grazing and breeding areas, native food and medicinal plant colonies, burial sites and Dreaming or spiritual sites.

Murray Lower Darling River Indigenous Nations is a partner in this project and will assist in the establishment and support of working groups where appropriate.

8. Adaptive management and reporting

An adaptive approach is critical in managing water-dependent ecosystems because it enables land managers and policy-makers to update strategies based on the outcomes of research and watering actions. This is known as 'learning by doing' and involves designing, implementing, monitoring, reporting and evaluating our work.

Environmental water management plans are constantly refined by adaptive management, which incorporates outcomes from environmental delivery, ecological monitoring, works, modelling and community consultation.

The Living Murray Annual Environmental Watering Plan is developed at the beginning of each watering season and complements the environmental water management plan. As the season progresses, the annual water planning process responds to water availability, opportunities and environmental priorities. A flexible decision-making framework is included in the annual plan so the Environmental Watering Group can assess water priorities throughout the year according to the water resource condition.

To highlight and analyse previous activities and outcomes, the Murray–Darling Basin Authority works with icon site managers to produce an annual TLM implementation report (as required under clause 199 of The Living Murray Business Plan), which is used by the Independent Audit Group. An annual external audit is conducted to ensure TLM is implemented at an appropriate level of transparency and accountability, and to promote public confidence in the program's efforts and outcomes. The implementation report and external audit are presented to the Murray–Darling Basin Ministerial Council.

To capture key learning and changing icon site management practices, schedules appended to the environmental watering management plan are updated as required.

Adaptive management

A close relationship is required between water management and monitoring to ensure that the system is operated to optimise ecological outcomes and minimise environmental risks.

Management of environmental water will occur adaptively in line with the following process (see **Figure 8.1**).

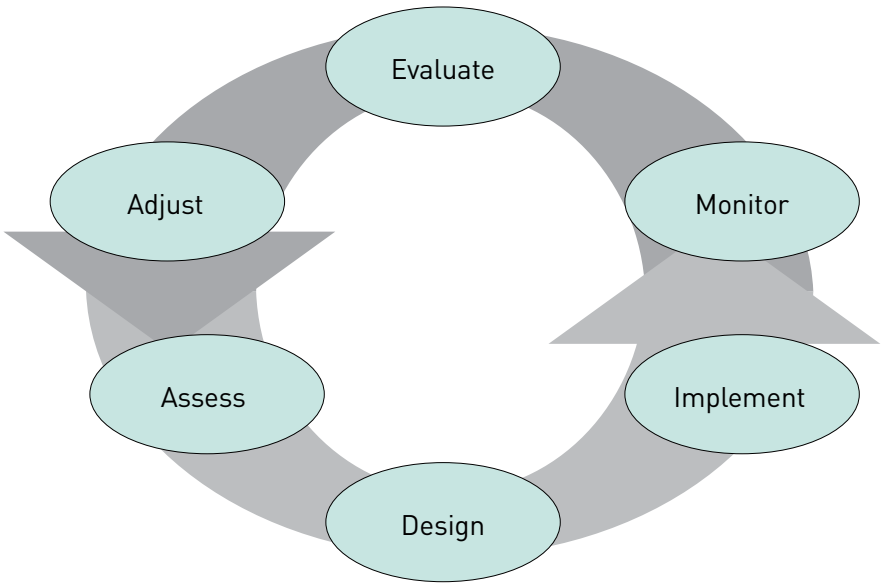

Figure 8.1: Adaptive management cycle

Assessment

The ecological issues, objectives, water requirement, priority areas and actions, and associated risks for restoring the floodplain are assessed. This stage requires community and expert input.

Design

Knowledge of the floodplain condition and its ecology are used to develop hypotheses in terms of expected responses and set objectives and targets. Interventions are designed, including a proposed package of works and operating rules.

Implementation

The recommended interventions are implemented.

Monitoring

The monitoring program will be coordinated by the Mallee Catchment Management Authority in conjunction with land managers. The different types of monitoring are discussed in **chapter 5**.

Evaluation

The monitoring results will be evaluated in light of the expected outcomes— ecological response. Triggers will be identified to inform if/how management needs to adjust (e.g. the size of flood event adopted, depending on water availability). Both short- and long-term triggers will be used. Short-term triggers include water movement into or out of structures, and whether specific biota (flora and fauna) begin to appear. Long-term triggers will include more detailed targets for ecological response.

Adjustment

The Icon Site Management Committee will consider the monitoring outcomes (and any new knowledge on the issues) to determine whether changes are required to the operating strategy and to redefine the expected outcomes from the operation (i.e. the objectives).

Assessment

Proposed changes will be assessed by the Icon Site Management Committee to consider if such changes still meet their expectations. Additional information provided through this step will be reviewed and considered.

Design

The program then moves back to the design stage where agreed changes are converted into changes to structural, operation or procedural plans.

Reporting

Improvements to actions and practices at the icon site (identified through the adaptive management process) will be reported to stakeholders through the existing governance arrangements described in **chapter 1**. This environmental water management plan will be reviewed periodically to capture the key lessons and changes in icon site management practices.

The outcomes achieved against the environmental water management plans will provide evidence of TLM progress. This information will be incorporated into the annual TLM implementation report and presented to the Murray–Darling Basin Ministerial Council. This meets the obligation to report on the annual progress of The Living Murray Initiative under clause 199 of The Living Murray Business Plan.

List of figures and tables

Figures

Tables

Appendix A: Victorian icon site governance arrangements

In Victoria, The Living Murray (TLM) Initiative is delivered by the Department of Sustainability and Environment, which provides high-level policy input and coordinates TLM delivery across all Victorian icon sites.

With the exception of the Hattah Lakes, all TLM icon sites in Victoria are multi-jurisdictional. Interstate coordination for these cross-border sites occurs through the integrated coordinating committees and icon site management committees.

Victoria has set up a TLM steering committee to oversee TLM delivery in that state (see **Figure A.1**). This high-level committee, which is chaired by the Department of Sustainability and Environment, comprises representatives from key agencies responsible for implementing TLM. Goulburn–Murray Water has also convened a state construction committee to oversee the detailed design and construction phases.

The chief executive officers of the Mallee and North Central management authorities act as regional icon site coordinators for relevant icon sites. Icon site coordinators are responsible for delivering TLM at each icon site. Accordingly, the Department for Sustainability and Environment has entered into a memorandum of understanding with the Mallee and North Central catchment management authorities that:

- establishes a collaborative working relationship between the organisations
- sets out a common understanding of intent
- commits the organisations to sub-jurisdictional arrangements for delivery of The Living Murray Business Plan.

State water authorities (Goulburn–Murray Water and SA Water) are Murray–Darling Basin Authority-delegated constructing authorities for the icon sites. As such, they are responsible for detailed design and construction under the environmental water management plan once investment proposals have been approved by the MDBA.

Specific icon site arrangements and committees for Lindsay–Wallpolla Island are set out below.

Icon Site Management Committee

The Icon Site Management Committee is composed of representatives from the Mallee Catchment Management Authority, South Australia Water, the Murray–Darling Basin Authority, the Victorian Department of Sustainability and Environment (Office of Water and State-Wide Services), Parks Victoria and NSW Office of Water.

The purpose of the committee is to:

- oversee implementation of Victoria's obligations for TLM and the Environmental Delivery program at the Lindsay–Wallpolla Islands
- provide a forum for the cooperative delivery of TLM and the Environmental Delivery program for the Lindsay–Wallpolla Islands
- advise the Icon Site Coordinator (Mallee Catchment Management Authority Chief Executive Officer) on TLM matters and the Environmental Delivery program for the Lindsay–Wallpolla Islands
- facilitate and monitor progress of TLM program delivery.

The role of the committee is to facilitate TLM implementation through their respective agencies by:

- generating support for TLM environmental works and measures and environmental delivery projects planned for the Lindsay–Wallpolla Islands within their own agencies and facilitating resolution of issues relevant to their agency
- ensuring agency commitments for TLM environmental works and measures and environmental delivery projects are fulfilled
- attending meetings with the Icon Site Management Committee and Icon Site Coordinator, as required
- disseminating information regarding long-term obligations and annual deliverables to relevant agency officers, including engaging broader staff within their organisations
- providing advice to the Icon Site Coordinator regarding implementation, policy or legislative issues, as relevant to their respective agencies, which may affect program delivery

- providing advice regarding the progress of program implementation, as required
- nominating appropriate representatives from their respective agencies to participate on project working groups, as requested
- ensuring active and timely participation of the nominated representative
- ensuring that the nominated working group representative undertakes broader engagement within their organisation, including updates to the relevant committee member.

Icon Site Construction Committee

The Icon Site Construction Committee consists of representatives from the Mallee Catchment Management Authority, South Australia Water (chair), the Victorian Department of Sustainability and Environment (Office of Water and State-Wide Services), Parks Victoria, NSW Office of Water and the MDBA.

The objective of the committee is to:

- oversee the development of detailed designs and construction of works funded under TLM at the Lindsay–Wallpolla Islands, ensuring works are consistent with the approved investment proposal and construction proposal and address any issues identified in the assessment of these documents
- foster a sharing of expertise to ensure that environmental works are designed, constructed, operated, and commissioned efficiently, and effectively to deliver the agreed environmental functionality.

The specific tasks of the committee include providing technical oversight, identifying and addressing all land management issues associated with the works, regularly reviewing project costs and timelines, reviewing risks and mitigating measures and seeking endorsement from the State Construction Committee for any project changes.

While the committee sits under the State Construction Committee, information regarding project progress is also provided to the Icon Site Management Committee.

Icon Site Community Reference Group

The Lindsay–Wallpolla Islands Community Reference Group was established in 2008 as a requirement of The Living Murray Business Plan. The Lindsay–Wallpolla Community Reference Group and Hattah Lakes Community Reference Group have merged and meet as one group. The Community Reference Group provides a platform to seek advice and a community perspective on the communication and engagement activities proposed for the project. The Community Reference Group will continue to be engaged as an advisory body for the implementation of communication tools and actions. Membership of the group includes six representatives of the local community plus the Mallee Catchment Management Authority Board chairman. The Community Reference Group reports to the Icon Site Coordinator.

Icon Site Indigenous Reference Group

An Indigenous Reference Group was planned to be established for the icon site as a mechanism for consulting with Traditional Owner groups and obtaining advice on broader Indigenous engagement.

This group has yet to be established and in the interim representatives from the Ngintait people, Wergaia/Nyeri Nyeri people and the Mildura Aboriginal Co-operative are members of the Icon Site Management Committee.

Appendix B: Fauna guilds and breeding waterbirds — water regime class relationships

Table B.1: Water regime class use by fauna guilds

Water regime classes are abbreviated as SPW Semi-permanent wetland, TW Temporary wetland, LS Lignum shrubland, RGF River gum forest, RGW River gum woodland, BBX Black box woodland, ANB Anabranches and AP Alluvial plain.

Fauna group	Guild	Number of species and species of conservation significance	Primary water regime classes	Supplementary water regime classes	Rarely used water regime classes
Waterbirds	Dabbling ducks	6 species and 2 significant	SPW and TW	LS	LS
	Deep water divers	3 species and 3 significant	SPW and TW		LS
	Grazing Water fowl	3 species and 0 significant	SPW and TW		LS
	Large waders	4 species and 1 significant	SPW and TW		LS
	Shoreline forages	7 species and 0 significant	SPW and TW		
	Piscivores	16 species and 6 significant	SPW and TW		LS
Birds of prey	Large carnivores	2 species and 1 significant	ANB and SPW		LS
	Small carnivores	18 species and 4 significant	RGF, RGW, BBX and AP		LS
Bushbirds	Insectivores	88 species and 14 significant	RGF, RGW, BBX and AP		
	Arboreal granivores	22 species and 4 significant	RGF, RGW, BBX and AP		
	Nectivores/ Omnivores	20 species and 0 significant	RGF, RGW and BBX		
	Frugivores	3 species and 1 significant	RGF, RGW, BBX and AP		
Frogs	Terrestrial frogs	5 species and 2 significant	SPW and ANB	RGF and TW	LS
	Burrowing frogs	2 species and 0 significant	RGF and RGW		
Mammals	Aquatic mammals	1 species and 0 significant	RGF and RGW		
	Arboreal herbivores	1 species and 0 significant	RGF	RGW and BBX	
	Piscivores	1 species and 0 significant	ANB and SPW	TW	LS
	Large grazers	3 species and 1 significant	RGF, RGW and BBX	AP	
Reptiles	Aquatic reptiles	4 species and 2 significant	SPW and ANB	TW	LS
	Large carnivores	7 species and 4 significant	RGF RGW and BBX		
	Small carnivores	22 species and 3 significant	RGF, RGW, BBX LS and AP		
	Omnivores	2 species and 0 significant	RGF, RGW, BBX, LS and AP		

Fauna group	Guild	Number of species and species of conservation significance	Primary water regime classes	Supplementary water regime classes	Rarely used water regime classes
Fish	Flow-dependent	2 species and 1 significant	ANB	SPW, TW and RGF	
	Large fish	3 species and 2 significant	ANB	SPW and TW	
	Small fish	2 species and 1 significant	SPW and TW	ANB	LS
	Floodplain	1 species and 0 significant	RGF and RGW	SPW and TW	BBX and LS
	Flow-dependent	1 species and 1 significant	ANB		
Aquatic invertebrates	Wetland	1 species and 0 significant	SPW and ANB	TW	

Table B.2: Water regime class use by breeding waterbirds

Water regime classes are abbreviated as SPW Semi-permanent wetland, TW Temporary wetland, LS Lignum Shrubland, RGF Red gum forest, RGW Red gum woodland, BBX Black box woodland and AP Alluvial plain.

Common name	Breeding stimulus	Nest type	Principle breeding water regime class	Supplementary breeding water regime class	Rarely used water regime classes
Red-necked avocet	Flooding, seasonal	Ground scrape in flooded reeds	SPW	TW	LS
Black-fronted dotterel	flooding	Ground scrape in flooded reeds	SPW	TW	LS
Masked lapwing	Flooding	Ground scrape in flooded reeds	SPW	TW	LS
Red-capped plover	Flooding	Ground scrape in flooded reeds	SPW	TW	LS
Black-winged stilt	Flooding	Ground scrape in flooded reeds	SPW	TW	LS
Freckled duck	Flooding, seasonal	Platform in reeds or shrubs 1m above water	SPW	TW	LS
Black swan	Flooding	Mattress of vegetation near reeds	SPW	TW	LS
Musk duck	Seasonal	Mattress of vegetation over reeds	SPW	TW	LS
Australasian grebe	Flooding	Raft of reedy vegetation over deep water	SPW	TW	LS
Buff-banded rail	Flooding, seasonal	Platform in or on flooded reeds	SPW	TW	LS
Dusky moorhen	Flooding	Platform in or on flooded reeds	SPW	TW	LS
Purple swamphen	Flooding	Platform in or flooded reeds	SPW	TW	LS
Darter	Flooding	Stick nest in flooded trees	RGF and RGW		BBX
Little egret	Flooding, seasonal	Stick nest in flooded trees	RGF and RGW		BBX
White-necked heron	Flooding, seasonal	Stick nest in flooded trees	RGF and RGW		BBX
White-faced heron	Flooding	Stick nest in flooded trees	RGF and RGW		BBX
Great cormorant	Flooding	Stick nest in flooded trees	RGF and RGW		BBX
Little black cormorant	Flooding	Stick nest in flooded trees	RGF and RGW		BBX
Pied cormorant	Flooding	Stick nest in flooded trees	RGF and RGW		BBX

Common name	Breeding stimulus	Nest type	Principle breeding water regime class	Supplementary breeding water regime class	Rarely used water regime classes
Little pied cormorant	Flooding	Stick nest in flooded trees	RGF and RGW		BBX
Yellow-billed spoonbill	Flooding, seasonal	Stick nest in flooded trees	RGF and RGW		BBX
Australian wood duck	Flooding	Tree hollows near water	RGF and RGW		BBX
Pink-eared duck	Flooding	Tree hollows or reedy platform	RGF and RGW		BBX
Blue-billed duck	Flooding	Tree hollows or reedy platform	RGF and RGW	TW	LS
Chestnut teal	Flooding	Tree hollow or reedy platform	RGF, RGW and SPW	TW	LS
Grey teal	Flooding	Tree hollow or reedy platform	RGF, RGW and SPW	TW	LS
Australian shelduck	Flooding, seasonal	Tree hollow or reedy platform	RGF, RGW and SPW	TW	LS
Pacific black duck	Flooding	Tree hollow or reedy platform	RGF, RGW and SPW	TW	LS

Schedules

For all schedules see ←www.mdba.gov.au/programs/tlm/icon_sites/emp.→.

Schedule 1: Operating plan for Mulcra Island and Lindsay Stage 1

Schedule 2: Risk management plan for Mulcra Island and Lindsay Stage 1

Schedule 3: Condition monitoring plan for the Chowilla–Lindsay–Wallpolla icon site

Schedule 4: Communication plan

Abbreviations and acronyms

AHD	Australian height datum
CAMBA	China–Australia Migratory Bird Agreement
GL	gigalitres
JAMBA	Japan–Australia Migratory Bird Agreement
LTCE	long-term Cap equivalent
MDBA	Murray–Darling Basin Authority
MDBC	Murray–Darling Basin Commission
ML/d	megalitres a day
RoKAMBA	Republic of Korea–Australia Migratory Bird Agreement
TLM	The Living Murray

Glossary

Aquatic ecosystem	A water environment from small to large, from pond to ocean, in which plants and animals interact with the chemical and physical features of the environment.
Ecological objectives	An objective is a statement of the desired condition. It is not necessary to quantify an objective.
Ecological targets	A target is generated from the ecological objective and will ideally be quantitative.
Environmental water	Water that is available for the environment.
Environmental Watering Group	A jurisdictional committee that develops and implements the annual The Living Murray Environmental Watering Plan. The Environmental Watering Group recommends annual TLM watering priorities and proposals to ensure consistency between icon sites.
Environmental Water Management Plan	A plan that details the aims, objectives and management actions at an icon site that are in accord with The Living Murray. The plan complements state-based plans and processes.
Murray–Darling Basin Ministerial Council (Ministerial Council)	A ministerial council that develops and agrees to intergovernmental agreements, approves The Living Murray Business Plan and makes key decisions — for example, approval of the Murray–Darling Basin Authority's Natural Resource Management program's budget in the Corporate Plan.
Objective	Refer Ecological objectives.
Parameter	A measurable or quantifiable characteristic or feature.
Preferred operating strategy	Optimum operation of a structure to achieve a TLM ecological objective.
Ramsar Convention	A global treaty adopted in the Iranian city of Ramsar in 1971 that focuses on the conservation of internationally important wetlands.
River Management Division	A business unit of the Murray–Darling Basin Authority responsible for operating the River Murray system in accordance with the Murray–Darling Basin Intergovernmental Agreement. River Management Division manages the River Murray system to ensure that the available water is continuously accounted for and distributed to New South Wales, Victoria and South Australia in accordance with the Murray–Darling Basin Agreement.
River Murray Increased Flows (RMIF)	The component of the water recovered under the Snowy Water Inquiry Outcomes Implementation Deed (SWOID) that is returned to the River Murray system as an environmental flow.
Target	Refer Ecological target.
The Living Murray Committee	A jurisdictional committee responsible for implementing The Living Murray Business Plan.
Unregulated Flow	The volume of water surplus to regulated requirements and determined by the volume of flow in the River Murray exceeding (or predicted to exceed) the inlet channel capacity for Lake Victoria and entitlement flow for South Australia
Water requirements	Includes the flow, volume, timing, duration, velocity, depth, quality or any other attribute that is required to meet the ecological target.

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