VICTORIAN ENVIRONMENTAL WATER HOLDER

Seasonal Watering Plan 2013–14

VICTORIAN ENVIRONMENTAL WATER HOLDER

State Government Victoria

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Acknowledgment of Country
The Victorian Environmental Water Holder acknowledges Aboriginal Traditional Owners within Victoria, their rich culture and their spiritual connection to Country. The contribution and interests of Aboriginal People and organisations in the management of land and natural resources is also recognised and acknowledged.

Cover image: Glenelg River, by Bridie Velik-Lord
Back cover image: Sawpit Swamp, by VEWH
Pictured above: Doctors Swamp, by Jo Wood

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Foreword

I am proud to present the Victorian Environmental Water Holder's (VEWH) Seasonal Watering Plan 2013-14.

This third annual plan provides the blueprint for the Victorian environmental watering program. It is a scoping document which outlines the watering actions which may be delivered during the year, depending on seasonal conditions.

During 2012-13, Victoria's rivers, wetlands and floodplains experienced another year of average to wet conditions. Some systems experienced natural flooding, providing continued opportunity for much-needed recovery of plant and animal populations following the extended and severe drought experienced since 1997. Environmental watering in 2013-14 will largely focus on building on this environmental recovery and further enhancing the priority environmental values of Victoria's rivers, wetlands and floodplains.

Adaptively managing Victoria's Water Holdings continues to be a major focus of the seasonal watering plan. It uses a range of planning scenarios to allow decisions to be made quickly to respond to emerging conditions. This allows full advantage to be taken of opportunities, ensuring the greatest environmental benefits can be realised.

Management of the Water Holdings is focused on delivery of water to achieve environmental outcomes in priority river reaches, wetlands and floodplains. The use of management tools such as carryover and water trading are also important. However, taking advantage of these tools for environmental purposes is a relatively new undertaking and environmental water managers have much to learn in this area.

Over the past two years, seasonal conditions and water resource availability has meant the VEWH has been in a position to sell small amounts of allocation in northern Victoria, and contribute to the purchase of a small amount of allocation in southern Victoria. This emphasises the importance of trade as a tool to manage environmental water demands that vary across both space and time. As seasonal conditions unfold in 2013-14, trade opportunities will continue to be assessed and, where appropriate, undertaken in line with the VEWH's water trading business rule.

With regards to carryover, there are likely to be sufficient amounts of water carried over in most systems to provide a good starting position for the year ahead. Regardless of seasonal conditions in 2013-14, the VEWH and its delivery partners are well placed to manage the associated risks and achieve valuable environmental outcomes.

Finally, I would like to emphasise the importance of the VEWH's pivotal delivery partners, Victoria's waterway managers (catchment management authorities and Melbourne Water). Without the invaluable planning, consultation, implementation and reporting done by these dedicated organisations, Victoria's environmental watering program would not be possible. In particular, on behalf of the VEWH Commission and office, I would like to extend my sincere thanks to these waterway managers for their hard work in producing high-quality seasonal watering proposals, which are the key input for the development of this seasonal watering plan.

The VEWH looks forward to working with all our partners, including waterway managers, land managers, storage managers and other water holders, to implement this plan in 2013-14, as we all work towards improving the health of Victoria's rivers, wetlands and floodplains.

Denis Flett

Chairperson, Victorian Environmental Water Holder

Section 1

Background

This section of the plan provides some general information about the VEWH. It provides a brief outline of the VEWH's strategic programs, including the three core programs (planning, managing and reporting) and the three enabling programs (governance, relationships and engagement, and innovation and learning). Further information about these programs, including priority outputs and key performance indicators can be found in the VEWH's *Corporate Plan 2013-14 to 2016-17*.

Sections 2 to 5 provide specific information about the priority watering actions for 2013-14 for each system in Victoria for which water from the Water Holdings may be available.

1.1 Introduction

Environmental water management is a complex and evolving field. This section explains the importance of environmental watering and where the VEWH fits within the broader context of environmental water management.

The VEWH's mission is to manage Victoria's environmental Water Holdings and cooperate with partners to improve the environmental health of rivers, wetlands and floodplains.

The VEWH holds the environmental water entitlements that make up the Victorian environmental Water Holdings. The Water Holdings are held in 13 source systems for delivery to 17 receiving systems. The volume of water available from the Water Holdings varies in any given year due to seasonal conditions, including rainfall and runoff in the catchments.

Victorian river systems may also be allocated environmental water from other water holders, including partners in the Living Murray program and the Commonwealth Environmental Water Holder. It is the role of the VEWH to coordinate with other holders of environmental water entitlements to maximise the benefits for Victorian waterways, and to ensure the delivery of this water will not have any adverse impacts in Victoria (see sections 2 to 5 for more information). In most cases, these other water holders will transfer the agreed amount of water to the VEWH; it then becomes part of the Victorian Water Holdings.

Waterway managers are the key partners of the VEWH, undertaking the local planning for, implementation of and reporting on watering actions, including engaging with public land managers, storage managers and local communities.

The Water Holdings represent less than 10 percent of Victoria's broader Environmental Water Reserve (EWR). They are the component that can be actively managed, with discretion as to when, where and in what volumes water is delivered. The EWR is the term used to describe the amount of water set aside to achieve environmental outcomes. In addition to the Water Holdings, the EWR includes water provided through:

- water set aside for the environment as obligations on consumptive water entitlements held by urban and rural water corporations – these are usually called 'passing flows' that must be released from storages or provided at a particular point of a river
- 'above cap' water provided once limits on consumptive water use have been reached or due to unregulated flows and spills from storages, usually created by heavy rainfall.

Why is environmental water important?

Some benefits of **environmental flows**

(1) Stimulate fish breeding and allow fish to move within the system (2) Provide habitat for waterbirds and stimulate breeding (3) Move sediment and maintain channel shape (4) Improve water quality (5) Provide habitat for frogs (6) Regenerate instream vegetation (7) Trigger plants to seed or germinate (8) Allow movement of carbon (eg. leaf litter between floodplains and rivers) (9) Flush out salt from riverbanks and floodplains (10) Restore groundwater supplies (11) Provide social, recreational and tourism opportunities

1.1 Introduction

River systems across Victoria provide water that is important to our consumptive water supply and modern agriculture. As a result, many of Victoria's river systems have become highly regulated and now operate in a way that is significantly modified from natural conditions. For example, instead of water flowing uninterrupted from the top of a catchment to the sea, water is stored in dams and weir pools, diverted via pipelines and man-made channels, and used for towns, cities and irrigation. This regulation of water has effects on the health of Victoria's waterways.

Many plants and animals depend on water, just as humans do. For example, rivers, wetlands and floodplains support various plant communities, from in-stream reeds through to Australia's iconic river red gum forests and blackbox communities. These systems and their plant communities in turn support a range of animals such as waterbirds, fish, turtles and frogs.

These environmental values are what make Victoria's waterways so important to their local communities. It is a big part of the reason people enjoy camping, picnicking, walking or running beside them, boating, fishing or yabbying on them, or taking part in any other countless recreational activities associated with them.

This is why it is so important we continue to look after our rivers, wetlands and floodplains. And water is a major factor in this.

With significant amounts of water allocated for consumptive use, water also needs to be set aside for the environment. After determining the environmental values of most importance to the community, scientific studies are undertaken to identify the environmental flows required to protect these values. Water from the Water Holdings is then released, as best it can be, to create the recommended flow patterns. Often these releases help mimic what would have happened in a river, wetland or floodplain under natural conditions. However, it is recognised that as most river systems are highly modified, they will not be returned to a pristine condition; rather the focus is on protecting the important values that still remain.

It is not only water from the Water Holdings that is beneficial to waterways. Other types of water can also provide environmental benefits, for example:

- consumptive water en route (water on its way to being delivered to urban, rural and irrigation water users)
- system operating water (water required to be released down regulated rivers and through channels to enable water to be delivered to consumptive users)
- unregulated flows (water occurring naturally in rivers that cannot be captured in storages).

These other types of water are also considered in the development and implementation of the seasonal watering plan to ensure effective system operations, efficient use of water from the Water Holdings and to maximise environmental benefits. In many cases, timing of environmental releases can be combined with these other types of water to achieve greater environmental benefits than an environmental release alone could produce.

What does using consumptive water en route mean?

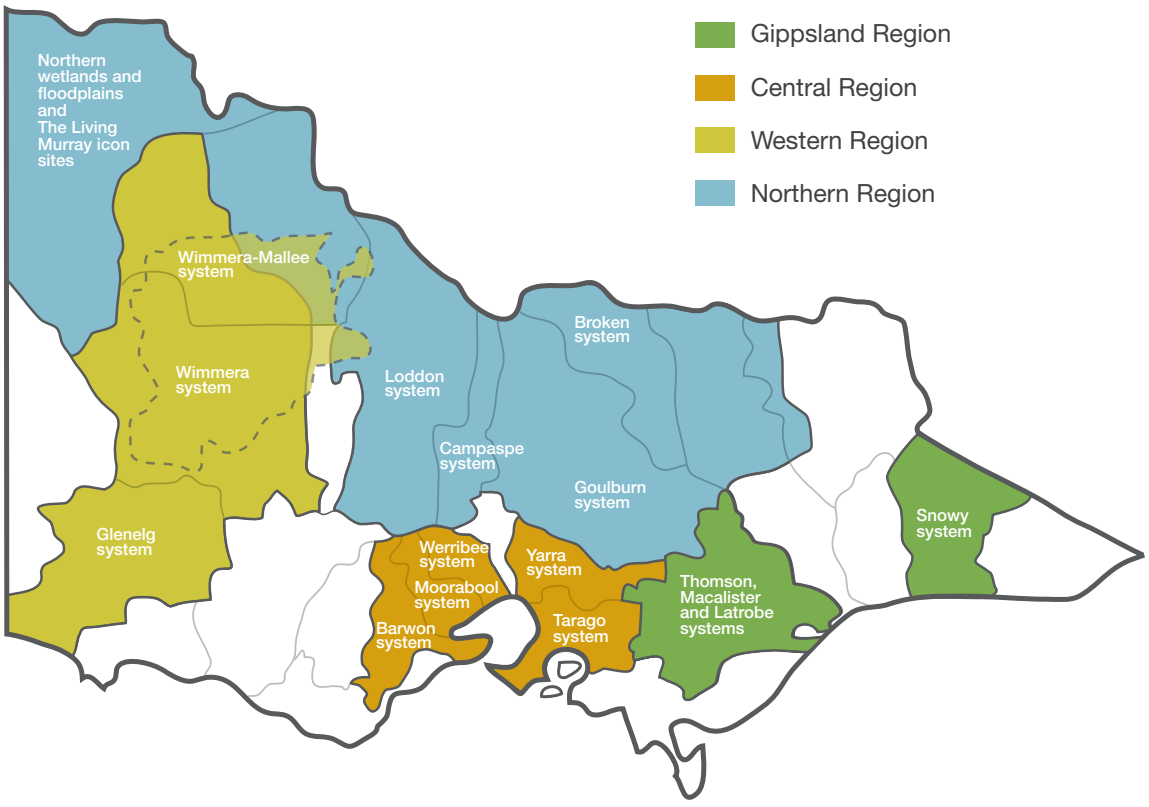
Consumptive water is water provided for all human uses (such as in the home or business and for industry and agriculture).

Rivers, creeks and wetlands are often used to deliver consumptive water from storages to water users. The timing and route of this delivery can sometimes be altered to provide environmental benefit without impacting water users. Using consumptive water en route can also involve timing environmental releases with consumptive releases to achieve greater environmental benefits than an environmental release alone could produce. For example, environmental water can be used to build on flows for irrigation to water river red gums, which often requires a very high river flow. Environmental water can also be combined with consumptive water en route to reduce its potential negative impacts. For example, using environmental water to soften the rapid increase and decrease in flows by providing a gradual ramp up and down when large releases are made.

The use of consumptive water en route can also reduce the amount of extra environmental water needed to meet specific objectives.

Some river systems connect naturally, some are connected by man-made structures, and others do not connect at all. Environmental entitlements are sourced from reservoirs in one river system but may be able to be delivered and used in a number of river reaches and wetlands, depending on the specific rules of the entitlement and the physical connectivity between systems. For example, an entitlement held in the Goulburn River may be available for use in River Murray wetlands. Figure 1.1 illustrates the systems where it is possible to deliver water from the Water Holdings.

Figure 1.1 Systems that receive water from the Water Holdings



1.2 Planning for use of the Water Holdings

Having a robust planning framework in place ensures the Water Holdings can be managed to maximise environmental benefits. This section outlines Victoria's environmental water planning framework and the other factors considered when planning the effective management of the Water Holdings.

1.2.1 Victoria's environmental water planning framework

The planning process for environmental watering in Victoria is summarised in Figure 1.2.

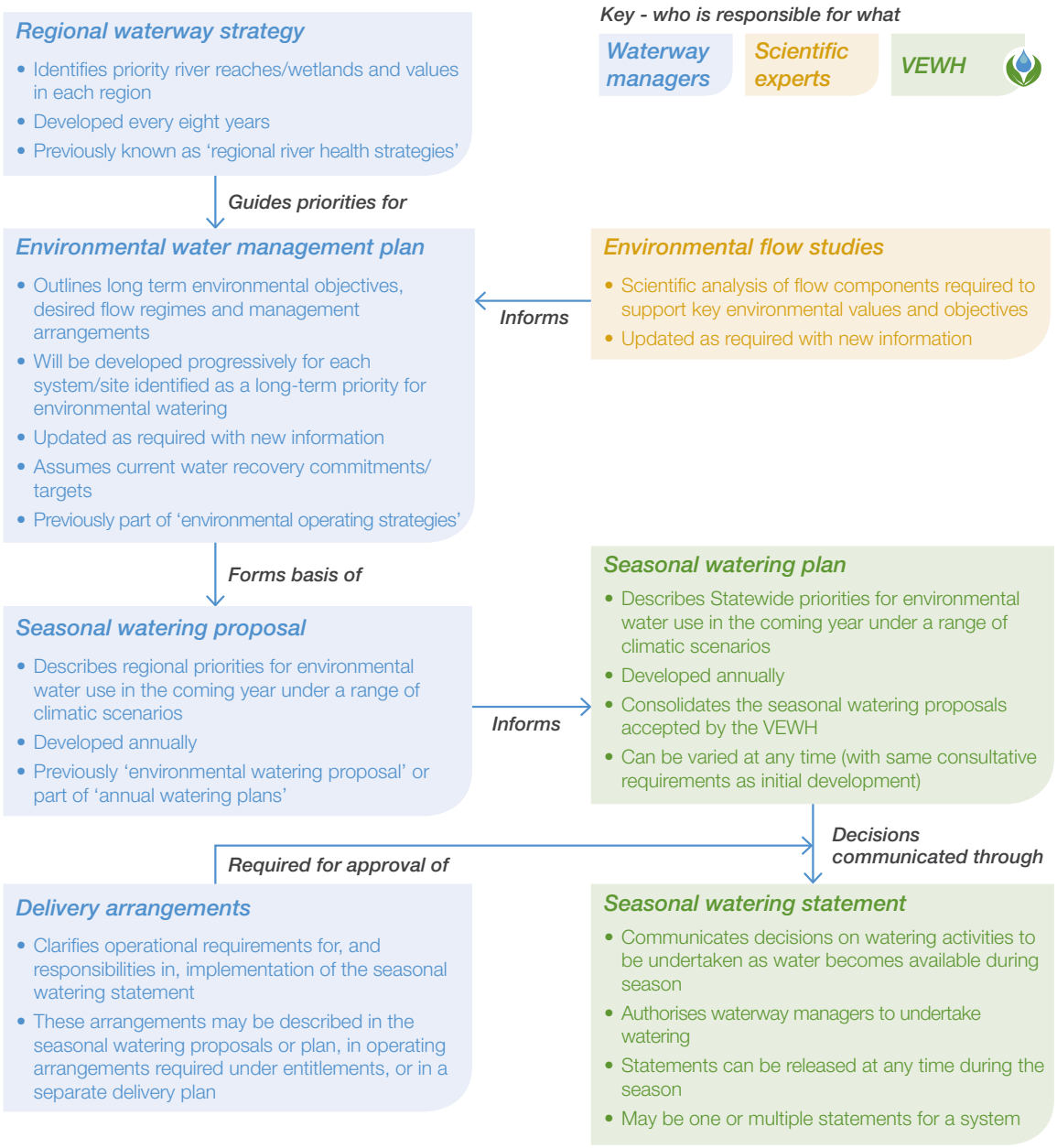
Seasonal watering proposals produced by waterway managers identify the regional priorities for environmental water use in each system under a range of planning scenarios. The proposals provide a clear rationale to directly inform the State wide priorities in the seasonal watering plan. The VEWH produces a set of guidelines for waterway managers to base their proposals on, encouraging an improved and consistent approach to environmental water planning across Victoria.

The seasonal watering proposals are informed by relevant regional waterway strategies, developed in consultation with the community and other partners. In addition, scientific studies into the magnitude, timing, duration and frequency of environmental flows required for each system (known as environmental flow studies), provide the scientific basis for seasonal watering proposals. These studies will also inform environmental water management plans which outline long term environmental objectives, desired flow regimes and management arrangements for each system, river reach and site identified as a long-term priority for environmental watering. Regional waterway strategies and environmental water management plans will be developed or refined over the next few years.

Seasonal watering proposals submitted by waterway managers have been considered by the VEWH and incorporated into this plan.

Pictured: Little Gunbower Creek, by A. Chatfield

Figure 1.2 Planning for use of Water Holdings



1.2.2 The Water Holdings

The Water Holdings are the environmental water entitlements held by the VEWH. Table 1.1 details the entitlements held by the VEWH as at 30 April 2013, including those held in trust for the Living Murray program.

Table 1.1 The Water Holdings (as at end April 2013)

System	Entitlement	Volume (ML)	Reliability
Latrobe	Latrobe River Environmental Entitlement 2011	n/a[1]	n/a
Thomson	Bulk Entitlement (Thomson River – Environment) Order 2005	10,000 n/a	High Passing flows
Macalister	Macalister River Environmental Entitlement 2010	9,346 4,672	High Low
Yarra	Yarra Environmental Entitlement 2006	17,000 55 n/a	High Unregulated Passing flows
Tarago	Tarago and Bunyip Rivers Environmental Entitlement 2009[2]	3,000[2]	n/a
Werribee	Werribee River Environmental Entitlement 2011	800[2]	n/a
Moorabool	Moorabool River Environmental Entitlement 2010[2]	2,500[2] n/a	n/a Passing flows
Barwon	Barwon River Environmental Entitlement 2011	n/a[1]	n/a
Wimmera and Glenelg	Wimmera and Glenelg Rivers Environmental Entitlement 2010[3]	41,560 n/a	High Passing flows
Goulburn	Goulburn River Environmental Entitlement 2010	1,432	High
	Environmental Entitlement (Goulburn System – Living Murray) 2007	39,625 156,980	High Low
	Environmental Entitlement (Goulburn System - NVIRP Stage 1) 2012	n/a[4]	n/a
	Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	30,252 8,156	High Low
	Water shares – Snowy River Environmental Reserve	8,036 17,852	High Low
	Silver and Wallaby Creeks Environmental Entitlement 2006	n/a	Passing flows
Campaspe	Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	126 5,048	High Low
	Campaspe River Environmental Entitlement 2013[5]	20,583 2,900	High Low
Loddon	Bulk Entitlement (Loddon River – Environmental Reserve) Order 2005[6]	3,480 7,490 2,024	High n/a Low
	Environmental Entitlement (Birch Creek – Bullarook System) 2009	100 n/a	n/a Passing flows
	Water shares – Snowy River Environmental Reserve	470	High
Murray	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999[7]	28,750 40,000	High Unregulated
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999 – Barmah-Millewa Forest Environmental Water Allocation	50,000 25,000	High Low
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999 – Living Murray	5,710 101,850 34,300	High Low Unregulated
	Environmental Entitlement (River Murray – NVIRP Stage 1) 2012	n/a[8]	n/a
	Bulk Entitlement (River Murray – Snowy Environmental Reserve) Conversion Order 2004	29,794	High
	Water shares – Snowy Environmental Reserve	14,671 6,423	High Low

Notes:

1 Use of these entitlements is dependent upon suitable river heights, as specified in both the Latrobe and Barwon environmental entitlements.

2 This volume represents the average annual entitlement volume. The entitlements consist of passing flows and a percentage share of inflows into storage (10.3 per cent – Tarago; 10 per cent – Werribee; 11.9 per cent – Moorabool), with the actual volume available in any year varying depending upon inflow conditions.

3 In addition to volumetric entitlement, the entitlement also consists of above cap water.

4 The volume available under this entitlement is equal to one-third of the total Phase 4 water savings from the Northern Victorian Irrigation Renewal Project Stage 1 achieved in the Goulburn component of the Goulburn Murray Irrigation District, as verified in the latest audit and any mitigation water available in the Goulburn system in that year.

5 Entitlement expected to be completed by 30 June 2013.

6 Amendment to include the additional 1,480 ML high-reliability entitlement expected to be completed by 30 June 2013.

7 Amendment to include the additional 1,150 ML high-reliability entitlement expected to be completed by 30 June 2013.

8 The volume available under this entitlement is equal one-third of the total phase 4 water savings from the Northern Victorian Irrigation Renewal Project Stage 1 achieved in the Murray component of the Goulburn Murray Irrigation District, as verified in the latest audit and any mitigation water available in the River Murray system in that year.

Further details about the Water Holdings can be viewed online at the Victorian Water Register (www.waterregister.vic.gov.au) or at the VEWH website (www.vewh.vic.gov.au).

1.2.3 Prioritising watering actions

It is necessary to prioritise watering actions for many reasons including: to address the variability in environmental water demand and supply from year to year; because some priority watering actions may be met naturally; or because there is not always enough water available to meet all watering demands. To address this, a flexible framework called the seasonally adaptive approach is used to plan for short-term climate variability and guide decision making. This robust planning framework involves developing scenarios that help identify and scope potential watering actions and determine the priority environmental objectives for all likely conditions. In dry conditions, priority watering actions are focused on protecting drought refuges and preventing critical or irreversible loss. In wetter conditions, the aim is to improve resilience and restore floodplain linkages.

As a result of natural connectivity and man-made channels, it is often possible to deliver water from a particular reservoir to a range of river or wetland systems. Northern Victoria is particularly connected. This interconnectivity provides the opportunity to prioritise environmental water use across systems and waterway management regions. It is the role of the VEWH to do this prioritisation. Determining priorities is most important when resources are constrained; for example, during drought periods or when there are limited funds for delivery charges. In considering seasonal watering proposals, developing the seasonal watering plan and prioritising the use of the Water Holdings, the criteria used include the:

- extent and significance of the environmental benefit expected from the watering action
  - for example, the area watered, the size of the breeding event to be triggered, the conservation status of the species that will benefit
- level of certainty of achieving the environmental benefit from the watering action and ability to manage other threats
  - for example, a flow has been provided in the past with demonstrated benefits and relevant complementary measures are being undertaken at the site
- the ability to provide ongoing benefits at the site at which the watering action is to take place
  - for example, where the management arrangements provide for watering in the long term
- the water requirements of the site at which the watering is to take place, taking into account watering history at that site and the implications of not undertaking the proposed watering action at the site
  - for example, the potential for critical or irreversible loss of important environmental values

- feasibility of the watering action
  - for example, flexibility of timing of delivery, operational requirements and constraints, and infrastructure capacity
- overall cost effectiveness of the watering action
  - for example, considering the likely benefit to be achieved against the costs of the watering action (including the volume of water to be used and any costs associated with delivery and risk management).

It is recognised that environmental watering can provide a range of environmental, social and economic benefits. In the interests of providing multiple outcomes wherever possible, opportunities to provide social and economic benefits will also be considered when prioritising watering actions, where there is no detriment to the potential environmental benefits.

1.2.4 Planning for the unknown

There are many unknown factors that can influence the planning and implementation of environmental water delivery. A number of these factors are outlined below.

Given Victoria's place in the Murray-Darling Basin, the VEWH plays a key role in planning for the delivery of Commonwealth environmental water and water from the Living Murray program. This plan specifically outlines the priority watering actions for the use of all water holders' water for environmental outcomes in Victorian river systems. However, the VEWH also acts as the intermediary for the delivery of other water holder's environmental water held in Victoria for downstream demands; for example, for the Lower Lakes in South Australia. As it is not currently possible to anticipate the specifics of these demands, it is not possible to include this detail in this plan. However, the VEWH will seek to facilitate and authorise the use of other water holder's water for environmental outcomes elsewhere, provided there are no adverse impacts on Victoria's waterways and any other risks are appropriately managed.

The VEWH may also receive water donations from individuals, community groups and other organisations, which can contribute to the priority watering actions identified in this plan. This may include: using the allocation in the system it is donated; selling the allocation to buy at a later time or in a different system; or carrying it over for a priority watering action in a future year. Some donors may wish their water to be used for a specific purpose not listed in this plan, such as a local priority watering action of importance to the donor. The benefits and cost of this would need to be weighed up by the VEWH; these types of actions may be authorised if considered beneficial.

Research proposals requiring a small volume of environmental water may be received by the VEWH throughout the year. Water may be allocated from the Water Holdings for research and development purposes where it is likely to enhance knowledge, ultimately leading to better management of the Water Holdings. Research proposals will be considered on a case-by-case basis, and water use authorised where it is considered they maximise environmental outcomes in the long term.

In some cases, environmental water may be needed for an emergency management situation or to mitigate the impacts of a natural event, including reducing the impact of natural blackwater events, preventing fish deaths or mitigating the effects of blue-green algae. It could also include smoothing the transition to or from a high natural flow event; for example, supplementing natural flows to provide a more gradual rate of 'rise and fall' to minimise the threat of river bank slumping. It is not possible to specifically plan for these events at the start of the year, and swift action is often necessary when they occur. The VEWH will liaise closely with waterway managers and storage managers who share responsibility in such situations, and may decide, while considering current water availability and priority watering actions, to use a portion of the Water Holdings to mitigate adverse environmental impacts during these emergency situations.

Due to the changing nature of each system, including evolving demands on systems and new water saving projects coming online, delivery constraints in a particular system may change during the water year. Likewise, it may be necessary for waterway managers or storage managers to undertake construction, scoping, maintenance or other works during the year. These will be taken into account as the season unfolds and delivery of environmental water adjusted as appropriate.

Priority watering actions listed in sections 2 to 5 detail the targeted flow rates which environmental water releases aim to achieve. However, actual flow rates may be slightly more or slightly less, and will likely vary day-to-day in response to variable unregulated flows and other system conditions. In addition, priority watering actions may also be delivered outside of the specified timing if conditions are considered appropriate to still achieve the environmental objectives sought.

1.2.5 Variations to the seasonal watering plan

In line with the *Water Act 1989*, the VEWH can only authorise a priority watering action where it is consistent with a seasonal watering plan. The VEWH is able to vary any section of the seasonal watering plan at any point during the water year. Variations may be required throughout the year to include new or amended entitlements, or to address any circumstances that could not have been identified at the start of the water year. Section 1.2.4 highlights some of the circumstances where it will not be necessary to vary the plan in order to authorise a priority watering action. Section 1.3.2 also highlights where a variation is not required if the delivery of priority watering actions needs to be adjusted in order to manage associated risks.

All variations will be made publicly available as separate attachments to the original plan. These will be available on the VEWH website and printed copies will be available on request from the VEWH office.

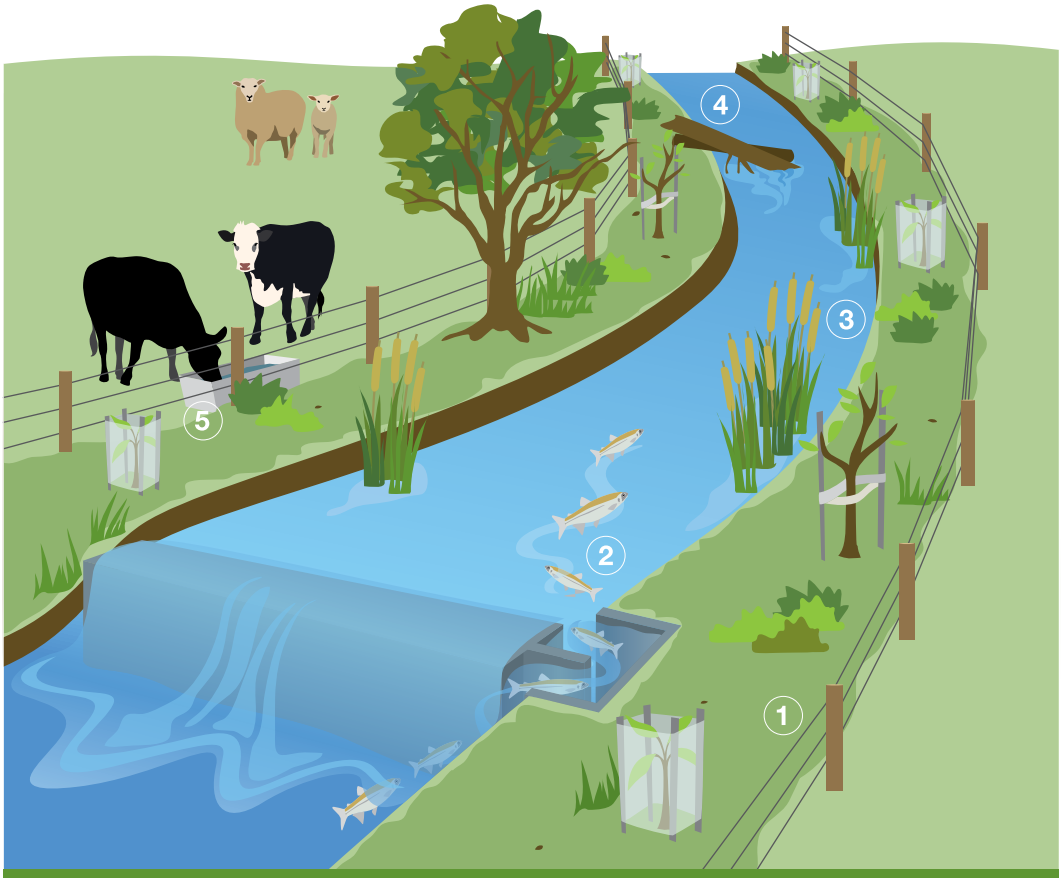
While this plan outlines the priority watering actions for 2013-14, environmental water planning is carried out over a rolling 18-24 month period. As a result, a number of priority watering actions in this plan begin before, or continue beyond 2013-14. This plan and any variations will remain valid for the 2013-14 water year, and until the subsequent seasonal watering plan is released. This ensures priority watering actions that continue beyond the 2013-14 water year can continue if there are any unforeseen delays in the release of the 2014-15 plan.

Pictured: Glenelg River, by Bridie Velik-Lord

1.2.6 Integrated waterway management

It is not only environmental flows that are important for healthy waterways. Equally important are complementary works and measures. Waterway managers are responsible for planning the integration of flows with works and measures. In part, this is done through their regional waterway strategies (see section 1.2.1).

Complementary works and measures



Complementary **works and measures**

(1) Streamside fencing to protect river bank from livestock (2) Construction of fishways to allow fish passage through weirs etc (3) Revegetation of waterways to provide habitat and prevent erosion (4) Placement of in-stream logs for bug and fish habitat (5) Creation of off-stream watering points for livestock to reduce nutrients entering the stream

1.3 Managing the Water Holdings

The effective and efficient management of the Water Holdings involves a number of processes and management tools. This section discusses the arrangements that must be in place before a priority watering action can be implemented, and how carryover and trade can be used to make the most effective use of the Water Holdings.

1.3.1 Delivering priority watering actions

The physical storage and delivery of environmental water to sites in Victoria is guided by, and subject to, a number of conditions, rules, and in some cases fees and charges. A seasonal watering statement must be issued by the VEWH before water delivery can commence.

Before issuing a seasonal watering statement to authorise a waterway manager to order the delivery of water by storage managers, the VEWH must be sure delivery arrangements are in place and that any costs to be met by the VEWH are acceptable.

Delivery details include water source, delivery route, strategies to overcome delivery constraints, local site governance, mechanism, timing and triggers for watering, water ordering process, costs and funding sources, and reporting and monitoring requirements.

Priority watering actions will be undertaken by waterway managers in accordance with seasonal watering statements, and in consultation with the appropriate storage manager and, where relevant, land manager.

Depending on the particular system and the entitlement being used, delivery arrangements might be outlined in any of the following:

- the seasonal watering plan
- seasonal watering proposals
- operating arrangements required to be developed under some entitlements
- a separate delivery plan.

Once delivery arrangements have been confirmed, environmental watering can begin. This may be via a release from an upstream storage or by diverting directly from a river or channel.

A number of seasonal watering statements issued in 2012-13 extend into the 2013-14 watering year. These statements and the watering actions they authorise are in line with watering priorities in both 2012-13 and 2013-14.

1.3.2 Risk management

A consistent risk identification and categorisation process has been adopted for the development of each seasonal watering proposal. This process assesses and rates risks relating to the implementation of priority watering actions. These risks include impacts of watering actions on third parties, unintended adverse environmental impacts of watering, and non-achievement of the environmental objectives associated with watering actions. Sections 2 to 5 outline the risks identified by waterway managers, and list the intended mitigating strategies for each.

Watering actions will not be implemented where there are unacceptable associated risks.

The risks of personal injury and flooding of private land and/or public infrastructure are of particular note and have been assessed, with associated mitigating strategies identified in all seasonal watering proposals. The VEWH and waterway managers will not flood private land without the prior consent of affected land owners. Risk management strategies will be implemented as necessary to address the risk of accidental or exacerbated flooding. If rainfall events are significant enough to create a flood threat (ie. a flood watch or flood warning being issued by the Bureau of Meteorology), environmental flows will be reduced or ceased, resuming again if required once the flood risk has passed.

Before watering actions are undertaken, waterway managers, storage managers and water holders work together to assess risks and implement mitigating strategies as necessary. A project is currently underway to develop an agreed and documented framework for risk management associated with the use of environmental water holdings in Victoria (including water from the CEWH and Murray-Darling Basin Authority [MDBA] where it is made available for use in Victoria). This framework will include the roles and responsibilities, processes and tools used by all watering partners. The project will focus on clarifying the roles and responsibilities of agencies that deliver environmental water, in line with their statutory powers and functions.

Watering actions will not be undertaken where the residual risk (ie. following the implementation of mitigating strategies) is considered unacceptable.

In some cases, the priority watering actions detailed in this plan may need to be delivered in a slightly different way; the target flow magnitude, duration, frequency, timing or even location will be adjusted as necessary in order to achieve environmental outcomes listed with minimal risk.

1.3.3 Carryover and trade

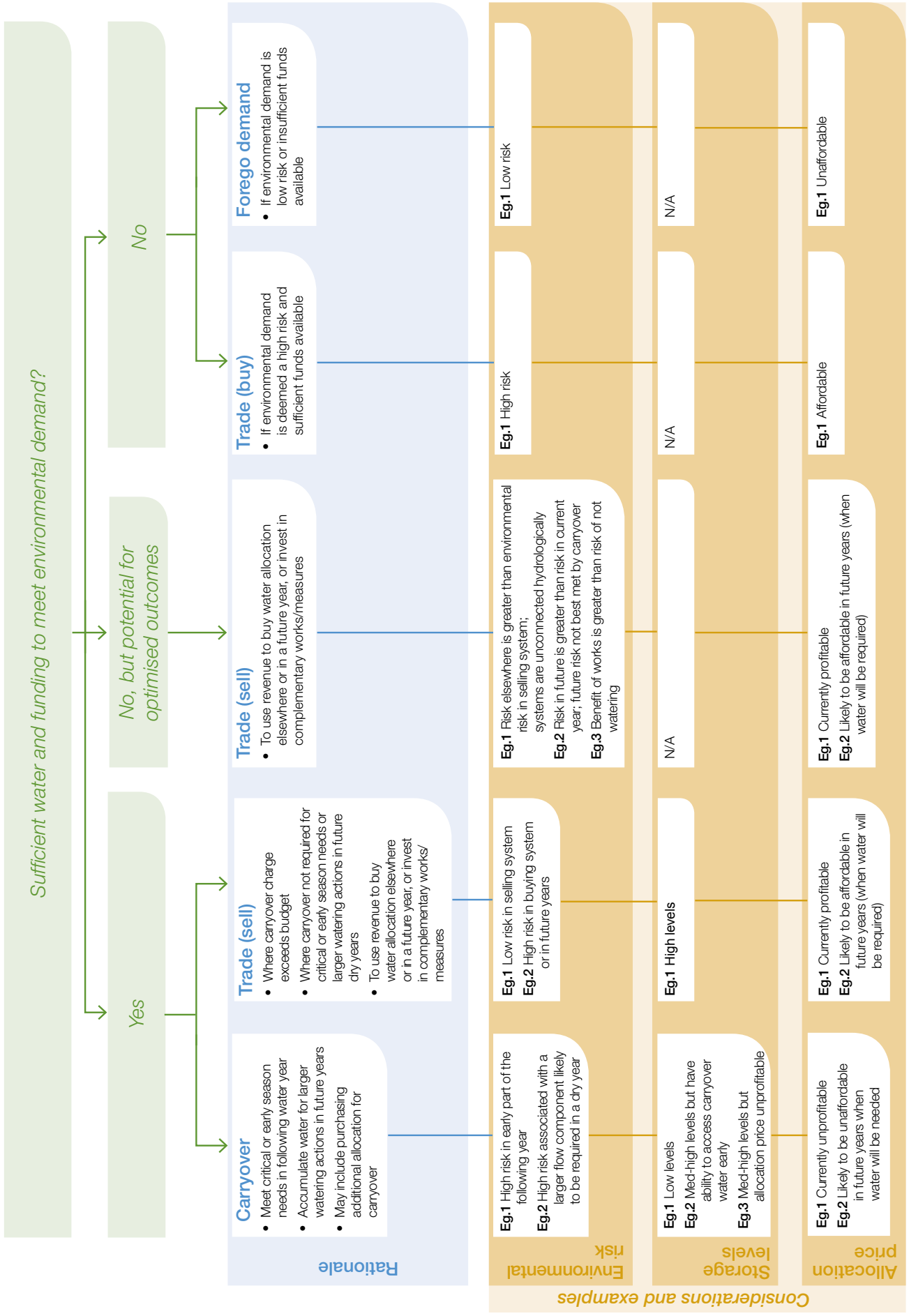
In certain circumstances, the VEWH can carry over allocation into the following water year and trade its water entitlements or allocations, consistent with the VEWH objectives – that is, the carryover or trade needs to benefit the environment. The mix of management tools including water use, carryover and trade will be used to optimise environmental benefits.

Carryover provides opportunities for more flexibility and efficiency in environmental water planning and delivery by allowing water holders to use environmental water when it is of greatest value to the environment. Water allocation left over at the end of the water year can be carried over and kept in storage for use in the following water year, subject to certain conditions.

Water trading also provides some opportunities to maximise environmental outcomes. For example, revenue raised through allocation trade may be used to purchase allocation at a different time or in a different system, to cover delivery costs associated with priority watering actions, invest in technical work to address key knowledge gaps or even to fund small priority structural works to improve water use efficiency. While the VEWH also has the power to trade its water entitlements (ie. permanent trade), subject to approval by the Minister for Environment and Climate Change, it is not anticipated that this power would be used very often.

The VEWH has developed a decision tree (outlined in Figure 1.3) to outline some of the key considerations to guide carryover and allocation trading decisions. This involves assessing the amount of water available to meet environmental demand and then considering factors such as environmental risk, storage levels and allocation price.

Figure 1.3 Key considerations in allocation trade and carryover decisions



All carryover and trade must be:

- in line with the general rules put in place by the Minister for Water (that apply to all entitlement holders)
- in line with any specific conditions in the entitlements, and any rules put in place by the Minister for Environment and Climate Change
- undertaken only to maximise environmental outcomes.

The VEWH has also developed a business rule to guide the internal decision making processes for allocation trading. This includes assessing potential third party impacts and mitigating these where possible.

In some instances, it may be appropriate for the VEWH to carry over allocation into 2014-15 or to sell some water allocation, rather than using it in the current water year. Likewise, it may be necessary to buy additional water allocation in order to complete a priority watering action in a particular system. Carryover and trade opportunities will be assessed throughout the season and undertaken only where they maximise environmental outcomes.

The VEWH must report annually on the management and use of the Water Holdings, including carryover and trade, to ensure transparency and accountability.

Pictured: Doaks Reserve, Campaspe River by Darren White

1.4 Reporting on the Water Holdings

It is important to demonstrate that environmental water has been delivered, and that this water is resulting in environmental outcomes. This section outlines the water accounting, ecological monitoring and reporting undertaken by the VEWH.

The VEWH is required to report on when, where, how and why environmental water is used. The environmental objectives of environmental watering are summarised in sections 2 to 5.

1.4.1 Water accounting

Environmental water accounting provides information on the volume of water released, delivered and used at each of the environmental watering sites, in addition to any water carried over or traded throughout the water year.

As priority watering actions are implemented, the VEWH maintains internal water accounting records to keep track of water use and the volumes remaining in the Water Holdings.

In addition, allocation bank accounts are held for most of the entitlements held by the VEWH. As water is allocated to or delivered from each entitlement, these amounts are recorded in the Victorian Water Register (www.waterregister.vic.gov.au). All carryover and trading activity conducted by the VEWH will be also recorded on the Victorian Water Register and published in the VEWH annual report.

1.4.2 Ecological monitoring

Scientific environmental flow studies demonstrate the links between particular flow components (such as freshes or overbank flows) and specific environmental outcomes (such as breeding of a priority fish species). In addition to these flow studies, the Victorian Government has developed and is undertaking the Victorian Environmental Flow Monitoring and Assessment Program (VEFMAP). This program will provide a sound scientific basis for the link between particular flow components and the ecological response.

The VEWH and waterway managers focus their monitoring efforts on actual water delivery, but may also conduct targeted ecological monitoring to improve future management decisions. To aid with this, the VEWH is currently prioritising monitoring projects to be undertaken across Victoria.

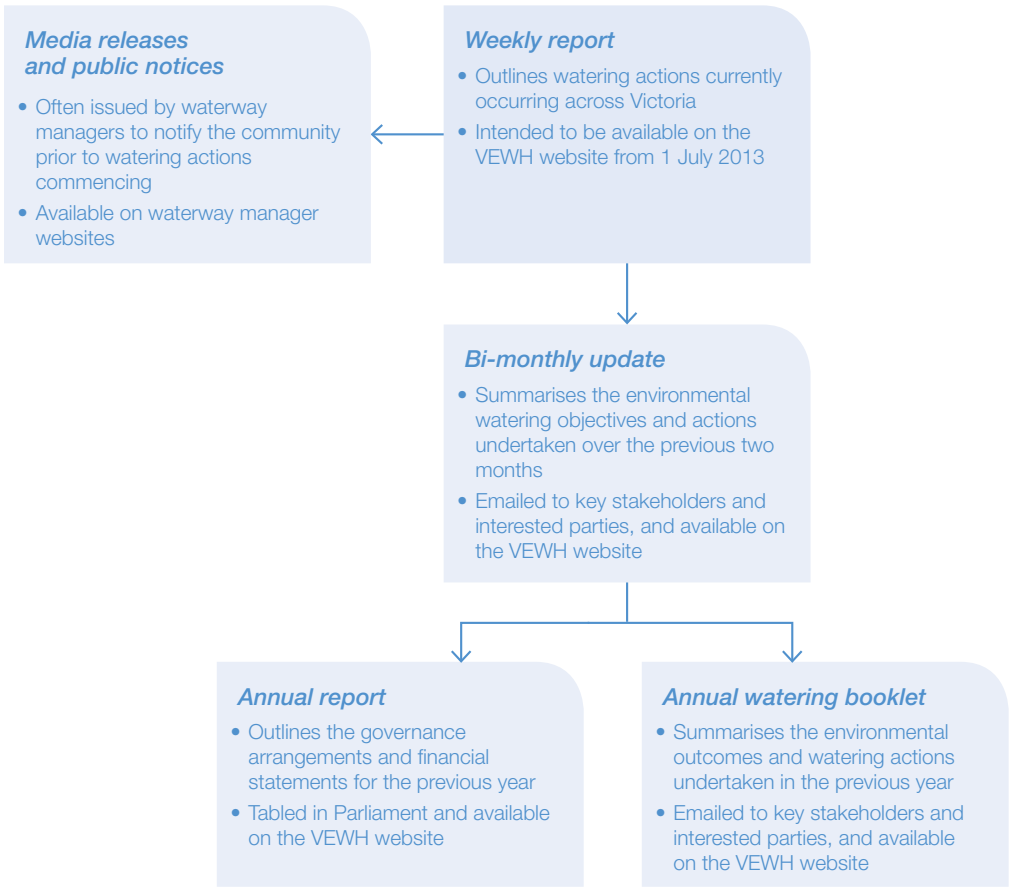
1.4.3 Reporting

The VEWH's reporting framework is outlined in Figure 1.4. The VEWH will report the management of the Water Holdings at the end of each water year in its annual report. The VEWH also contributes environmental water information to the Victorian Water Register, which is a public register of all water-related entitlements in Victoria.

In reporting on the priority watering actions that are implemented, the VEWH largely relies on information provided by waterway managers. Throughout the season, watering actions will be communicated by waterway managers through media releases and stakeholder updates targeting river operators, users, local landholders and the broader community.

This information is collated and made available on the VEWH website and in the bi-monthly watering update which reports on all use of the Water Holdings across Victoria. The environmental outcomes observed from priority watering actions will be summarised in *Reflections – environmental watering in Victoria* and in updates on the VEWH website. The VEWH will also report on environmental watering outcomes through its website, media releases and other publications as required.

Figure 1.4 Reporting on the use of Water Holdings



Information about the use of the broader Environmental Water Reserve (EWR) is available through the Monthly Water Report, (produced by the Department of Environment and Primary Industries). The Monthly Water Report provides a summary of the status of Victoria's water resources and water supplies at the end of the reporting month (http://www.water.vic.gov.au/monitoring/monthly). This information is also collated in the Department of Environment and Primary Industries' annual Victorian Water Accounts.

1.5 Governance

Good governance arrangements and practices ensure the VEWH is independent, transparent and accountable. This section describes the roles and responsibilities of the VEWH in relation to its mission and the *Water Act 1989*. It also details the VEWH's Water Holdings.

1.5.1 The role of the Victorian Environmental Water Holder

The VEWH's mission is to manage Victoria's environmental Water Holdings and cooperate with partners to improve the environmental health of rivers, wetlands and floodplains. In undertaking its mission, the VEWH:

- makes decisions on the most effective use of the Water Holdings, including use, carryover and trade
- liaises with other water holders to ensure coordinated use of all sources of environmental water
- authorises waterway managers to implement watering decisions
- publicly communicates environmental watering decisions and outcomes.
- commissions targeted projects to demonstrate ecological outcomes of environmental watering at key sites or to improve environmental water management.

The VEWH consists of three part-time Commissioners, supported by a small operations team. Denis Flett (Chairperson), Geoff Hocking (Deputy Chairperson), and Ian Penrose (Commissioner) act as a board of governance and were appointed by the Governor in Council on the recommendation of the Minister for Environment and Climate Change.

L-R - Geoff Hocking, Denis Flett and Ian Penrose

The objectives and functions of the VEWH are set out in sections 33DA-33DZA of the *Water Act 1989*.

The VEWH also acts in accordance with Victorian Government policy including:

- any rules issued by the Minister for Environment and Climate Change under section 33DZA of the Water Act
- regional sustainable water strategies
- the *Victorian River Health Strategy* (soon to be replaced by the Victorian Waterway Management Strategy).

The VEWH reports to the Minister for Environment and Climate Change. The Department of Environment and Primary Industries has a role in advising the Minister of the VEWH's performance.

1.6 Relationships and engagement

Environmental watering occurs through the collaboration of a range of agencies and individuals, ensuring it is coordinated and effective, bringing about the best outcomes for Victoria's rivers, wetlands and floodplains. This section outlines how the VEWH engages its key delivery partners (those with a role in implementing watering actions) and key stakeholders (those with an interest in inputting to watering actions) to facilitate and support effective environmental watering.

1.6.1 Environmental watering delivery partners

Delivery partners are those with a role in implementing watering actions. Figure 1.5 outlines the VEWH's key environmental watering partners.

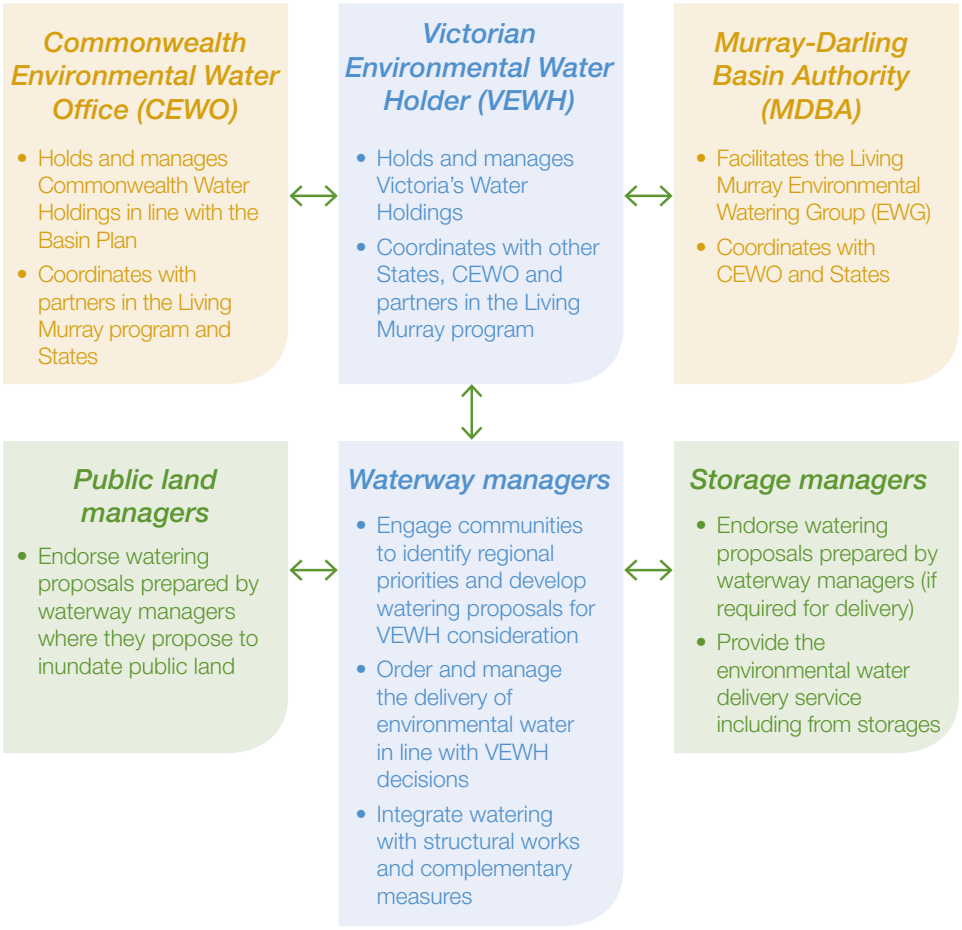
The VEWH engages directly with waterway managers through the development and implementation of the seasonal watering plan. Waterway managers are the key partners of the VEWH, undertaking the local planning for, implementation of and reporting on watering actions. In developing their seasonal watering proposals, waterway managers seek the endorsement of public land managers and storage managers to ensure that the proposed watering actions align with land management objectives and that it is feasible to deliver them within planned system operations. Waterway managers also consult with local communities on their proposed watering actions (see next section).

The seasonal watering proposals and seasonal watering plan are also provided to other water holders to ensure planning is aligned and coordinated. The VEWH works closely with other water holders, such as the Commonwealth Environmental Water Holder (through the Commonwealth Environmental Water Office), the Murray-Darling Basin Authority and other partners in the Living Murray program, to negotiate use of their water in Victorian rivers, wetlands and floodplains.

VEWH consultation and engagement activities include:

- holding a planning session with waterway managers to modify the seasonal watering proposal guidelines to facilitate improved and more consistent planning across Victoria
- holding a seasonal watering proposal conference with waterway managers, the Commonwealth Environmental Water Office and the Murray-Darling Basin Authority
- ongoing liaison with waterway managers during the development of seasonal watering proposals
- regular attendance at Environmental Water Reserve Officer Working Group and Victorian Waterway Manager Forum meetings
- ongoing involvement in the Murray-Darling Basin Authority's Environmental Watering Group, which is responsible for planning the delivery of water from the Living Murray program environmental water
- fortnightly teleconferences and regular meetings with both the Commonwealth Environmental Water Office and the Murray-Darling Basin Authority
- ongoing communication with waterway managers on the implementation and outcomes of seasonal watering statements
- Commission meetings held in regional locations twice a year, combined with environmental watering site visits to discuss existing or emerging issues and opportunities.

Figure 1.5 Key environmental watering partners in Victoria



1.6.2 Key stakeholders in environmental watering

Other stakeholders with an interest in environmental watering include environmental groups, local government, other water entitlement holders, landholders and local communities. Waterway managers are the key link between water holders and these other important stakeholders. They undertake a range of consultation activities to ensure the views of stakeholders are captured in identifying priority river reaches, wetlands and floodplains, setting priority environmental objectives and understanding the associated priority watering actions. Some stakeholders may also wish to indicate any additional benefits or potential impacts they see associated with the intended watering actions. For example, this is particularly important for landholders adjacent to watering sites.

In some systems, consultation is undertaken through the establishment of formal advisory groups; some specific to environmental watering, others more general in nature. In other systems, consultation is more targeted, with the level of consultation tailored to the level of interest and availability of particular interest groups and individuals.

The specific consultation and engagement activities undertaken by waterway managers during the development of their seasonal watering proposals and implementation of priority watering actions are detailed in sections 2 to 5 of this plan.

However, this consultation does not only occur during the development of seasonal watering proposals and implementation of the seasonal watering plan. It is also a key component of the development of: regional waterway strategies, which identify priority sites and values; and environmental water management plans, which identify long-term objectives and environmental flow requirements.

1.6 Relationships and engagement

Now that the VEWH has been established for two years, it has had a good chance to establish effective working relationships with its key delivery partners. In addition to maintaining and strengthening these relationships, the VEWH is now also focussing on improving consultation with other stakeholders with an interest in the Statewide environmental watering program. A key mechanism through which this is being done is through the establishment of a Stakeholder Information Forum. This forum provides an opportunity for Statewide or National stakeholders to share information relevant to environmental watering in Victoria and may influence how VEWH undertakes its role. The first meeting focussed on sharing information about the development of this plan and discussing any issues relating to the environmental watering program.

It is important to note that the VEWH's consultation with key stakeholders does not replace the important consultation undertaken by waterway managers on local environmental watering issues or opportunities. Any community members interested in sharing their views on local environmental watering actions are encouraged to contact their local waterway managers (see section 6.1 for contact details). The VEWH's consultation is intended to complement the waterway manager's existing consultation, with a focus on Statewide issues. Any Statewide or National stakeholder groups interested in being involved in the VEWH's Stakeholder Information Forum are encouraged to email general.enquiries@vewh.vic.gov.au.

Pictured: Brolga at Murphy's Lake, by D.Cook

1.7 Innovation and learning

A major focus of the VEWH is to take a leading role in improving the field of environmental water management. This section describes what the VEWH and its partners are doing to learn more about environmental water management to achieve greater environmental outcomes for Victoria's rivers, wetlands and floodplains.

1.7.1 Addressing knowledge gaps and constraints

Environmental water management is a relatively new endeavour. As such, there are many areas where additional information is required to enable better decision making and ultimately, better environmental outcomes.

The VEWH will work with waterway managers and other partners to address these areas as best as possible. In some cases, this may require technical work to address limitations in existing environmental flow studies. In others, it may only need the development of an environmental water management plan to pull together existing information and 'operationalise' scientific recommendations (ie. using science to develop management actions). The VEWH will continue to prioritise its investment in addressing these key knowledge gaps.

In addition, the VEWH will continue to work with the Department of Environment and Primary Industries and other policy bodies to improve environmental water policy. An example includes improving environmental water accounting policies to allow greater reuse of return flows.

There are also opportunities for waterway managers to continue to work with storage managers to adjust system operations to provide environmental outcomes, as long as there are no associated adverse third party impacts. This could include changing the pattern in which consumptive water is delivered to provide short peaks in flow, rather than constant low flows, to trigger fish breeding events. It could also include adjusting the way in which 'pre-releases' are made (ie. releases made from storage to mitigate flooding impacts), in order to minimise the environmental impacts, such as bank slumping.

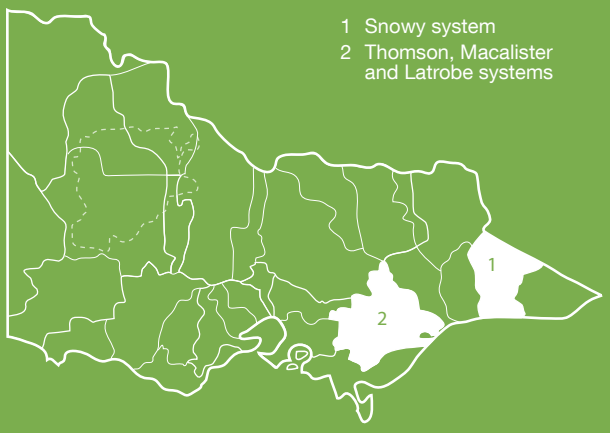
1.7.2 Adaptive management

As knowledge gaps are addressed, constraints are overcome, and as environmental water managers learn from their experiences, lessons will be incorporated into future planning.

In addition, the VEWH is in a unique position as a Statewide body, to facilitate shared learning between all waterway managers. In this way, environmental water management will continue to improve, ultimately leading to healthier rivers, wetlands and floodplains.

Section 2

Gippsland Region



Gippsland overview

There are five systems in the Gippsland Region that can receive water from the Water Holdings (see sections 2.1 – 2.5). These include the Snowy, Latrobe, Thomson and Macalister rivers, and the lower Latrobe wetlands.

The Snowy River originates in New South Wales and is connected to the River Murray in northern Victoria via a series of tunnels, pipelines and aqueducts. Water Holdings held in the Goulburn, Loddon and Murray systems are used to increase environmental flows in the Snowy River via substitution.

Water Holdings available for use in the Latrobe, Thomson and Macalister Rivers are held in Blue Rock Reservoir, Thomson Reservoir and Lake Glenmaggie respectively. The systems become linked near Sale, where the Macalister and Thomson Rivers join the Latrobe River. From here, the Latrobe River flows past the lower Latrobe wetlands (Sale Common, Heart Morass and Dowd Morass) before entering Lake Wellington.

Water Holdings available for use in the Gippsland Region are shown in Table 2.0.1.

Water Holdings in the Gippsland Region

Table 2.0.1 Water Holdings available for use in the Gippsland Region

Entitlement	Description
Snowy system	
Bulk Entitlement (Goulburn System – Snowy Environmental Reserve) Order 2004	30,252 ML high-reliability entitlement 8,156 ML low-reliability entitlement
Bulk Entitlement (River Murray – Snowy Environmental Reserve) Order 2004	29,794 ML high-reliability entitlement
Water shares	8,036 ML Goulburn high-reliability water share 17,852 ML Goulburn low-reliability water share 14,671 ML Murray high-reliability water share 6,423 ML Murray low-reliability water share 470 ML Loddon high-reliability water share
New South Wales entitlements (available for use in the Snowy system)	278,237 ML (at 1 March 2013)
Latrobe system	
Latrobe River Environmental Entitlement 2010	Access to water from the Latrobe River to inundate the lower Latrobe wetlands when river height is above -0.7m AHD at Swing Bridge gauging station
Blue Rock Environmental Entitlement (expected to be finalised by 30 June 2013)	9% share of storage inflows
Thomson system	
Bulk Entitlement (Thomson River – Environment) Order 2005[1]	Up to 10,000 ML per year Minimum passing flows at various points
Macalister system	
Macalister River Environmental Entitlement 2010	12,461 ML high-reliability entitlement 6,320 ML low-reliability entitlement

[1] Entitlement amendment expected to provide an additional 8,000 ML allocated throughout the year based on percentage of inflows. Currently awaiting funding to implement.

Consultation

West Gippsland Catchment Management Authority has engaged key stakeholders and relevant individuals in preparation of the seasonal watering proposals for the Latrobe River, lower Latrobe wetlands, Thomson River and Macalister River.

Table 2.0.2 Key stakeholders involved in the preparation of the seasonal watering proposals

Latrobe River
Latrobe Entitlement Holders Group (Latrobe Valley power generators, Southern Rural Water, Department of Treasury and Finance, West Gippsland Catchment Management Authority, VEWH, Gippsland Water)
Lower Latrobe Reference Group (West Gippsland Catchment Management Authority, Field and Game Australia, Heart Morass Committee of Management, Department of Environment and Primary Industries [Fisheries], local bird observers, commercial fishers, recreational fishers, Wellington Shire, licensed diverters, Southern Rural Water)
Southern Rural Water
Technical experts involved in the environmental flows studies previously completed for the Latrobe River (geomorphology and vegetation)
Gippsland Water
West Gippsland Catchment Management Authority Board, management and staff
VEWH
Lower Latrobe wetlands
Lower Latrobe Reference Group (as above)
Heart Morass Committee of Management (West Gippsland Catchment Management Authority, Wetlands Environmental Taskforce Trust (Field and Game Australia), Bug Blitz, Watermark
Parks Victoria
Wetlands Environmental Taskforce Trust (Field and Game Australia)
West Gippsland Catchment Management Authority Board, management and staff
VEWH
Thomson River
Melbourne Water
Southern Rural Water
West Gippsland Catchment Management Authority Board, management and staff
VEWH
Macalister River
Melbourne Water
Southern Rural Water
West Gippsland Catchment Management Authority Board, management and staff
VEWH

Triggers for action

West Gippsland Catchment Management Authority has developed a hierarchy of management actions to apply where practical. These actions will help maximise water use efficiency, minimise operating constraints and keep environmental water management aligned with local conditions:

1. Mimic natural: monitor storage inflows and respond accordingly
2. Piggy-backing: amplify or extend natural events
3. Positive action: provide an entire watering action when there is sufficient water in the Water Holdings and the action has not been provided naturally.

Throughout the season, storage inflows and streamflows will inform environmental water releases. The following factors will also be considered:

- data and reports from monitoring programs
- latest scientific knowledge, understanding and emerging issues relevant to the systems
- climatic predictions
- flow modelling and scenario evaluation tool
- ecological condition
- achievement of historical environmental flows
- entitlement allocation

Further information

More detailed information can be sought from West Gippsland Catchment Management Authority (see section 6.1).

2.1 Snowy system

Waterway manager – East Gippsland Catchment Management Authority
Storage manager – Snowy Hydro Limited

The heritage-listed Snowy River originates on the slopes of Mount Kosciuszko, draining the eastern slopes of the Snowy Mountains in New South Wales, before flowing through the Snowy River National Park in Victoria and emptying into Bass Strait. Much of the Snowy valley and its remnant vegetation and wetlands continue to be important resting, feeding and breeding areas for migratory species from tropical rainforests in south-east Asia and wetland birds from Russia, China and Japan.

System overview

The Snowy Mountains Hydro-electric Scheme was constructed in Kosciusko National Park in New South Wales between 1949 and 1974 and can store up to 5,300,000 ML which is released to generate hydro-electricity. This resulted in the diversion of 99 percent of the Snowy River's natural flow at Jindabyne Dam (see Figure 2.1.1). While meeting critical demand for electricity generation and playing a vital irrigation role for farms in the west, flow diversion and other human activities have impacted on the river's health.

Under its licence, Snowy Hydro Limited has an obligation to release annual volumes of 1,062,000 ML to the River Murray and 1,026,000 ML to the Murrumbidgee systems.

Since 2000, the New South Wales, Victorian and Commonwealth governments have committed $425 million to recover 212,000 ML for the Snowy (21 percent of average natural flows downstream of the Jindabyne Dam), plus 70,000 ML for the River Murray. In 2003, Water for Rivers was established as a joint government enterprise to undertake the water recovery. The water has been primarily recovered through irrigation modernisation projects, but also included some entitlement purchases.

A substitution arrangement is in place for Water Holdings in the Murray, Loddon and Goulburn systems to increase environmental flows in the Snowy system. Water savings in the Murray and Goulburn systems provide additional water that can be supplied for consumptive use in northern Victoria. Similar arrangements apply on the New South Wales Murray and Murrumbidgee systems. This reduces the volume of water that must be supplied from the Snowy system (ie. reduces the 1,062,000 ML per year) to the River Murray and Murrumbidgee River, thereby freeing up water for environmental flows in the Snowy.

This water recovery is now complete and the subsequent environmental water entitlements created. The Victorian entitlements are held by the VEWH in trust for the Snowy program. The VEWH manages the administrative requirements of these entitlements to ensure Victoria meets its commitments to provide water to the Snowy system but has no management role in the delivery of water to the Snowy. The VEWH oversees the substitution arrangements in the Victorian rivers, which are then reported to the New South Wales Ministerial Corporation that requests this volume of environmental water to be released by Snowy Hydro down the Snowy River. Decision making processes for this water, including the future role of the Snowy Scientific Committee which previously provided advice on the appropriate release pattern to maximise environmental benefits, are being reviewed by the New South Wales Office of Water. The VEWH will continue to input to this process to ensure continued Victorian input to these environmental water releases.

Pictured: Tulloch Ard Gorge by EGCMA

Figure 2.1.1 The Snowy system

Current situation

During 2012-13, the New South Wales, Victorian and Commonwealth governments committed 84,800 ML to be released to the Snowy River below Jindabyne Dam in September 2012. This flow mimicked the natural snow melt floods that had occurred every year prior to the construction of the Snowy Mountains Scheme.

The health of the Snowy River improved, in particular by the removal of silt and algae from the river bed.

Priority watering actions and environmental objectives

The New South Wales Office of Water has developed priority watering actions for the Snowy system during 2013-14. From September to November 2013, flows into the Snowy River will be released from Jindabyne Dam to increase the variability of the system and reflect the natural hydrological cues.

2.2 Latrobe system

2.2a Lower Latrobe wetlands

Waterway manager – West Gippsland Catchment Management Authority
Storage manager – N/A

The Latrobe wetlands are situated along the Latrobe River between its confluence with the Thomson River and Lake Wellington. They form part of the Gippsland Lakes system which is listed as a wetland of international importance under the Ramsar Convention. The lower Latrobe wetlands that can be actively managed with environmental water are Sale Common and Heart Morass on the northern floodplain and Dowd Morass on the southern floodplain.

Sale Common is the only remaining naturally freshwater wetland on public land in the Gippsland Lakes system and provides sheltered feeding, breeding and resting habitat for a diverse range of waterbirds for its relatively small size (230 ha). It is highly valued for its environmental and recreational values by the community of Sale and surrounding areas.

Heart Morass is a large 1,870 ha brackish wetland comprised of mainly private and some Crown land. It is the site of one of the largest private wetland restoration projects ever undertaken in Victoria. Its open expanses provide shallow feeding habitat for large numbers of waterbirds.

Dowd Morass is a large 1,500 ha brackish wetland. It regularly supports an important rookery of colonial nesting waterbirds.

System overview

River regulation and water extraction from the Latrobe, Thomson and Macalister rivers has reduced the frequency of small-medium floods that would naturally inundate the lower Latrobe wetlands (see Figure 2.2.1). Construction of levees, drains and filling in of natural depressions has also substantially altered wetland water movement.

For over 20 years, Parks Victoria and preceding organisations actively managed the water regimes using structures that connect the wetlands to the Latrobe River in order to mitigate the effects of reduced freshwater flow on Sale Common and Dowd Morass. Although these structures were designed to drain water from the wetland into the river; they were also used to inundate the wetland during the prolonged drought in the 2000s. Recognition of the long history of active management led to the establishment of a formal entitlement to divert 'end of system' flows into the lower Latrobe wetlands. Although the entitlement is for an unlimited volume of water, it can only be taken when the river is above -0.7 m Australian Height Datum (AHD). The Latrobe River is expected to flow higher than this for the season.

There are two regulators between Dowd Morass and the Latrobe River. They were installed in 1987 and consist of concrete culverts and associated channels. The culverts have flap-gates at either end that enable the regulator to allow water to flow into or out of the wetland, in both directions, or not at all. Structures in the Heart Morass date back decades to when the wetland was intensively farmed. They consist of culverts and constructed channels or natural low points designed to drain water from the wetland to the river. There are five structures located along the length of the wetland. The regulator connecting Sale Common to the Latrobe River has recently been upgraded.

Pictured: Lower Latrobe wetlands by WGCMA

Figure 2.2.1 The Latrobe wetland system

Current situation

The ecological condition of the lower Latrobe wetlands is influenced by the quality and quantity of flow in the lower Latrobe River, which is in turn affected by flow in the upper Latrobe, Thomson and Macalister rivers, and the water level and salinity of Lake Wellington.

The lower Latrobe wetlands were filled by natural flooding in June 2012. A series of minor floods and high river baseflows provided further inflows to Dowd and Heart Morass from July to October 2012. Wetland water levels have substantially reduced since late spring due to low rainfall and high evaporation rates, resulting in significant drawdown in all three wetlands. A partial wetting flow was actively delivered to Dowd Morass in March 2013 and Sale Common in May 2013 to prolong the inundation of these wetlands, providing important waterbird habitat.

Wetland plant and animal populations have continued their strong recovery from the Millennium drought during 2012-13. Waterbird numbers were high in winter/spring, with numbers of waterfowl in the district much higher than average for the last 20 years.

Due to the hot and dry summer and autumn, the lower Latrobe wetlands may now be providing the majority of the remaining fresh-brackish wetland habitat in the south-east of the State. Drawdown has provided opportunities for wetland plants to germinate and grow, and has opened up new shallow feeding habitat for waterbirds.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 2.2.1.

The environmental objective in 2013-14 is to consolidate and build on the benefits from the good inflow conditions experienced in 2011 and 2012, and the drawdowns in summer and autumn 2012-13. The approach will be to allow water levels to fluctuate with seasonal conditions, and undertake active watering to augment this where appropriate.

In addition to environmental objectives, these watering actions will also provide sightseeing, bird watching, eel fishing and recreational hunting opportunities.

Table 2.2.1 Priority watering actions and environmental objectives for the lower Latrobe wetlands

Priority watering action	Environmental objectives
Sale Common	
Flushing/wetting flow during winter/spring (August to November)	Discourage the spread of giant rush Encourage the spread of tall spike rush Maximise available aquatic habitat
Partial drawdown primarily during summer/autumn (December to March)	Encourage the growth and reproduction of wetland plants, particularly aquatic herbland and aquatic sedgeland
Wetting flow (anytime during season)	Provide flexibility and natural variability in active wetland watering to benefit overall environmental condition
Wetting flow during summer/autumn (December to April)	Discourage the spread of giant rush Maintain/enhance waterbird and/or wetland plant habitat
Dowd Morass	
Flushing/wetting flow during winter/spring (August to November)	Encourage colonial waterbird breeding Reduce salinity Maximise available aquatic habitat
Partial drawdown primarily during summer/autumn (December to March)	Encourage the growth and reproduction of wetland plants, particularly swamp scrub, tall marsh, aquatic herbland and brackish herbland
Wetting flow (anytime during season)	Avoid/mitigate risks to wetland plants and waterbird habitat from adverse salinity/pH conditions Provide flexibility and natural variability in active wetland watering to benefit overall environmental condition
Wetting flow during summer/autumn (February to April)	Maintain/enhance waterbird and/or wetland plant habitat
Heart Morass	
Flushing/wetting flow during winter/spring (August to November)	Reduce salinity and maintain/increase pH levels in wetland Maximise available aquatic habitat
Partial drawdown primarily during summer/autumn (December to March)	Encourage the growth and reproduction of wetland plants, particularly swamp scrub, tall marsh, aquatic herbland and brackish herbland
Wetting flow (anytime during season)	Avoid/mitigate risks to wetland plants and waterbird habitat from adverse salinity/pH conditions Provide flexibility and natural variability in active wetland watering to benefit overall environmental condition
Wetting flow during summer/autumn (February to April)	Maintain/enhance waterbird and/or wetland plant habitat

Table 2.2.2 Priority watering actions for the Latrobe wetland system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	River water level limitation	River water level limitation	River water level limitation	River water level limitation
	N/A – No volumetric limitation	N/A – No volumetric limitation	N/A – No volumetric limitation	N/A – No volumetric limitation
Sale Common				
Priority watering actions	Wetting flow (anytime) Drawdown (Jul-Jun)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Dec-Apr)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Dec-Apr)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Dec-Apr)
Possible volume required from the Water Holdings	0 - 1,300 ML	2,500 ML	850 ML	0 ML
Dowd Morass				
Priority watering actions	Wetting flow (anytime) Drawdown (Jul-Jun)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Feb-Apr)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Feb-Apr)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Feb-Apr)
Possible volume required from the Water Holdings	0 - 5,800 ML	8,500 ML	4,200 ML	0 ML
Heart Morass				
Priority watering actions	Wetting flow (anytime) Drawdown (Jul-Jun)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Feb-Apr)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Feb-Apr)	Flushing/wetting flow (Aug-Nov) Partial drawdown (primarily Dec-Mar) Wetting flow (anytime) Wetting flow (Feb-Apr)
Possible volume required from the Water Holdings	0 - 7,100 ML	10,300 ML	5,200 ML	0 ML

General triggers for undertaking watering actions in the Latrobe wetlands have been included in the regional overview for Gippsland (refer to section 2).

General principles for wetland water regimes guide the lower Latrobe wetlands' active watering throughout the season. One principle is that active management of water regimes is ecologically appropriate when consistent with local climatic conditions, as wetland plant and animal populations can respond to changes associated with climate other than, or in addition to, river flow or wetland inundation, such as temperature or atmospheric pressure. Using local climate as a watering trigger also ensures a degree of natural variability in the wetlands' water regimes.

Considerations in implementing the priority watering actions relate to the physical ability to get water from the river into the wetlands at an appropriate time, volume and quality (principally driven by climate), and the ecological benefits and risks of watering at a particular point in time. Physical considerations include water level and water quality. Ecological considerations include the condition of plant species or the presence of animal species that are the subject of the wetland's environmental objectives. The physical and ecological considerations will be monitored throughout the season to determine when priority watering actions should be undertaken.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 2.2.3 summarises these risks, and the mitigating strategies identified by the West Gippsland Catchment Management Authority.

Table 2.2.3 Risk management in the lower Latrobe wetlands

Risk type	Mitigating strategies
Improved conditions for non-native species (eg. carp)	New carp screens have been installed as part of refurbishment of Sale Common's Latrobe regulator Carp screens exist on the Dowd Morass regulators Investigate installation of carp screens on inlets to Heart Morass Environmental benefits of watering outweigh risk posed by European carp
Environmental watering causes flooding to public infrastructure	Inflows through the Sale Common's regulator will be slower than overbank flooding, minimising the likelihood of damaging infrastructure
Unable to undertake environmental watering efficiently and effectively	Develop and implement operational monitoring program Continue to explore options to progress the design and upgrade/construction of water control regulators and complementary earthworks to manage water diversion to Dowd and Heart Morasses
Key stakeholders unsupportive of environmental water action	Engage key stakeholders in the development of seasonal watering proposals, and in their implementation Ensure landholder support for environmental watering prior to proceeding with active inundation of private land in Heart Morass by establishing landholder agreements (as required by clause 10 of the Latrobe River Environmental Entitlement)
Environmental watering causes unplanned flooding of private land	Establish agreement with affected landholders
Unable to demonstrate compliance with the environmental entitlement	Develop and implement a metering program
Unable to provide evidence in meeting ecological objective	Undertake environmental monitoring to enable reporting on the effects of environmental water management and in refining understanding and management over time Document basis of decisions made throughout the year

2.2b Latrobe River system

Waterway manager – West Gippsland Catchment Management Authority
Storage manager – Southern Rural Water

The Latrobe River rises near Powell Town in west Gippsland and eventually flows into Lake Wellington, the western-most point of the Gippsland Lakes. The upper Latrobe River is ecologically healthy with endangered and vulnerable riparian vegetation communities present in all but the most modified river reach that flows through the Latrobe Valley. The river supports many fish and bird species of high conservation significance. Along with the Thomson River, the Latrobe River provides an essential source of freshwater to the Ramsar-listed Gippsland Lakes system (44 percent of annual average inflows), of which the lower Latrobe wetlands are an important component. The river also provides for boating and recreational fishing in the lower reaches.

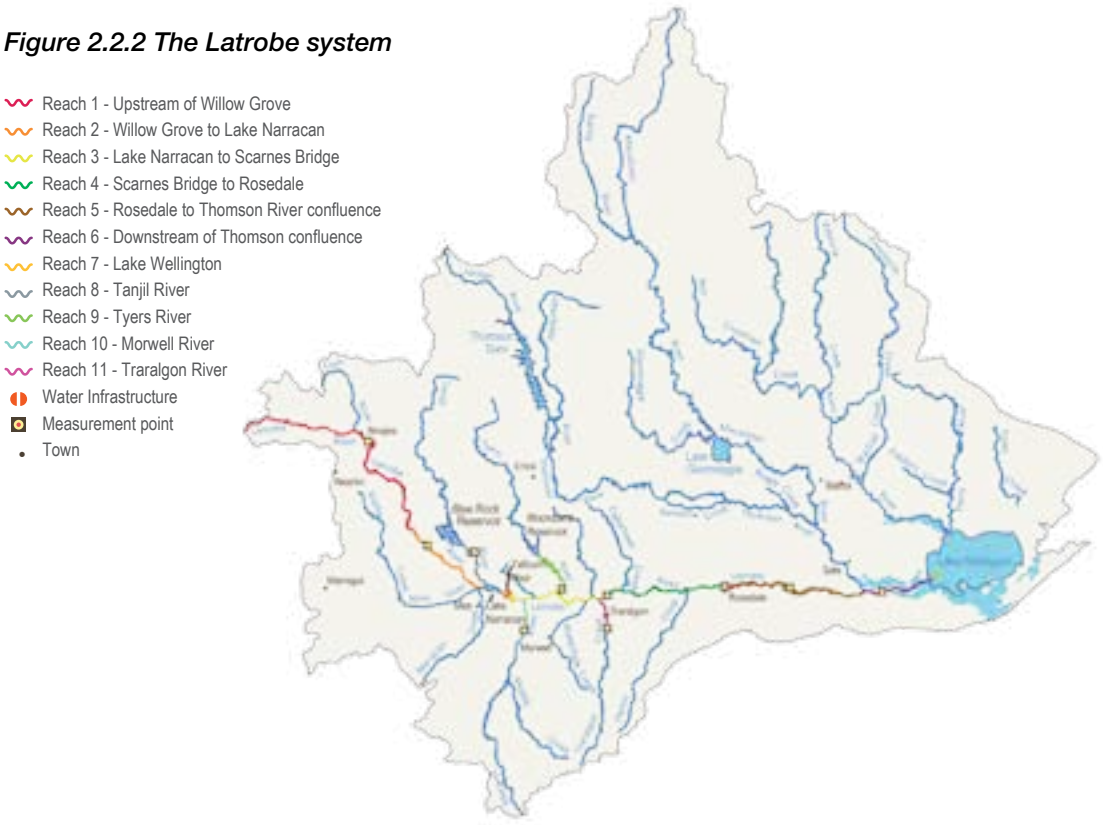
System overview

The tributaries along the length of the Latrobe include the Tanjil River, Narracan Creek, Morwell River, Tyers River, Traralgon Creek and Thomson River see (Figure 2.2.2). Environmental water is stored in Blue Rock Reservoir.

Large areas of the catchment have been cleared for major agricultural, industrial, mining and power generation activities which heavily impact the river and some of its tributaries. Significant de-snagging, straightening, floodplain drainage and channelisation have been undertaken. In addition, stock access and water regulation and extraction are ongoing pressures.

Due to its good stands of endangered riparian vegetation, the Latrobe River from Rosedale to the Thomson River confluence (reach 5) is the priority reach for active environmental watering in 2013-14. This reach has the most potential to improve its environmental condition through the use of stored environmental water. Rehabilitation of the lower reaches is important as their erosion exports nutrient and sediments to the Gippsland Lakes, which contributes to blue green algal blooms. By providing flows to this reach from Blue Rock Reservoir, additional environmental benefits will be provided to other priority reaches in the system.

Figure 2.2.2 The Latrobe system



Current situation

Rainfall over the last decade has been below average. However, during 2012-13, winter rainfall in the Latrobe system was average or above, resulting in good baseflows throughout winter and spring. Other influences on streamflow included the spilling of Blue Rock Reservoir (which started in winter 2012 and continued into spring), and the de-watering of the Yallourn mine, into which the Morwell River diversion collapsed in June 2012. Minor floods occurred in the Latrobe River during winter and early spring. During spring and summer, rainfall dropped to well below average. In response to this and drier catchment conditions, summer and autumn flows were substantially reduced.

Vegetation such as swamp paperbark, common reed and silver wattle began to establish on the lower river bank and in the river bed during the drought. Recent higher flows have encouraged this vegetation, and in many places trapped silt that will enable more in-stream vegetation to establish. This is a positive step toward stabilising the river bed, improving the quality of aquatic habitat, and reducing the exportation of sediment and nutrients to the Gippsland Lakes.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 2.2.4.

Environmental objectives focus on rehabilitation of the in-stream habitat by encouraging vegetation growth low in the river channel. This is the crucial first step to stabilising the river and improving habitat for aquatic plants and animals.

Table 2.2.4 Priority watering actions and environmental objectives for the Latrobe River

Priority watering action	Environmental objectives
Year round freshes (up to four freshes in each season of 1,300 ML per day for up to four days each in reach 5)	Encourage vegetation distribution along lower banks and recruitment/ maintenance of in-stream vegetation (watering of bank and in-stream bar vegetation is especially important in spring and summer) Flush pools to improve water quality and introduce carbon and nutrients (re-oxygenation of water is especially important in summer and autumn) Disturb river bed to flush accumulated fine sediment and organic matter Redistribute organic matter for incorporation into aquatic food webs Allow for fish movement between habitats Prevent excessive in-channel encroachment by terrestrial vegetation
Winter/spring baseflows (up to 1,500 ML per day during June to November in reach 5)	Facilitate the formation of in-stream bars Allow for fish movement between reaches Prevent excessive in-channel encroachment by terrestrial vegetation
Summer/autumn baseflows (up to 690 ML per day during December to May in reach 5)	Provide in-stream habitat for aquatic plants and animals, especially macroinvertebrates, fish and vegetation Allow for local fish movement Inundate coarse woody debris to encourage colonisation by biofilms (groups of microorganisms)

Higher flows are also important in the Latrobe system as they maintain and enhance native fish community structure and create disturbance and scour within the river channel. This may occur naturally during 2013-14, but will not be actively managed due to the volume of water required and potential flooding risk involved.

Table 2.2.5 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figure 2.2.3 illustrates the priority watering actions for 2013-14.

Table 2.2.5 Priority watering actions for the Latrobe River under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	Starting volume: 18,700 ML Share of inflows: up to 3,000 ML[1] Total: 21,700 ML	Starting volume: 18,700 ML Share of inflows: up to 4,000 ML[1] Total: 22,700 ML	Starting volume: 18,700 ML Share of inflows: up to 5,000 ML[1] Total: 23,700 ML	Starting volume: 18,700 ML Share of inflows: up to 8,000 ML[1] Total: 26,700 ML
Priority watering actions	Spring/summer freshes (one event in each season for two days each) Autumn/winter freshes (one event in each season for two days each) Winter/spring baseflows	Spring/summer freshes (two events in each season for two days each) Autumn/winter freshes (two events in each season for two days each) Winter/spring baseflows Summer/autumn baseflows	Spring/summer freshes (three events in each season for three days each) Autumn/winter freshes (three events in each season for three days each) Winter/spring baseflows Summer/autumn baseflows	Spring/summer freshes (four events in each season for four days each) Autumn/winter freshes (up to four events in each season for four days each) Winter/spring baseflows Summer/autumn baseflows
Possible volume required from the Water Holdings	12,300 ML	11,200 ML	10,800 ML	0 - 11,000 ML
Possible carryover into 2014-15	9,400 ML	11,500 ML	12,900 ML	15,700 - 18,700 ML

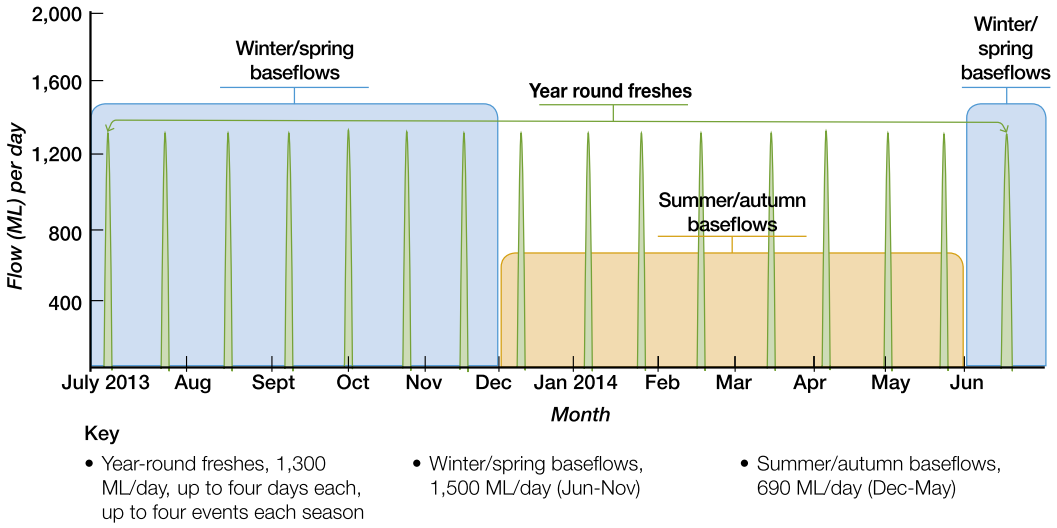
1 As the starting allocation is likely to be 100% and there is no access to additional reservoir storage space, no further allocations will be made to the entitlement until some water is released. Releases are not likely to begin until spring or summer, so the estimated annual share of inflows was discounted by around 50% to derive these figures.

General triggers for undertaking watering actions have been included in the regional overview for Gippsland (refer to section 2).

A further issue for consideration is that the duration of winter/spring baseflows may not need to span from June to November inclusive at 1,500 ML per day (as specified in Table 2.2.4). Bar formation and sediment deposition may occur during short-duration flow events, with fish movement between reaches likely when flows are at the target rate for at least five to 10 days. Therefore, there will be flexibility in how and when winter/spring baseflows will be provided.

Blue Rock Reservoir has a large storage volume. As the storage is unlikely to fill every year, the minimum desirable carryover amount should deliver the highest priority watering actions under a drought scenario in 2014-15 (approximately 12,300 ML for spring and summer freshes). Considering likely inflows over winter, about 9,300 ML should be carried over from 2013-14.

Figure 2.2.3 Priority watering actions in the Latrobe River system[1]



1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 2.2.6 summarises these risks, and the mitigating strategies identified by the West Gippsland Catchment Management Authority. Competition for outlet capacity and risk of downstream flooding are the key operating constraints. Effective implementation will require coordination by the storage manager as well as cooperation and negotiation with other entitlement holders.

Table 2.2.6 Risk management in the Latrobe River

Risk type	Mitigating strategies
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Negotiate short-term access to sufficient outlet capacity: document in operating arrangements and/or storage management rules
Release volume is insufficient in meeting required flow at target point	Monitor the flow achieved in the target reach to improve certainty in the required release volumes over time
Current recommendations on environmental flow inaccurate	Continue to apply best available scientific knowledge to environmental water management
Storage manager maintenance works affect ability to deliver water	Maintain regular contact with storage manager
Environmental water release causes personal injury to river user	Early notification to area of highest risk (along the Tanjil River) Document approach in operating arrangements
Environmental water account is overdrawn	Arrange access to the accounting system (Latrobe Bulk Entitlement Management System) and deal with this issue in operating arrangements
Environmental releases causes flooding of Crown or private land	Clarify the likely extent of inundation at the planned release rate, and develop mitigation strategies in consultation with Southern Rural Water and landholders along the lower Tanjil River; document these in operating arrangements
Key stakeholders unsupportive of environmental water release	
Unable to provide evidence in meeting ecological objective	Some basic ecological monitoring will be undertaken

2.3 Thomson system

Waterway manager – West Gippsland Catchment Management Authority

Storage manager – Melbourne Water (Thomson Reservoir); Southern Rural Water (Cowwarr Weir)

The Thomson River flows 213 kilometres in a south-easterly direction from the slopes of Mt Whitelaw on the Baw Baw Plateau to join the Latrobe River south of Sale. It is home to some of the most abundant and diverse native fish populations in the Gippsland region, with seven species of migratory fish inhabiting the river, including the protected Australian grayling. Two sections of the Thomson River (above Cowwarr Weir and the Aberfeldy River within the Baw Baw National Park) are also listed as heritage rivers for their significant environmental, recreational and cultural attributes. In addition, the river provides many recreational opportunities including camping, hiking and rafting. The Thomson Reservoir is the major storage in the system. This is integral to Melbourne's water supply, contributing approximately 60 percent of Melbourne's reservoir storage.

System overview

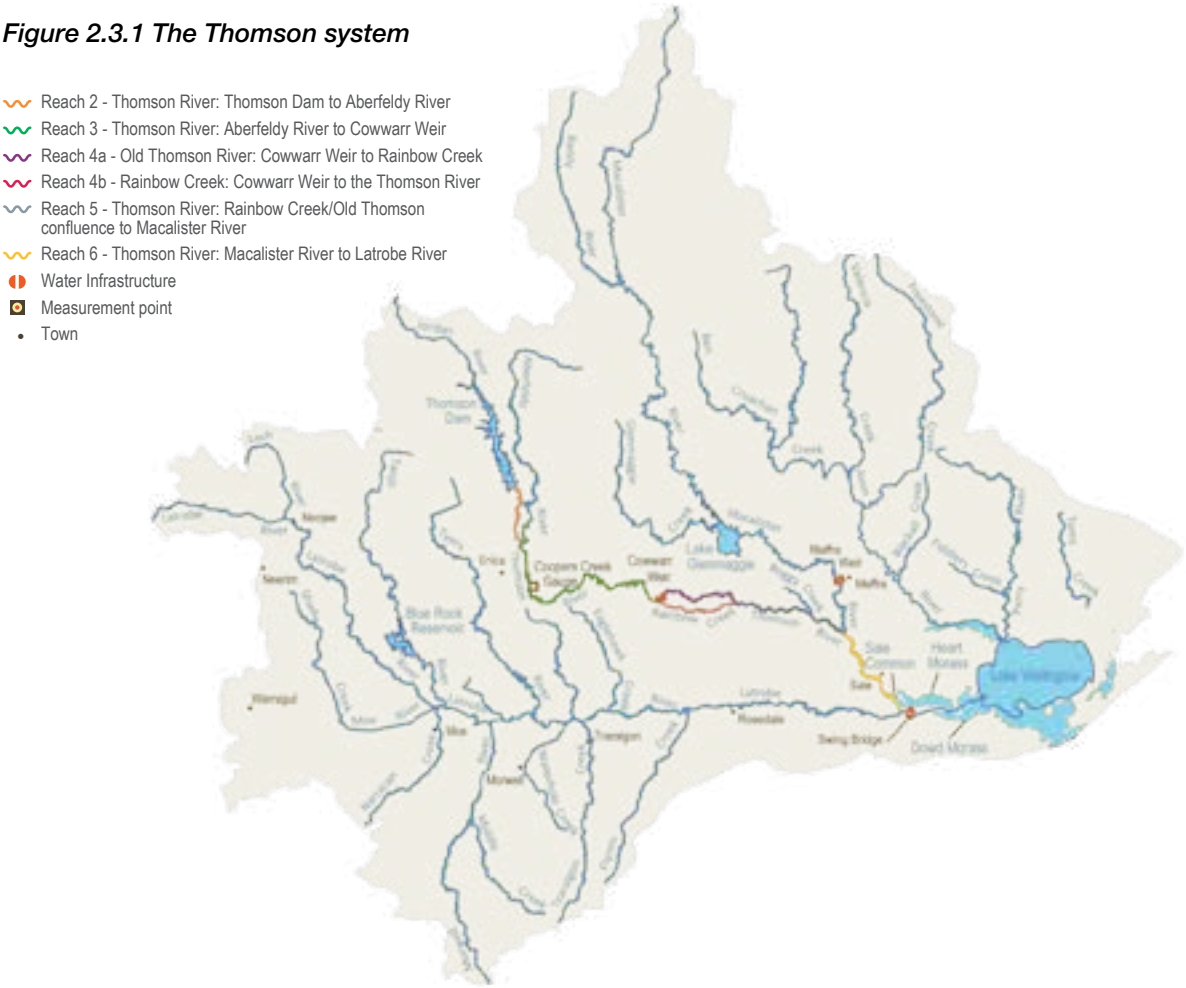
The major tributaries of the Thomson River are the Aberfeldy, Jordan and Macalister rivers, with most of its unregulated flows originating from the Aberfeldy River (see Figure 2.3.1). Extensive gold mining took place in the mountainous reaches of the river during the late 1800s, and continues today to a lesser extent. Floodplain reaches were cleared of streamside vegetation and desnagged during the development of farming activities in the region. There are two major structures on the Thomson River: the Thomson Reservoir constructed in the upper reaches during the 1980s; and Cowwarr Weir constructed at the top end of the floodplain reach in the 1950s.

The priority river reach for environmental watering in the Thomson system is from Aberfeldy to Cowwarr Weir (reach T3) due to its heritage river status, native riparian vegetation communities and fish populations including the protected Australian grayling. Other reaches benefit from flows delivered to target outcomes in reach T3. The key measurement point is at the Coopers Creek gauging station.

The environmental entitlement in the Thomson system is held in Thomson Reservoir. At Cowwarr Weir the Thomson River splits into two, and water can move down the Old Thomson course (reach T4a), and Rainbow Creek (reach T4b). The preference is to pass environmental water down the Old Thomson course to enable fish migration, as Cowwarr Weir prevents migration through the Rainbow Creek course. The lower reaches of the Thomson River have important environmental values, such as a diverse range of native fish, and the influence of environmental flow releases can be seen through these reaches.

Pictured: Thomson River by WGCMA

Figure 2.3.1 The Thomson system



Current situation

Rainfall over the last decade has been below average. However, during 2012-13, there was average or above average winter rainfall in the Thomson system, while spring and summer rainfall dropped to well below average. There were two natural overbank flow events during June 2012; however peak flows then reduced with no natural high flow events recorded between July 2012 and June 2013.

Australian grayling numbers declined during preceding seasons of low flows. Spawning flow releases (autumn freshes) were made consecutively from 2010 to 2012 and recent fish surveys have identified an increase in Australian grayling numbers.

The upper reaches contain good quality native vegetation that benefits from variable river flows, whilst downstream river banks are being fenced and revegetated to protect against erosion and improve biodiversity.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 2.3.1. Spawning and migratory flows remain a priority to help restore and enhance Australian grayling populations.

In addition to the environmental objectives, these watering actions will also provide improved recreational conditions for activities including rafting and fishing.

Table 2.3.1 Priority watering actions and environmental objectives for the Thomson system

Priority watering action	Environmental objectives
Autumn freshes (one to two events of 800 ML per day for four days each during April to May)	Maintain/enhance native fish community structure by providing a migration and spawning trigger for Australia grayling and other aquatic species Regeneration and inundation of riparian vegetation Sediment scour exposing fresh habitat areas
Spring baseflows (230 ML per day from October to November)	Maintain/enhance native fish community structure by providing habitat availability, large woody debris inundation, and fish migration cues for Australian grayling Provide opportunities for exotic fish management (particularly carp eg. drying) by exposing bed and banks
Autumn/winter baseflows (230 ML per day from May to June)	Maintain/enhance native fish community structure by providing a migration trigger for Australia grayling and other aquatic species
Spring freshes (one to two events of 800 ML per day for four days each during September to October)	Maintain/enhance native fish community structure by providing habitat availability and large woody debris inundation Provide opportunities for exotic fish management (carp eg. drying) by exposing bed and banks Regeneration and inundation of riparian vegetation Sediment scour exposing fresh habitat areas
Autumn/winter/spring freshes (four events of 800 ML per day for four days each during May to November)	
Summer/autumn freshes (seven events of 230 ML per day for three days each during December to April)	Maintain/enhance native fish community structure by providing opportunities for localised fish movement between habitats

Bankfull flows maintain and enhance native fish communities by enabling movement between habitats. This also creates disturbance and scour within the river channel, which maintains habitat conditions for aquatic life. Bankfull flows may occur naturally during 2013-14, but will not be actively managed due to the volume of water required and potential flooding risk involved.

Table 2.3.2 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figure 2.3.2 illustrates the priority watering actions for 2013-14.

Table 2.3.2 Priority watering actions for the Thomson system under a range of planning scenarios

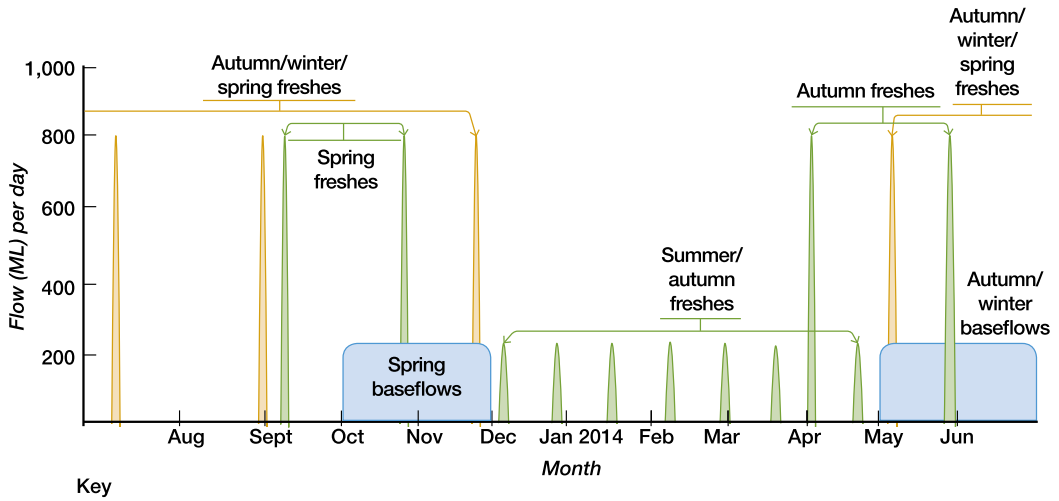
	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings[1]	10,000 - 12,000 ML	10,000 - 14,000 ML	10,000 - 18,000 ML	10,000 - greater than 18,000 ML
Priority watering actions	Spring baseflows Autumn/winter baseflows Summer/autumn freshes	One autumn fresh Spring baseflows Autumn/winter baseflows Summer/autumn freshes	One to two autumn freshes Spring baseflows Autumn/winter baseflows One to two autumn/winter/spring freshes Summer/autumn freshes	Two autumn freshes Spring baseflows Autumn/winter baseflows Two to three autumn/winter/spring freshes Summer/autumn freshes
Possible volume required from the Water Holdings	5,000 ML	10,000 ML	18,000 ML	25,000 ML
Possible carryover into 2014-15	5,000 - 7,000 ML	0 - 4,000 ML	0 ML	0 ML

1 First 10,000 ML of storage inflows allocated to environment at the beginning of the water year and 8,000 ML allocated throughout the year based on percentage of inflows. The entitlement amendment to provide the additional 8,000 ML is not finalised and the expected completion date is unclear. In addition, there may be opportunity to modify passing flows from storage for use at a later date.

General triggers for undertaking watering actions have been included in the regional overview for Gippsland (refer to section 2).

Research on Australian grayling indicates the optimal spawning period is between April and May. Due to the species' short lifespan (2-3 years), regular provision of these flows is critical for their sustainability.

Figure 2.3.2 Priority watering actions in the Thomson system[1]



Key

- 1-2 autumn freshes, 800 ML/day, 4 days each (Apr-May)
- Spring baseflows, 230 ML/day, (Oct-Nov)
- Autumn/winter baseflows, 230 ML/day (May-Jun)
- 1-2 spring freshes, 800 ML/day, 4 days each (Sep-Oct)
- 4 autumn/winter/spring freshes, 800 ML/day, 4 days each (May-Nov)
- 7 summer/autumn freshes, 230 ML/day, 3 days each (Dec-Apr)

1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 2.3.3 summarises these risks, and the mitigating strategies identified by the West Gippsland Catchment Management Authority.

Table 2.3.3 Risk management in the Thomson system

Risk type	Mitigating strategies
Storage manager maintenance works affect ability to deliver water	Ongoing dialogue with storage managers to schedule maintenance works
Limited personnel resources to deliver environmental release	Internal and external planning and information sharing on staff availability and planned releases Sufficient lead times and notifications with storage managers and stakeholders of upcoming flow release orders
Environmental release cause personal injury to river user	Adequate communication of planned flow releases
Environmental water account is overdrawn	Storage manager to maintain daily accounts and provide provisional weekly accounts during releases Passing flow savings will be held in storage and not used in discretionary releases. West Gippsland Catchment Management Authority to work with storage manager on spill and pre-release rules
Release volume is insufficient in meeting required flow at target point	Storage manager aims to meet required flow at target point as a minimum Flows are typically slightly higher than required
Current recommendations on environmental flow inaccurate	Continue to apply best available scientific knowledge to environmental water management
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Storage manager aims to meet required flow at target point as a minimum Flows are typically slightly higher than required
Environmental releases causes flooding of private land, Crown land and/or public infrastructure	Releases from Thomson Dam will remain less than 900 ML per day as per the Thomson and Macalister River Environmental Flows Taskforce recommendations to prevent flooding risk
Unable to provide evidence in meeting ecological objective	Some basic ecological monitoring will be undertaken
Key stakeholders unsupportive of environmental water release	Keep all stakeholders up to date with planned releases and monitoring outcomes through notification emails and media releases

2.4 Macalister system

Waterway manager – West Gippsland Catchment Management Authority
Storage manager – Southern Rural Water

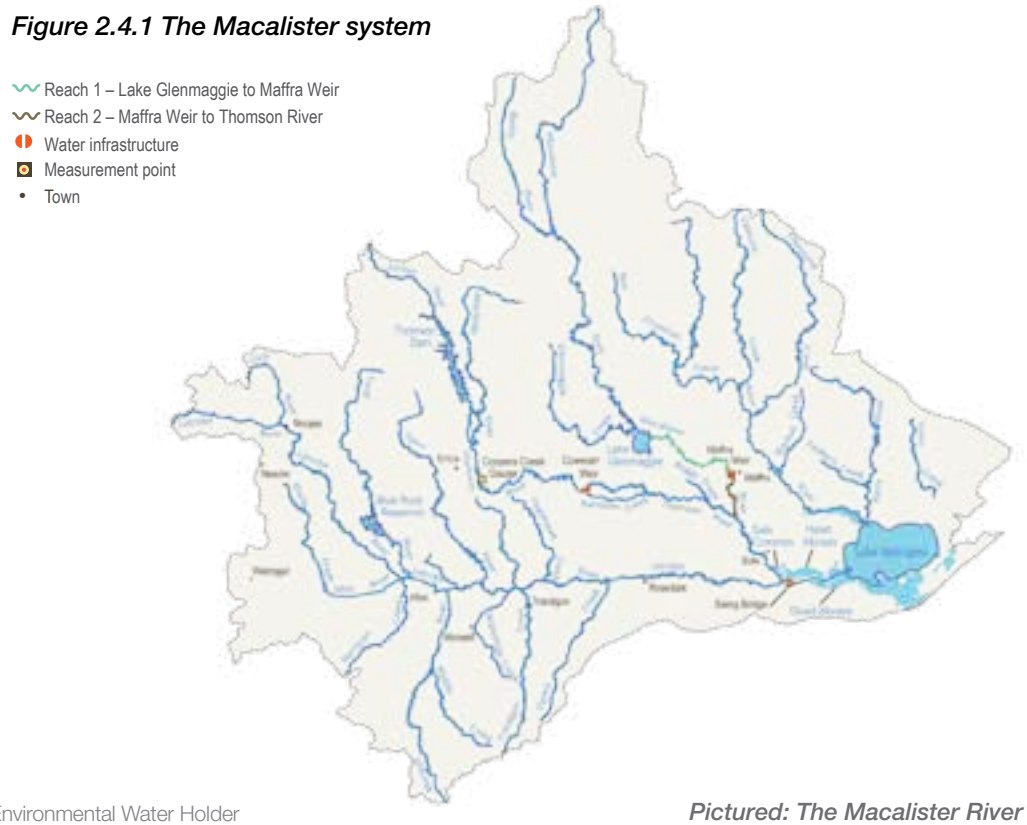
The Macalister River extends from Mt Tamboritha to join the Thomson River south of Maffra. The river is pivotal to the Gippsland Region, in part due to its supply of water to the Macalister Irrigation District – the largest irrigation area south of the Great Dividing Range, covering over 50,000 ha. The Macalister River also provides freshwater flows to the lower Latrobe River and the Gippsland Lakes. It is home to a range of aquatic plant and animal species including the protected Australian grayling. The system has high social values supporting recreational activities including rafting and fishing.

System overview

Lake Glenmaggie stores water for the Macalister environmental entitlement, therefore environmental water can only be actively managed downstream of this storage. Below Lake Glenmaggie, the Macalister River meanders through an extensively cleared floodplain to the confluence with the Thomson River. The primary land use in this section is dairy farming on irrigated pastures.

The Maffra Weir is a significant barrier to fish movement on the river; as a result, the priority reach for environmental water management is between Maffra Weir and the confluence with the Thomson River (reach M2). Diverse fish communities that use the lower Thomson River and Macalister River include the river blackfish and the protected Australian grayling. The key measuring points for environmental flow releases are immediately downstream of Lake Glenmaggie and Maffra Weir.

Figure 2.4.1 The Macalister system



Pictured: The Macalister River by WGCMA

Current situation

Rainfall over the last decade has been below average. However, during 2012-13, winter rainfall in the Macalister River was average or above average, while spring and summer rainfall dropped to well below average.

Australian grayling numbers declined during preceding seasons of low flows. Spawning flow releases (autumn freshes) were made consecutively from 2010 to 2012 and recent fish surveys have identified an increase in Australian grayling numbers.

Priority watering actions and environmental objectives

When harvesting at Lake Glenmaggie begins during autumn and winter, environmental flow shortfalls in the Macalister River occur. Priority watering actions focus on these shortfalls and target spawning and migratory flows for Australian grayling. Fish in the lower Macalister also use the Thomson system; as such, watering actions in the Macalister system complement flows in the Thomson River to achieve ecological outcomes for the Thomson, Latrobe and Macalister systems as a whole.

Potential priority watering actions along with their associated environmental objectives are provided in Table 2.4.1. In addition to environmental objectives, some of these watering actions will also provide improved recreational conditions for activities such as fishing.

Table 2.4.1 Priority watering actions and environmental objectives for the Macalister system

Priority watering action	Environmental objectives
Autumn freshes (up to three events of 350 ML per day for seven days each during April to June)	Maintain self-sustaining populations of flathead gudgeon, southern pygmy perch, Australian smelt, short-finned eel, and tupong by providing flows that target recruitment and allow fish to move between different habitats Restore self-sustaining populations of long-finned eel, Australian grayling and river blackfish by providing flows that target recruitment and allow fish to move between different habitats
Autumn/winter baseflows (140 ML per day from May to July) Spring baseflows (140 ML per day from October to November)	Maintain self-sustaining populations of flathead gudgeon, southern pygmy perch, Australian smelt, short-finned eel and tupong by providing flows to maintain habitat availability Restore self-sustaining populations of long-finned eel and Australian grayling and river blackfish by providing flows to maintain habitat availability
Summer/autumn freshes (three events of 350 ML per day for seven days each between December to April)	Maintain self-sustaining populations of flathead gudgeon, southern pygmy perch, Australian smelt, short-finned eel and tupong by providing flows that target recruitment and allow fish to move between different habitats Restore self-sustaining populations of long-finned eel, Australian grayling and river blackfish by providing flows that target recruitment and allow fish to move between different habitats
Autumn/winter/spring freshes (two events of 1,477 ML per day for nine days each during May to November)	Maintain self-sustaining populations of flathead gudgeon, southern pygmy perch, Australian smelt, short-finned eel and tupong by providing flows that target recruitment Restore self-sustaining populations of long-finned eel, Australian grayling and river blackfish by providing flows that target recruitment

Bankfull flows maintain and enhance native fish communities by enabling movement between habitats. This also creates disturbance and scour within the river channel, which maintains habitat conditions for aquatic life. Bankfull flows may occur naturally during 2013-14, but will not be actively managed due to the volume of water required and potential flooding risk involved.

Table 2.4.2 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figure 2.4.2 illustrates the priority watering actions for 2013-14.

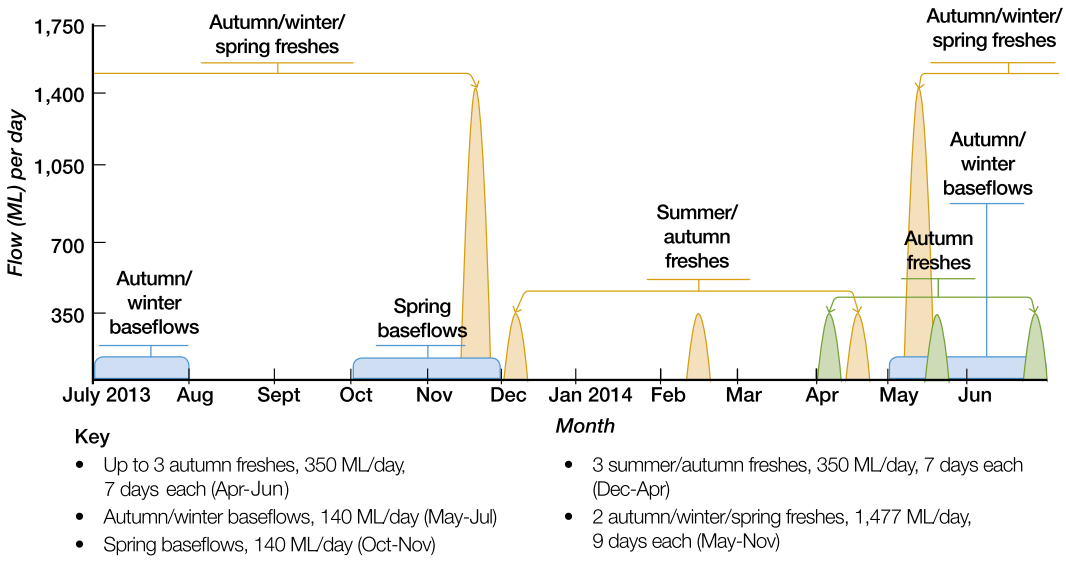
Table 2.4.2 Priority watering actions for the Macalister system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	8,000 ML	10,000 ML	14,000 ML	18,500 ML
Priority watering actions	Autumn/winter baseflows (May to July)	Two autumn freshes Autumn/winter baseflows (May to June)	Two autumn freshes Autumn/winter baseflows (May to July)	Three autumn freshes Autumn/winter baseflows (May to July)
Possible volume required from the Water Holdings	8,000 ML	10,000 ML	14,000 ML	18,500 ML
Possible carryover into 2014-15	0 ML	0 ML	0 ML	0 ML

General triggers for undertaking watering actions have been included in the regional overview for Gippsland (refer to section 2).

Lake Glenmaggie typically fills and spills each year. Any water carried over to the following year is lost in the spill. To best utilise the available water, priority watering actions exhaust the environmental water allocation for that year. Allocations are announced throughout the irrigation season with final allocations made in April prior to the highest priority watering actions.

Figure 2.4.2 Priority watering actions in the Macalister system[1]



1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

Risk assessment and management

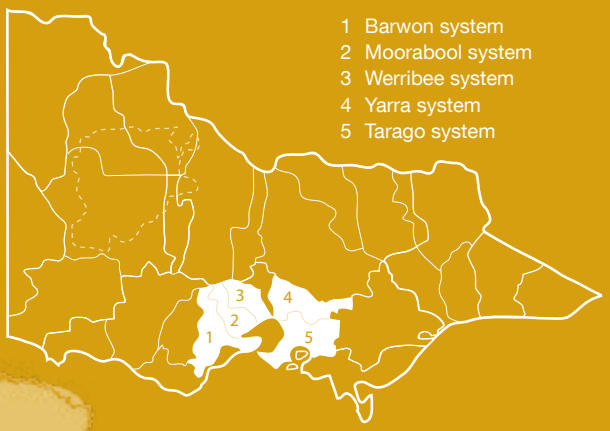
A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 2.4.3 summarises these risks, and the mitigating strategies identified by the West Gippsland Catchment Management Authority.

Table 2.4.3 Risk management in the Macalister system

Risk type	Mitigating strategies
Current recommendations on environmental flow inaccurate	Misalignment between flow magnitudes in reaches means that autumn/winter/spring fresh may not be fully realised in reach 2 A review of environmental flows recommendations should be initiated to develop a prioritised release schedule based on water availability and achievement of priority objectives
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Ongoing dialogue with storage manager to understand storage conditions and establish sophisticated release rules and planning
Storage manager maintenance works affect ability to deliver water	Ongoing dialogue with storage manager to schedule maintenance works
Limited Catchment Management Authority resources to deliver environmental release	Internal planning and information sharing on staff availability and planned releases Pre-order release if no staff available prior to release
Release volume is insufficient in meeting required flow at target point	Storage manager aims to meet required flow at target point as a minimum; flows are typically slightly higher than required
Environmental release cause personal injury to river user	Adequate communication of planned flow releases
Environmental water account is overdrawn	Storage manager to maintain daily accounts and provide provisional weekly accounts
Environmental releases causes flooding of private land, public infrastructure and/or Crown land	Request releases from Lake Glenmaggie at less than the known flooding levels
Unable to provide evidence in meeting ecological objective	Some basic ecological monitoring will be undertaken
Key stakeholders unsupportive of environmental water release	Keep all stakeholders up to date with planned releases and monitoring outcomes through notification emails and media releases

Section 3

Central Region



Central Region overview

There are five systems that can receive water from the Water Holdings in the Central Region of Victoria. These include the Yarra and Tarago systems in the east; and the Werribee, Moorabool and Barwon systems in the west.

Within southern Victoria, interconnections ensure urban water supply for Greater Melbourne and Greater Geelong. Following the completion of pending interconnections, water will move between the Thomson and the Yarra, the Yarra and the Barwon, and between the Barwon and Moorabool systems. However, the environmental water entitlements may place restrictions on these movements. The feasibility of these transfers requires exploration.

Water Holdings in the Central Region

Table 3.0.1 Water Holdings available for use in the Central Region

Entitlement	Description
Tarago system	
Tarago and Bunyip River Environmental Entitlement 2009	10.3% of inflows, after passing flows have been provided Passing flows of 12 ML per day or natural at Drouin West gauging station
Yarra system	
Yarra Environmental Entitlement 2006	17,000 ML per year Minimum passing flows at various points 55 ML per year in the Yarra River downstream of the confluence with Olinda Creek
Werribee system	
Werribee River Environmental Entitlement 2011	10% of inflows to Lake Merrimu Passing flows at Melton Reservoir
Moorabool system	
Moorabool River Environmental Entitlement 2010	11.9% of inflows to Lal Lal Reservoir Maximum use of 7,500 ML in any consecutive three-year period
Barwon system	
Barwon River Environmental Entitlement 2011	Access to water from the Barwon River to inundate the lower Barwon wetlands (Reedy Lake and Hospital Swamps) when Barwon River flows are above 0.7m AHD upstream of the Lower Barrage gauging station

Consultation

Melbourne Water and Corangamite Catchment Management Authority have engaged with key stakeholders and other relevant individuals in the preparation of the seasonal watering proposals for the Tarago River, Yarra River, Werribee River, Moorabool River and lower Barwon wetlands.

Table 3.0.2 Key stakeholders engaged in the development of the seasonal watering proposals

Tarago system
Tarago and Bunyip Rivers Environmental Flow Advisory Group including representatives from local councils, irrigators, landholders, and Landcare groups
Melbourne Water (Water Supply Operations and Strategic Planning)
Southern Rural Water
Melbourne Water Board
VEWH
Yarra system
Yarra River Environmental Flows Advisory Group including representatives from local councils, irrigators and landholders, Yarra Valley Water, Environment Protection Authority (Victoria), Yarra River Keepers, Native Fish Australia and Environment Victoria
Melbourne Water (Water Supply Operations and Strategic Planning)
Melbourne Water Board
VEWH
Werribee system
Werribee River Community Advisory Group including representatives from Western Wyndham, Melton and Moorabool Councils, 'Friends of' groups, Landcare groups and fishing clubs
Southern Rural Water and licensed diverters
Melbourne Water Board
VEWH
Moorabool system
People for a Living Moorabool (made up of community members)
Australian Platypus Conservancy
Department of Environment and Primary Industries
Southern Rural Water
Central Highlands Water
Barwon Water
VEWH
Barwon system
Lower Barwon Wetlands Advisory Group including representatives from Field and Game Geelong Branch, local landowners, community members and local commercial eel fishing licence holders
Scientific consultants
Local Member of Parliament
Department of Environment and Primary Industries (Fisheries)
Department of Environment and Primary Industries (Water Group)
Parks Victoria
Corangamite Catchment Management Authority Board, management and staff
VEWH

Triggers for action

Throughout the year, the following factors will be monitored and considered to inform the delivery of priority watering actions across central Victorian systems:

- weather forecasts
- catchment inflows and streamflow conditions
- ecological factors, such as plant and animal responses and water quality
- availability of environmental water
- relative priority of the flow being delivered, and flows still to be delivered
- critical carryover needs for future years.

In addition, decision support tools and ecological triggers have been developed to assist in adaptively managing within and between seasons.

3.1 Yarra system

Waterway manager – Melbourne Water
Storage manager – Melbourne Water

The Yarra River catchment is the largest within the Port Phillip and Westernport region, being home to over two million people (one third of Victoria's population). It is one of Victoria's most iconic waterways, covering over 4,000 square kilometres, flowing from the tranquil Yarra Valley to the heart of Melbourne's central business district at Southbank. The pristine upper reaches of the river are important water supply catchments, supplying approximately 70 percent of Melbourne's drinking water. The lower reaches provide social and recreational opportunities for more than four million people who live in and travel to Greater Melbourne. The reaches of the Yarra River support many important environmental values, including platypus and nationally-significant fish species such as the Australian grayling and the Macquarie perch.

System overview

Environmental water can be released from the Upper Yarra, Maroondah and O'Shannassy reservoirs. Tributaries to the Yarra River significantly impact the flow conditions observed through the system. In the lower reaches, tributaries such as Diamond Creek, Plenty River and Merri Creek provide additional water to the Yarra River. In the upper reaches, the system is influenced by tributaries such as the Woori Yallock Creek, Watts River and Little Yarra River. These tributaries significantly increase the volume of water passing through the river.

The Yarra River provides habitat for fish species including the protected Australian grayling and Macquarie perch. In the upper reaches, vegetation is largely intact with a range of shrubs, grasses, ground ferns and sedges in the riparian zone, and aquatic vegetation through the river channel.

In dry conditions, the priority river reaches for environmental watering are reach 2 (immediately downstream of Armstrong Creek) and reach 5 (immediately downstream of Yering Gorge). Reach 2 provides habitat for fish species, including river blackfish, spotted galaxias and common galaxias. Reach 5 contains Australian grayling and Macquarie perch, as well as river blackfish and galaxias.

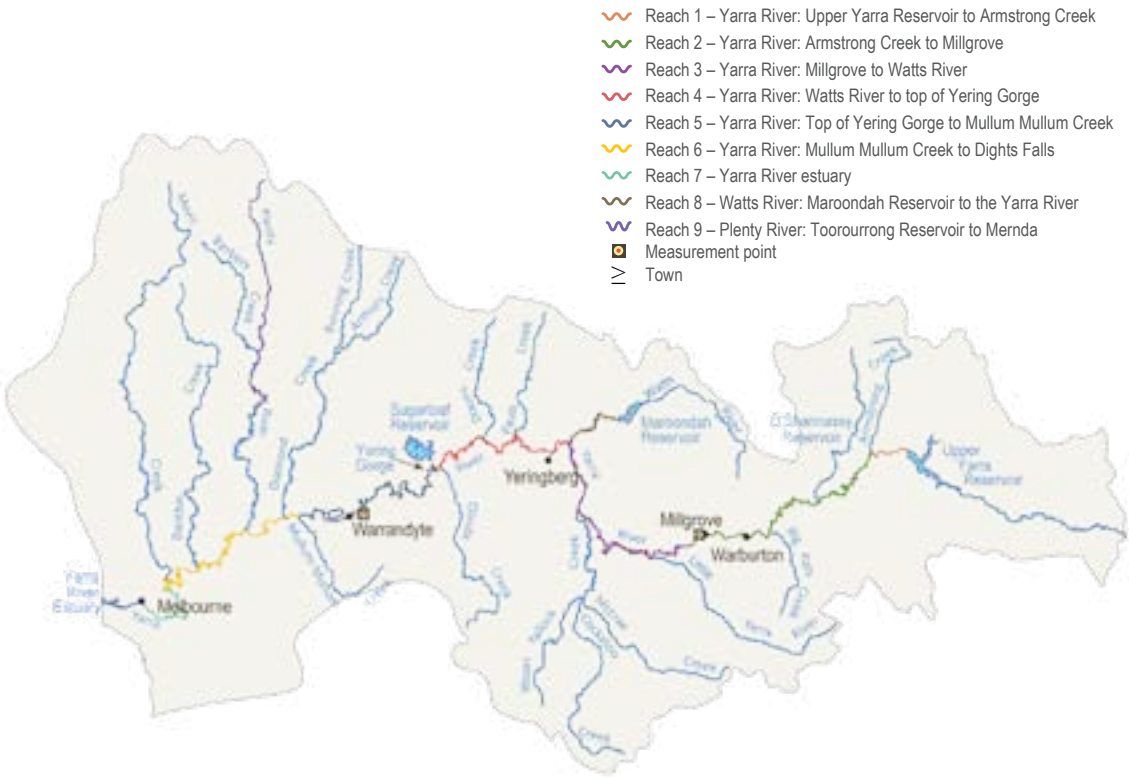
When conditions are suitable, and sufficient water is available, the whole river is a priority for watering, which includes linking these priority drought refuge reaches with the rest of the system. Measurement points for these reaches are at Millgrove in reach 2 and Warrandyte in reach 5. The environmental flow reaches for the Yarra system are shown in Figure 3.1.1. Reach 1 and the upper part of reach 2 can only receive environmental water from the Upper Yarra Reservoir. The lower part of reach 2 and reach 3 can also be supplied from O'Shannassy Reservoir, while water from Maroondah Reservoir flows into the Yarra River via Watts River at reach 4.

As well as the river itself, there are several billabongs in the Yarra system. These are an important feature of the Yarra River floodplain downstream of Millgrove and support a variety of distinct vegetation communities, providing foraging and breeding habitat for waterbirds and frogs. Except in very high flow events, the billabongs are disconnected from the Yarra River. A project is underway to investigate the water requirements of these wetlands, and identify options and feasibility of actively delivering environmental water to priority wetland sites.

Passing flows are provided at many locations in the Yarra system. Managed environmental water releases seek to build on the benefits of these passing flows.

Pictured: Yarra River, by Sarah Gaskill

Figure 3.1.1 The Yarra system



Current situation

The Yarra River experienced good streamflows throughout winter 2012, resulting in the natural achievement of a range of priority watering actions. Winter/spring high flows and freshes occurred naturally in the lower Yarra, assisting in Macquarie perch spawning and reducing terrestrial vegetation encroachment into the river channel. During this time, a winter/spring fresh was actively delivered to Reach 1 which is not strongly influenced by unregulated flows. This release resulted in improved habitat for fish and macroinvertebrates, and assisted in redistributing organic matter and fine sediment build up, mimicking the natural processes of sediment transport.

In spring and summer, streamflows declined with reduced rainfall and drier conditions. As a result, two summer freshes were actively delivered to improve habitat for fish and macroinvertebrates.

Native fish have been recorded using the newly-completed fishway at Dights Falls, which enables the migration of native fish from the Yarra River estuary to the freshwater reaches of the system. Monitoring of the fishway will continue throughout 2013-14.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 3.1.1.

The environmental objectives focus on: improving access to suitable habitats for fish and macroinvertebrates; maintaining water quality; assisting priority fish species (including Macquarie perch and Australian grayling) spawning and migration; and maintaining longitudinal connectivity for fish passage. In addition, improvement in vegetation responses through the Yarra system will be sought by providing water to inundate the low banks of the river, increasing the zone of flood-tolerant vegetation.

In addition to the environmental objectives, these watering actions will also provide recreational opportunities including walking, cycling, and water sports such as canoeing and kayaking.

Table 3.1.1 Priority watering actions and associated environmental objectives for the Yarra system

Priority watering action[1]	Environmental objective
Year-round low flows[2] (varying rates between 10 and 350 ML per day all year)	Provide fish and macroinvertebrate habitat Prevent water quality decline
Summer/autumn freshes (three to four freshes of varying rates between 60 ML and 750 ML per day for two to four days each during December to May)	Improve connectivity and access to habitat for fish and macroinvertebrates
Autumn high flows (one event of varying rates between 560 and 1,300 ML per day for seven to 14 days during April to May)	Assist Australian grayling spawning
Winter/spring freshes (one to two freshes of varying rates between 100 and 2,500 ML per day for two to seven days each during June to September)	Assist Macquarie perch spawning and support native fish migration

1 The magnitude and duration of priority watering actions depends upon the target reach, with the lower range generally occurring in the upper reaches, and higher range occurring further downstream.

2 During dry conditions, it may be necessary to supplement low flows using water from the Water Holdings. These flows are generally provided by passing flows under the environmental entitlement.

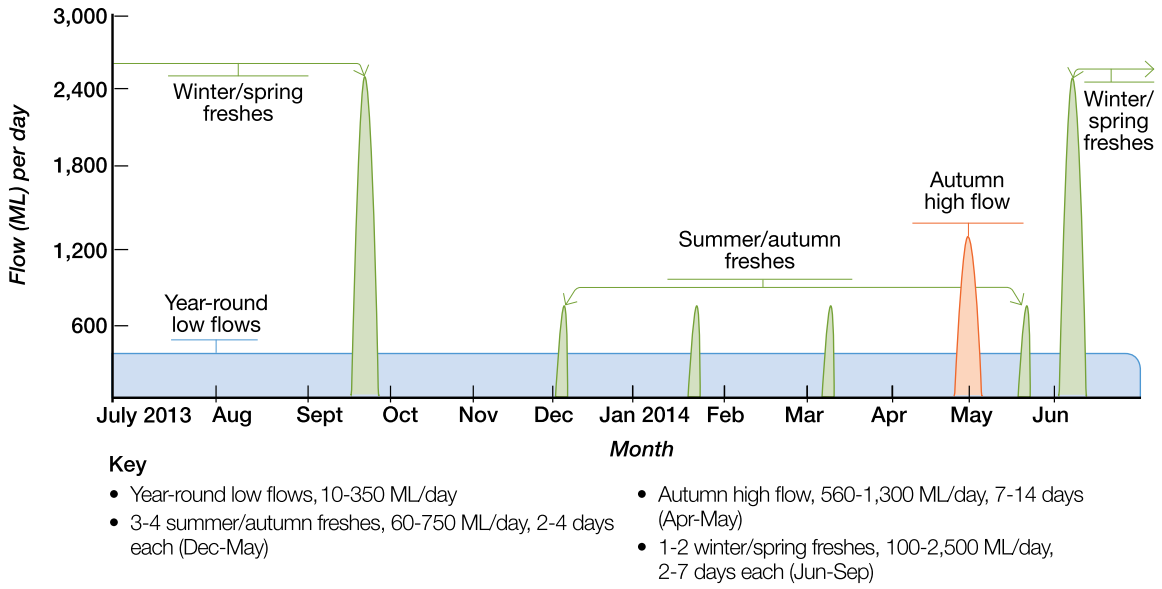
Winter/spring high flows, bankfull and overbank flows are also important to the health of the Yarra River, as identified in the scientific flow study. These flow components help maintain channel form, entrain organic matter and engage high flow channels and the floodplain. As the environmental entitlement specifies that these cannot be met through managed flows, achievement of these flow components relies solely on natural events.

Table 3.1.2 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figure 3.1.2 illustrates the priority watering actions for 2013-14.

Table 3.1.2 Priority watering actions for the Yarra system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	32,000 ML carryover 17,000 ML allocation 49,000 ML total	32,000 ML carryover 17,000 ML allocation 49,000 ML total	32,000 ML carryover 17,000 ML allocation 49,000 ML total	32,000 ML carryover 17,000 ML allocation 49,000 ML total
Priority watering actions	Year-round low flows Summer/autumn freshes when required Autumn high flows Winter/spring freshes	Year-round low flows Summer/autumn freshes Autumn high flows Winter/spring freshes	Year-round low flows Summer/autumn freshes when required Autumn high flows Winter/spring freshes Targeted billabong watering	Year-round low flows Summer/autumn freshes when required Autumn high flows Winter/spring freshes Targeted billabong watering Winter high flows and bankfull and overbank may occur naturally but will not be provided.
Possible volume required from the Water Holdings	30,000 ML	24,000 ML	28,000 ML	15,000 ML
Possible carryover into 2014-15	19,000 ML	25,000 ML	21,000 ML	34,000 ML

Figure 3.1.2 Priority watering actions in the Yarra system[1]



1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Central Region (refer to section 3).

There are several release points that can be used to deliver environmental water into the Yarra system to achieve flow rates and ecological objectives. In general, these flow rates increase with distance downstream and mimic tributary inflows. Therefore, water released in the upper reaches can be built upon to achieve objectives lower in the system. Water delivery to the lower section of the system can still happen if events are naturally achieved in the upper reaches. This provides flexibility in flow event management, and efficiently uses available environmental water.

Environmental water delivery to priority billabongs on the Yarra River floodplain may be considered during 2013-14, depending on outcomes of the water requirement investigation. If the project identifies wetlands that need watering in 2013-14 and all works to facilitate delivery are completed, a delivery plan will be confirmed before any watering action is authorised. The 55 ML unregulated product available under the Yarra environmental entitlement may be accessed to undertake these actions.

Carryover is managed as a critical drought reserve in the Yarra system. Water carried over during wet years will be used to support and protect important values. This ensures priority watering actions (such as flows that enable Australian grayling migration) can be provided, even during drought.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 3.1.3 summarises these risks, and the mitigating strategies identified by Melbourne Water.

Table 3.1.3 Risk management in the Yarra system

Risk	Mitigating strategies
Current environmental flow recommendations are inaccurate	Flow recommendations are based on the best possible science Monitoring program to identify if an ecological objective is not being achieved
Unable to provide evidence in meeting ecological objective	Monitoring program to identify if an ecological objective is not being achieved
Release volume is insufficient to meet target flows	Real time monitoring of flows at compliance points Ability to alter water orders on a daily basis
Storage manager maintenance works affect ability to deliver water	Regular communication with storage manager
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Seasonally adaptive management approach allows watering actions to be tailored to the volume of water available in the entitlement Ongoing communication with the storage manager is used to identify and overcome release capacity constraints where possible
Environmental releases cause personal injury to river user	Adequate communication of planned flow releases as detailed in the communication plan Detailed risk assessment undertaken prior to each release event
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid-sulphate soils, etc.)	Water quality monitoring Water temperature monitoring of reservoirs is available through the OLARIS website If water quality is not suitable a release will not proceed
Environmental water account is overdrawn	Accounting principles agreed on with resource manager Regular communication with resource manager Resource manager is consulted prior to all releases
Environmental releases cause flooding of private land, public infrastructure and/or Crown land	Overbank and bankfull releases have not been selected as priority watering actions due to the risk of flooding
Key stakeholders unsupportive of environmental water release	Consultation process used to consult key stakeholders during development of seasonal water proposal

3.2 Tarago system

Waterway manager – Melbourne Water
Storage manager – Melbourne Water

The Tarago River is a major tributary of the Bunyip River, which rises in the Bunyip State Forest. The headwaters of the system are within the Tarago State Forest and the river flows into the Tarago Reservoir at Neerim. Downstream of the reservoir, the Tarago flows through the towns of Rokeby and Robin Hood before meeting the Bunyip River at Longwarry North, supplying many irrigators in the catchment. The Tarago system is home to many native fish species including the protected Australian grayling, along with one of Australia's most iconic marsupials, the platypus.

System overview

Water available under the Tarago environmental entitlement is stored in and released from Tarago Reservoir.

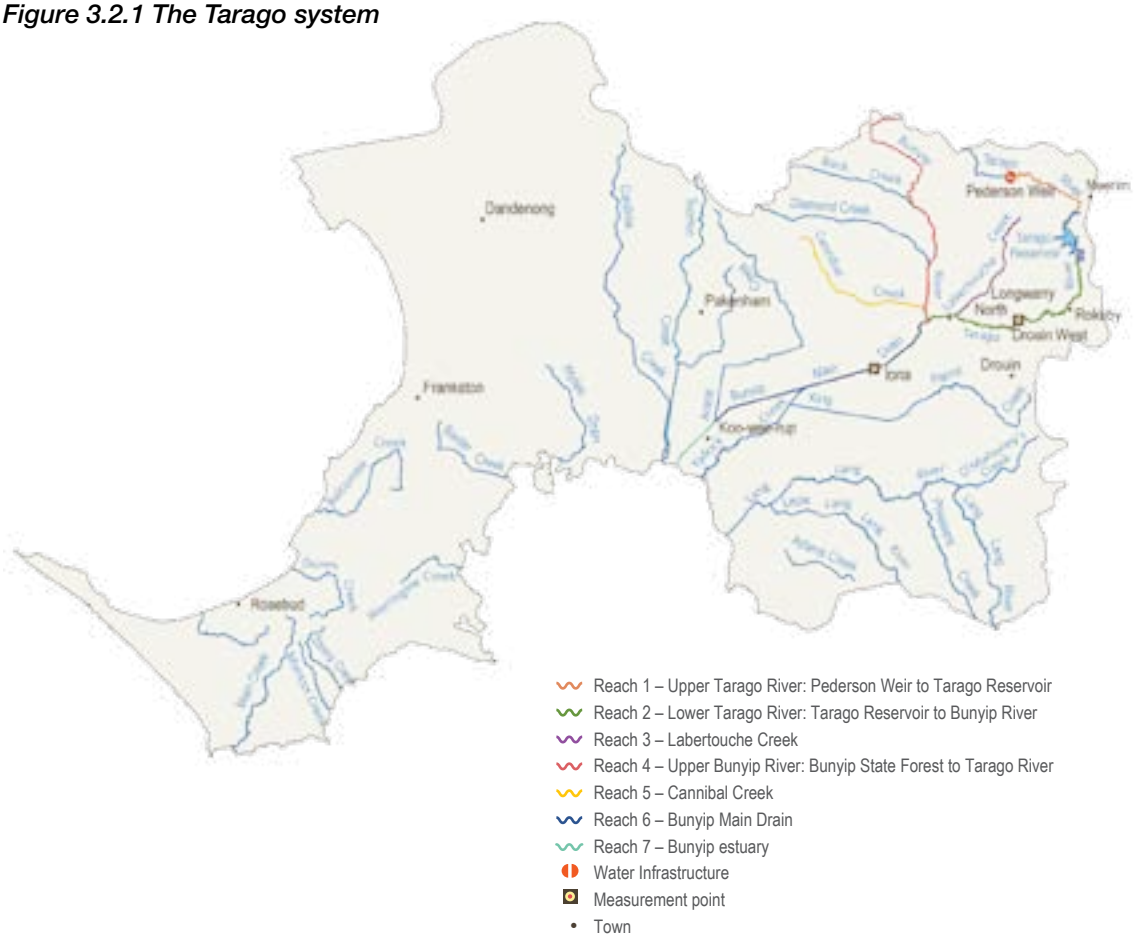
The priority reach for environmental watering is reach 2, the Tarago River from Tarago Reservoir to the Bunyip River confluence. This reach has priority environmental values and is the reach most influenced by water released from Tarago Reservoir. Some benefit will also be provided to the lower Bunyip River and the Bunyip River estuary which lie downstream of reach 2. The measurement point for target flows is at Drouin West. The environmental flow reaches are shown in Figure 3.2.1.

The Tarago system contains significant native plant and animal species, including populations of the protected Australian grayling. Threatened vegetation species such as long pink-bells, tree geebung, and swamp bush-pea can be found along some river reaches. The upper catchment contains healthy riparian vegetation and in-stream habitat diversity, supporting native fish including river blackfish and mountain galaxias. While the lower catchment has been highly modified, it contains good patches of remnant vegetation and healthy populations of Australian grayling and platypus.

Passing flows are provided at some locations in the Tarago system. Managed environmental water releases seek to build on the benefits of these passing flows.

Pictured: Tarago Reservoir environmental water release, by Helen Clarke

Figure 3.2.1 The Tarago system



Current situation

The Tarago system benefited from above average streamflows from July to October 2012. The flows discouraged the growth of terrestrial vegetation in the river channel and restored important habitat for aquatic species such as Australian grayling. Many priority watering actions were achieved naturally.

Streamflows decreased in late 2012, followed by a hot and dry summer period. During this time, environmental water was released for a spring high flow that assisted juvenile native fish migration from the estuary into the upper reaches. This event marked the first managed release of environmental water in the Tarago system. No juvenile Australian grayling were detected in fish surveys undertaken in the lower Bunyip River following this release; however, ongoing monitoring will assist in determining if any successful recruitment in the population occurred.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 3.2.1.

The environmental objectives for the Tarago system focus on: maintaining and improving aquatic species' habitat; assisting native fish spawning and migration; maintaining habitat connectivity; and discouraging terrestrial vegetation encroachment into the channel.

In addition to the environmental objectives, these watering actions will also provide improved visual amenity at various picnic areas and nature reserves along in the Tarago system.

Table 3.2.1 Priority watering actions and associated environmental objectives for the Tarago system

Priority watering action	Environmental objective
Summer/autumn freshes (five events of 100 ML per day for four days each during December to May)	Prevent vegetation growing on sand bars, encourage scour hole creation, and improve habitat availability for aquatic species
Autumn high flow (one event of 100 ML per day for two days between April and May)	Spawning of Australian grayling
Spring high flow (one event of 280 ML per day for four days between late October and December)	Migration of Australian grayling, and inundation of barriers, providing for fish passage
Winter/spring freshes (up to four events of 280 ML per day for three days between June and November)	Generate habitat variability, prevent sedimentation, and provide sufficient depth for fish passage
Summer/autumn low flows (12 ML per day from December to May)[1]	Maintenance of water quality and provision of habitat for river blackfish, Australian grayling, platypus, and macroinvertebrates

1 Year-round low flows are generally provided by passing flows under the environmental entitlement however, during dry conditions it may be necessary to supplement these flows using water from the Water Holdings.

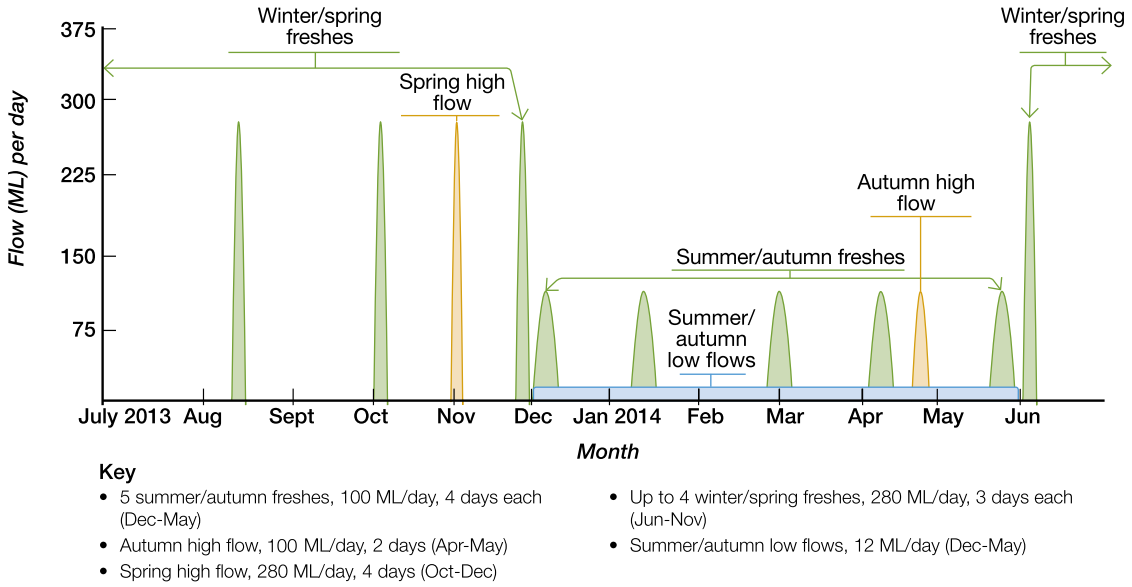
Bankfull and overbank flows generate and maintain scour holes to create habitat, and help establish riparian vegetation. This may occur naturally during 2013-14, but will not be actively managed due to the volume of water required, infrastructure constraints and potential flooding risk.

Table 3.2.2 outlines the priority watering actions and expected water usage for the Tarago system under a range of planning scenarios. Figure 3.2.2 illustrates the priority watering actions for 2013-14.

Table 3.2.2 Priority watering actions for the Tarago system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	1,000 - 1,700 ML carryover 200 ML allocation 1,200 - 1,900 ML total	1,000 - 1,700 ML carryover 500 - 1,000 ML allocation 1,500 - 2,700 ML total	1,000 - 1,700 ML carryover 1,000 - 2,200 ML allocation 2,000 - 3,900 ML total	1,000 - 1,700 ML carryover 2,200 - 3,500 ML allocation 3,200 - 5,200 ML total
Priority watering actions	Summer/autumn low flows Summer/autumn freshes	Summer/autumn freshes Autumn high flow	Summer/autumn freshes Autumn high flow Spring high flow (partial achievement)	Summer/autumn freshes Autumn high flow Spring high flow Winter/spring freshes
Possible volume required from the Water Holdings	1,000 ML	1,000 - 1,500 ML	1,000 - 2,700 ML	0 - 3,500 ML
Possible carryover into 2014-15	200 - 900 ML	500 - 1,200 ML	1,000 - 1,200 ML	1,000 - 1700 ML

Figure 3.2.2 Priority watering actions in the Tarago system[1]



Key

- 5 summer/autumn freshes, 100 ML/day, 4 days each (Dec-May)
- Autumn high flow, 100 ML/day, 2 days (Apr-May)
- Spring high flow, 280 ML/day, 4 days (Oct-Dec)
- Up to 4 winter/spring freshes, 280 ML/day, 3 days each (Jun-Nov)
- Summer/autumn low flows, 12 ML/day (Dec-May)

1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Central Region (refer to section 3).

The scientific flow study for the Tarago system was reviewed in 2013, resulting in increases to several environmental flow recommendations. This included extending the duration of spring high flows, which target the migration of Australian grayling. The new recommendations require substantially more water than the previous recommendations. Due to the high volume of water required to provide the full high flow events, under average or drier conditions, spring high flow events will be managed to a reduced duration of one day, in line with recommendations identified in the 2007 environmental flow study.

The VEWH has been granted access to available 'airspace' (temporarily unused storage) in Tarago Reservoir to store additional water on a trial basis throughout 2013-14, subject to conditions. This airspace will provide security and improve flexibility in achieving environmental objectives, particularly in dry years when water availability is low.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 3.2.3 summarises these risks, and the mitigating strategies identified by Melbourne Water.

Table 3.2.3 Risk management in the Tarago system

Risk	Mitigating strategies
Unable to provide evidence in meeting ecological objective	Monitoring program to confirm if an ecological objective is being achieved
Environmental releases cause personal injury to river user	Detailed risk assessment undertaken prior to each release event This risk assessment will consider catchment conditions, the seven day weather forecast and the level of communication required; if the risk is considered too high the release will not proceed Continual monitoring of river level and rainfall during the release to allow adjustments to be made to the flow as required
Release volume is insufficient to meet target flows	Tarago rainfall/runoff model assists in predicting the release required to meet flow targets Real time monitoring of flows at compliance points Ability to alter water orders on a daily basis
Current environmental flow recommendations are inaccurate	Flow recommendations are based on the best possible science Monitoring program to identify if an ecological objective is not being achieved High-level review completed in early 2013
Storage manager maintenance works affect ability to deliver water	Regular communication with storage manager Major maintenance work completed in 2012-13
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Seasonally adaptive management approach allows watering actions to be tailored to the volume of water available in the entitlement Ongoing communication with storage managers to identify and work around any system constraints
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid-sulphate soils, etc.)	Continual water quality monitoring installed at Drouin West compliance point Water temperature monitoring of Tarago Reservoir is available through the OLARIS website If water quality conditions are unsuitable the release will not proceed
Environmental water account is overdrawn	Accounting principles agreed with resource manager Regular communication with resource manager Resource manager is consulted prior to all releases
Environmental releases cause flooding of private land, public infrastructure and/or Crown land	Overbank and bankfull releases have not been selected as priority watering actions due to the risk of flooding
Key stakeholders unsupportive of environmental water release	Consultation with key stakeholders during development of seasonal watering proposal

3.3 Werribee system

Waterway manager – Melbourne Water
Storage manager – Southern Rural Water

The Werribee River flows south-east from the Wombat State Forest to the undulating plains of basalt soils north of Ballan before flowing into Port Phillip Bay at Werribee. The Lerderderg River is a major tributary that joins the river at Bacchus Marsh. Some upper tributaries maintain healthy vegetation and macroinvertebrate communities. The middle reaches of the Werribee River provide good habitat for fish and a significant platypus population. The lower reaches of the river are home to migratory wading birds and many fish species and are lined with highly-valued river red gums. The Werribee River provides water for urban users in Melton and Bacchus Marsh, irrigation districts at Bacchus Marsh and Werribee and private diverters west of Werribee. The estuarine reaches are valued for recreational fishing and the lower freshwater reaches pass through the Werribee Tourist Precinct, which attracts many visitors from Melbourne and beyond.

System overview

The Werribee River environmental entitlement provides 10 percent of flows into Lake Merrimu that can then be released to the Werribee system from Lake Merrimu and Melton Reservoir. There is no secure access to storage capacity, only opportunistic access to airspace (temporarily unused storage). Lake Merrimu receives a significant amount of inflow from the Lerderderg River via a tunnel system, and operation of this tunnel influences the amount of water available under the environmental entitlement.

The priority river reaches for the Werribee system are reach 6, downstream of Lake Merrimu, and the estuary. Water may also be delivered to target environmental objectives in reaches 8 and 9 in some circumstances. These priority river reaches support fish species including migratory short-finned eels, black bream, river blackfish, flathead gudgeon, tupong and Australian smelt. A diverse community of macroinvertebrates inhabit the upper reaches and a significant platypus population occurs in the lower reaches. The Werribee River estuary is also a priority as its freshwater-saltwater interface is a regionally significant ecosystem. Reaches 8 and 9 should also receive some benefit from the environmental flows. The measurement points for target flows are below Lake Merrimu in reach 6, below Melton Reservoir in reach 8 and the Werribee Diversion Weir for Reach 9 and the estuary.

Passing flows are provided at many locations in the Werribee system. In addition, environmental water releases will be combined with unregulated flows and consumptive water en route to maximise environmental outcomes.

Pictured: Coimadai Creek, by Bill Moulden

Figure 3.3.1 The Werribee system

Current situation

Flow in the Werribee River has been at or above average since the end of the decade-long dry spell in late 2010. Melton Reservoir filled for the first time in five years in 2010, and Lake Merrimu for the first time in 14 years in 2012. Most priority watering actions in the lower reaches were at least partially achieved due to natural flows during 2011 and 2012. During winter 2012, active environmental water deliveries also provided much needed flows to reach 6 and the estuary. This was facilitated partly through the joint purchase of allocation by Melbourne Water and the VEWH, increasing the water available to meet priority watering actions in the system.

Winter freshes and high flows that have occurred in the last two years resulted in enhanced vegetation, habitat and passage for fish in the lower reaches. In the estuary, these flows have established an extensive salt wedge that provides ideal conditions for black bream spawning and recruitment, as well as benefiting fringing vegetation. The winter fresh and high flows in reach 6 were the first significant flows in this reach in almost 15 years, improving habitat availability for macroinvertebrates and frogs.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 3.3.1.

The environmental objectives focus on enhancing fish populations in the lower reaches and estuary, and enhancing macroinvertebrate populations below Lake Merrimu. Secondary objectives are to improve vegetation and platypus populations in the lower reaches and frog populations below Lake Merrimu.

In addition to the environmental objectives, these watering actions will also provide benefits for recreational fishing and passive users of the lower reaches.

Table 3.3.1 Priority watering actions and associated environmental objectives for the Werribee system

Priority watering action	Environmental objective
Winter/spring freshes in reach 6 (10 events [or natural][1] of 10 ML per day for five days each during July to November)	Scour silt and sand from riffles Promote vegetation growth Provide habitat for pygmy perch and macroinvertebrates
Summer/autumn/winter freshes in reach 6 (four events of 5 ML per day for three days each during December to June)	Maintain pool habitat for pygmy perch and macroinvertebrates
Winter/spring high flows in reach 6 (two events of 93 ML per day for two days each during July to November)	Disturb macrophytes, possibly provide frog habitat
Spring/summer freshes in the estuary (two events of 80 ML per day for two days each during September to December)	Promote juvenile black bream recruitment
Winter/spring baseflows in the estuary (15 ML per day from June to November)	Provide black bream habitat
Autumn freshes in the estuary (three events of 90 ML per day for two days each during March to May)	Provide fish passage between estuary and freshwater reaches
Autumn/winter/spring freshes in the estuary (eight events of 100 ML per day for one day each during May to November)	Inundate salt marsh with brackish water
Summer/autumn freshes in reach 9 (three events of 137 ML per day [or natural][1] for one day each during January to April)	Maintain pool water quality for fish and platypus Allow for fry dispersal and mobilise silt from riffles

[1] The specification of 'or natural' in priority watering actions accounts for natural variability, and as such rates may be above or below these specified target rates depending upon climatic conditions.

Bankfull and overbank flows are important to the health of all freshwater reaches and the estuary, and the frequency of these flows is less than natural. These flow components are important in maintaining channel form and disturbing riparian vegetation. This may occur naturally during 2013-14, but will not be actively managed due to the volume of water required, infrastructure constraints and potential flooding risk.

Table 3.3.2 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figure 3.3.2 illustrates the priority watering actions for 2013-14.

Table 3.3.2 Priority watering actions for the Werribee system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	800 ML carryover 200 ML allocation 1,000 ML total	800 ML carryover 400 ML allocation 1,200 ML total	800 ML carryover 400 - 900 ML allocation 1,200 - 1,700 ML total	800 ML carryover >900 ML allocation >1,700 ML total
Priority watering actions	***Reach 6:*** Winter/spring freshes Summer/autumn/ winter freshes ***Estuary:*** Spring/summer freshes Winter/spring baseflow	***Reach 6:*** Winter/spring freshes Summer/autumn/ winter freshes Winter/spring high flows ***Estuary:*** Spring/summer freshes Winter/spring baseflow Autumn freshes ***Reach 9:*** Summer/autumn freshes	***Reach 6:*** Winter/spring freshes Summer/autumn/ winter freshes Winter/spring high flows ***Estuary:*** Spring/summer freshes Winter/spring baseflow Autumn freshes Autumn/winter/ spring freshes ***Reach 9:*** Summer/autumn freshes	***Reach 6:*** Winter/spring freshes Summer/autumn/ winter freshes Winter/spring high flows ***Estuary:*** Spring/summer freshes Winter/spring baseflow Autumn freshes Autumn/winter/ spring freshes (additional) ***Reach 9:*** Summer/autumn freshes
Possible volume required from the Water Holdings	900 ML	1,500 ML	1,500 ML	2,000 ML
Possible carryover into 2014-15[1]	100 ML	0 ML	0 – 200 ML	0 ML

1 The purchase of water allocation is a potential option in the Werribee system, as occurred in 2012-13. This would increase the volume of water available to meet the shortfall identified in the water required to meet priority watering actions in 2013-14.

Figure 3.3.2 Priority watering actions in the Werribee system reaches[1]

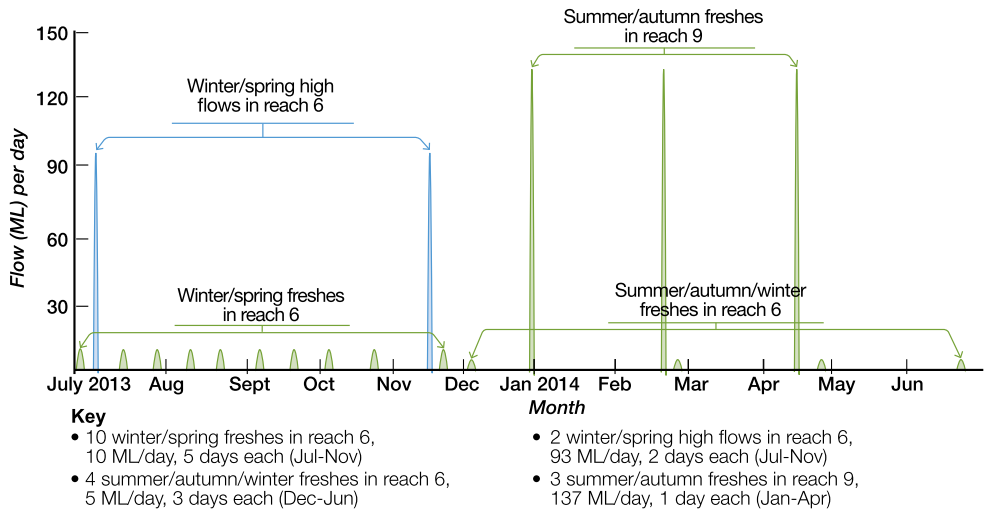
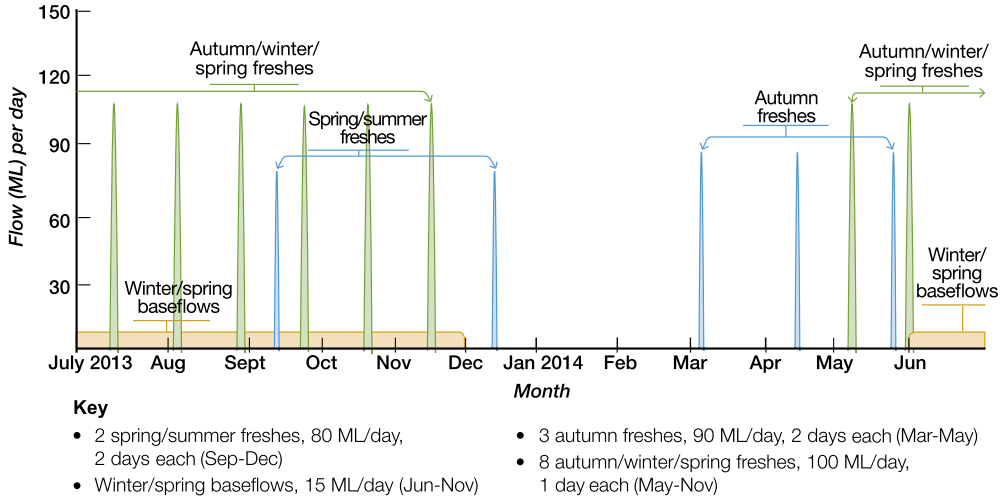


Figure 3.3.3 Priority watering actions in the Werribee system estuary[1]



1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Central Region (refer to section 3).

The environmental entitlement in the Werribee system does not include secure storage space, therefore there is limited capacity for environmental water carryover to provide certainty in water availability. Due to its relatively small catchment area and the influence of the tunnel system diverting from the Lerderderg River, flows into and out of Lake Merrimu can be closely managed by the storage manager. The storage is managed to avoid spills by reducing diversions from the Lergerderg River when the reservoir level is high. Whilst there may be opportunities to carry over environmental water in any airspace that may be available, if a large amount of environmental water is stored in the reservoir while tunnel diversions are high, environmental water could be lost to spills within the reservoir. For this reason, large volumes of environmental water will generally not be carried over from one season to the next.

Upgrade works are scheduled for the Melton Reservoir release valve in mid-2013 to increase capacity and enable the delivery of winter passing flows and freshes. The works are due for completion by spring 2013. These works may interrupt the delivery of environmental water during the winter period, and may limit the ability to deliver flows to the estuary. Melbourne Water will work closely with Southern Rural Water to minimise any impacts.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 3.3.3 summarises these risks, and the mitigating strategies identified by Melbourne Water.

Table 3.3.3 Risk management in the Werribee system

Risk	Mitigating strategies
Unable to provide evidence in meeting ecological objective	Access to Southern Rural Water's flow gauging has been negotiated Comprehensive ecological monitoring is planned to demonstrate ecological outcomes
Environmental releases cause personal injury to river user	Detailed risk assessment undertaken prior to each release event; this risk assessment will consider catchment conditions, the seven day weather forecast and the level of communication required Release will cease in the event that a flood watch is issued
Release volume is insufficient to meet target flows	To date, orders have generally been slightly higher than required to ensure the target flow rate is met Close communication with storage managers and monitoring of losses is increasing the required body of knowledge
Current recommendations on environmental flow are inaccurate	Flow recommendations are based on the best possible science Undertake monitoring program to identify if an ecological objective is not being achieved High-level review completed in early 2013
Storage manager maintenance works affect ability to deliver water	Measures will be in place to provide passing flows and some additional low flows The works period does not overlap with the delivery period for high priority fresh events
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Seasonally adaptive management approach allows watering actions to be tailored to the volume of water available in the entitlement There is sufficient storage and outlet capacity to deliver the watering actions identified, provided that water is available
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid-sulphate soils, etc.)	Water quality monitoring is in place to measure effects of releases; preliminary results suggest that water quality impacts are generally beneficial and that blackwater effects are localised, transient and within the range of natural variability
Environmental water account is overdrawn	Accounting principles agreed on with resource manager Regular communication with resource manager Resource manager is consulted prior to all releases
Environmental releases cause flooding of private land, public infrastructure and/or Crown land	Overbank and bankfull releases have not been selected as priority watering actions to the risk of flooding Releases to provide base flow and freshes will be cancelled if a flood watch is issued
Key stakeholders unsupportive of environmental water release	An email list of interested parties has been created and updates on planned watering occur regularly Interest from Wyndham City Council indicates a reasonably widespread level of community support

3.4 Moorabool system

Waterway manager – Corangamite Catchment Management Authority
Storage manager – Central Highlands Water

The Moorabool River flows southward from the Central Highlands between Ballarat and Ballan, passing through State Forest near Meredith and flowing south to join the Barwon River at Fyansford. The system sustains native fish of high conservation significance, platypus populations and stands of significant remnant vegetation, including river red gum, silver wattle and woolly tea tree. The Moorabool is an important catchment for the major urban centres of Geelong and Ballarat, and sustains economic values by contributing to extensive agricultural practices. Local communities have a strong connection to and a long history with the river which provides many social and recreational opportunities through its spectacular scenery, including parks, picnic sites, lookouts, swimming holes, fishing spots and historic bridges.

System overview

The Moorabool River's catchment is heavily farmed with about three-quarters of its catchment area used for agriculture. It is a highly regulated waterway with several large water storages in the upper reaches including Lal Lal Reservoir. In the lower reach between She Oaks and Batesford, there are nine private diversion weirs that are a significant barrier to fish. These barriers have increased the extent of slow-flowing habitat and reduced habitat diversity in the lower reach of the Moorabool. Despite this development, years of drought and large volumes of water extraction, the river still retains significant environmental values.

The priority reach for environmental water management in the system is reach 3 from Lal Lal Reservoir to She Oaks Diversion Weir. Environmental water for the Moorabool system is held in Lal Lal Reservoir for release downstream and there are no impediments to flow along the length of this reach. Native fish recorded in this reach include non-migratory species such as river blackfish, Australian smelt and southern pygmy perch, as well as short-finned eel and tupong. Other ecological values in the reach include a diverse population of macroinvertebrates and widespread platypus and water rat populations. The environmental flow reaches are shown in Figure 3.4.1.

At the She Oaks Diversion Weir, the majority of flows in the Moorabool River are harvested for urban water supply. Remaining water flows through this reach (reach 4), joining up with the Barwon River outside of Geelong. Historically this reach has suffered from extended periods of low flow, however it is known to contain eight species of native fish including Australian grayling, southern pygmy perch and tupong. Platypus have been recorded in various locations throughout this reach.

Pictured: Russels Bridge, by Mark Schultz CCMA

Figure 3.4.1 The Moorabool system

Current situation

In the past three years, the Moorabool River has received sustained inflows that have improved its condition since the extended Millennium drought. The winter of 2010 provided significant flows into water storages and also through reach 3 between Lal Lal Reservoir and the She Oaks Diversion Weir. Wetter conditions persisted throughout 2011, increasing storage levels at Lal Lal to 100 percent during August and again in 2012. During 2012-13, the reservoir remained full until November, spilling for the spring period. Passing flows continued until December 2012 when inflows to Lal Lal Reservoir subsided. These flows have been supplemented with environmental water during the season, with top ups for summer baseflows and summer freshes. The flows are critical in maintaining water quality and ensuring habitat exists for larger species such as fish and platypus.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 3.4.1.

A number of environmental objectives have been identified including supporting fish, macroinvertebrates, vegetation, habitat, physical processes and meeting water quality targets.

In addition to the environmental objectives, these watering actions will also provide improved conditions at the many parks, picnic spots, swimming holes, camping sites and fishing sites located along the length of the Moorabool.

Table 3.4.1 Priority watering actions and environmental objectives for the Moorabool system

Priority watering action	Environmental objective
Summer/autumn freshes (three events of greater than 31 ML per day for 10 days each during December to May)	Allow upstream movement of Australian smelt Reshape the channel form to maintain physical processes and habitat diversity and complexity
Summer/autumn low flows (20 ML per day from December to May)	Provide habitat for short-finned eel, southern pygmy perch and Australian smelt Maintain in-stream macrophyte species diversity and woody debris habitat within the river Maintain water quality
Winter/spring fresh (greater than 146 ML per day for five days during June to November)	Maintain diverse macroinvertebrate community Limit encroachment of in-stream vegetation and species common to non-flowing water-bodies Reinstate appropriate water quality
Winter low flows (83 ML per day during June)	Assist with providing adequate habitat for short-finned eel, southern pygmy perch and Australian smelt Maintain in-steam macrophyte species diversity and woody debris/snag habitat

Winter high flows (3,000 ML per day) are not a priority for environmental watering as the flow volume exceeds the available water. Additionally, a flow of this rate can only be achieved when Lal Lal Reservoir is spilling, as it has an outlet capacity constraint of approximately 140 ML per day.

Table 3.4.2 outlines the priority watering actions and expected water use under a range of planning scenarios. Figure 3.4.2 illustrates the priority watering actions for 2013-14.

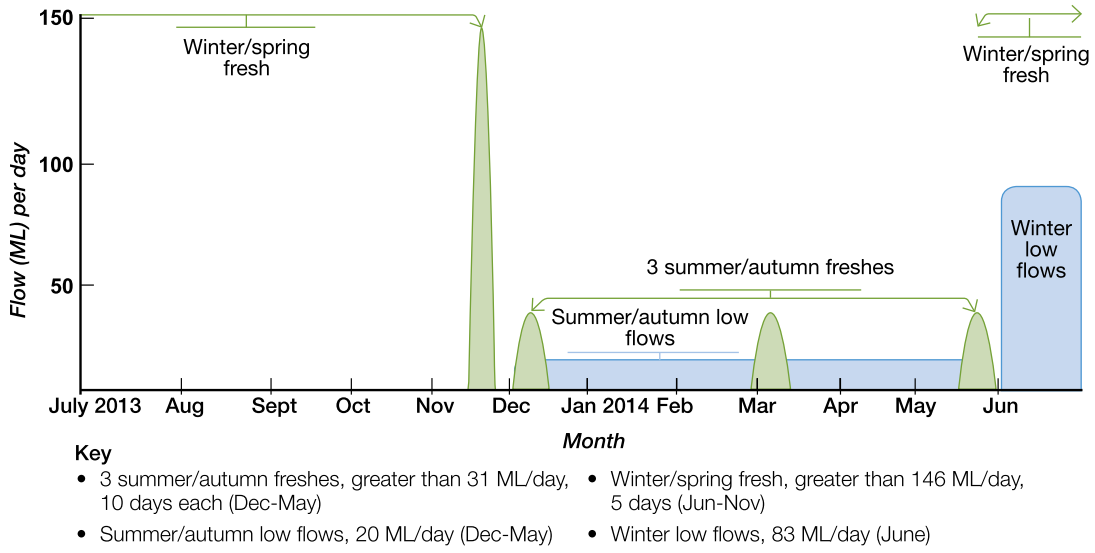
Table 3.4.2 Priority watering actions for the Moorabool system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings	6,500 ML	6,500 ML	6,500 ML	6,500 ML
Priority watering actions	Summer/autumn freshes Summer/autumn low flows	Summer/autumn freshes Summer/autumn low flows Winter/spring fresh	Summer/autumn freshes[1] Summer/autumn low flows Winter/spring fresh[1] Winter low flow Cease to flow	Summer/autumn freshes[1] Summer/autumn low flows Winter/spring fresh[1] Winter low flow
Possible volume required from the Water Holdings	2,500 ML	2,500 ML	2,500 ML	2,500 ML
Possible carryover into 2014-15[2]	4,000 - 5,475ML	5,500 - 6,350 ML	6,375 - 6,625 ML	> 6,650 ML

1 Target flow rates may be increased to ensure flows are sustained below the She Oaks Diversion Weir (into reach 4).

2 Use of water from the Moorabool environmental entitlement is restricted to an average of 2,500 ML per year use over a rolling three-year period. Volumes available for carryover at the end of the season will be based on irrigation allocations made during the year.

Figure 3.4.2 Priority watering actions in the Moorabool system[1]



1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Central Region (refer to section 3).

The environmental entitlement is insufficient to meet all flow recommendations, particularly the high-volume winter flows. Hence, summer flows, that are capable of being met with the 2,500 ML environmental entitlement combined with Barwon Water releases, have been prioritised over winter flows as this will also allow summer flow objectives to be met in the following two years. This strategy minimises the ecological risk to the Moorabool River as the volume of environmental water available over the next two years will be sufficient to maintain water quality in the priority reach should hot and dry conditions eventuate.

The flow objective for downstream of the She Oaks Diversion Weir (reach 4) focuses on increasing the volume of water that passes the weir during a summer fresh. This is necessary as Barwon Water operational releases are extracted at She Oaks Weir. Higher and more regular flushes through the reach will move organic matter and silt that has accumulated behind weirs, improve water quality and allow greater movement of native species such as river blackfish.

Over summer, water quality will be monitored at six sites between Lal Lal Reservoir and She Oaks Diversion Weir. If water quality declines below a set of trigger levels for dissolved oxygen, electrical conductivity and water temperature, environmental water may be released to assist in improving the water quality.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 3.4.3 summarises these risks, and the mitigating strategies identified by the Corangamite Catchment Management Authority.

Table 3.4.3 Risk management in the Moorabool system

Risk type	Mitigating strategies
Improved conditions for non-native species	Carp recruitment will be difficult to avoid; therefore, monitor distribution and responses of fish to inform future management actions
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Time freshes to coincide with natural rainfall events so less water from the entitlement is used leaving more to be used for winter low flow requirements
Unable to provide evidence in meeting ecological objective	Ongoing evaluation of monitoring results and implementation of environmental flow recommendations
Storage manager maintenance works affect ability to deliver water	Ongoing dialogue with Central Highlands Water to determine best timing for proposed works
Releases cause water quality issues	Monitor water quality before during and after releases; if water quality issues occur, discuss options with Barwon Water and Central Highlands Water and develop an action plan
Release volume is insufficient in meeting required flow at target point	Monitor flow at compliance point and readjust release volumes if necessary Release environmental flows in conjunction with releases for consumptive use or when passing flows increase due to rainfall
Limited catchment management authority resource to deliver environmental release	Resource capacity assessed before environmental release
Cost of delivery exceeds available funding	Cost of delivery and funding monitored
Environmental releases cause personal injury to river user	Media releases prepared to inform community of summer fresh and winter fresh flows
Blue-green algae bloom in reservoir results in the potential for releasing blue-green algae into the river	Environmental water delivery will be discontinued if it is considered that this will cause a blue green algae event in the river
Environmental water account is overdrawn	Environmental release volumes are tracked on a daily basis when a release is in progress
Environmental releases cause flooding to public infrastructure	Issue a media release before winter freshes Monitor water levels If a flood watch is issued by the Bureau of Meteorology, stop environmental water release
Key stakeholders unsupportive of environmental water releases	Community meeting prior to seasonal watering proposal Communication through media prior to environmental water release

3.5 Lower Barwon wetlands

Waterway manager – Corangamite Catchment Management Authority
Storage manager – N/A

The Barwon River rises in the Otway Ranges and flows through Geelong, joining the coast at Barwon Heads. It receives significant inflows from major tributaries, including the Moorabool and Yarrowee/Leigh rivers, which rise in the Victorian Central Highlands region of the Great Dividing Range. The estuarine reach of the Barwon River incorporates a system of wetlands and lakes including Lake Connewarre, Reedy Lake, Hospital and Salt Swamps, and Murtnaghurt Lagoon. Of these, environmental water can be actively managed at Reedy Lake and Hospital Swamps. These wetlands form part of the internationally significant Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site, and are also part of the Lake Connewarre State Game Reserve. They consist of a diverse range of aquatic vegetation communities, providing important feeding and breeding habitat for native fish and a number of wetland-dependent bird species, including the nationally vulnerable Australian painted snipe. Located near urban growth areas for Geelong and the Bellarine Peninsula, these wetlands are a popular destination for bird watchers, recreational hunters and they also support a commercial eel fishery.

System overview

The lower Barwon wetlands are located on the floodplain of the Barwon River, below its confluence with the Moorabool River, as shown in Figure 3.5.1.

The site has seen a series of agricultural and industrial developments since the early 1800s, when the area was opened up to sheep grazing and associated industries (wool scour and tannery). During the 1950s gold rush, vast tracts of land upstream were cleared for mining, and tailings from the mining operations flowed through the catchment and into the Barwon River and its lower wetlands. From the 1950s to the 1980s, Geelong and the Bellarine Peninsula saw increased urban growth and the lower Barwon breakwater was established.

Water available under the environmental entitlement does not consist of water held in storage. It allows for access to water from the Barwon River at any time, subject to river levels, for diversion into two of the lower Barwon wetlands, Reedy Lake and Hospital Swamps.

Existing wetland water control infrastructure on Reedy Lake and Hospital Swamps enables river flow diversion into these wetlands, and can also facilitate drying phases. Diversions into the wetlands can occur if the river is above 0.7m AHD. When the river is below 0.7m AHD there is a risk of bank slumping along the Barwon River. Outflows from the Reedy Lake can be managed through manipulation of the outlet regulator. There is limited ability to manage outflows from Hospital Swamps.

Overbank flows in the system can result in water entering the wetlands naturally, regardless of how the regulators are manipulated.

Reedy Lake and Hospital Swamps support aquatic vegetation communities that provide important feeding and breeding habitat for native fish, including Australian grayling, dwarf galaxias, and Yarra pygmy perch. They also support wetland-dependent bird species, including the threatened Australian painted snipe, Latham's snipe, Caspian tern and whiskered tern.

Pictured: Hospital Swamps by CCMA

Figure 3.5.1 The lower Barwon wetland system

Current situation

Between 1997 and 2010, the lower Barwon system was characterised by low river flows and low flow variability due to the dry conditions experienced across the region. The lack of high river flows reduced the potential for native fish movement and breeding events. Rainfall since 2010 has resulted in the inundation of Reedy Lake and Hospital Swamps, and coming into 2011-12 and 2012-13, both wetlands remained full from Barwon River flows.

The establishment of channel works, culvert installation, and levee banks in the wetlands has resulted in Reedy Lake being kept full most years in the recent past. This changed the natural wetting and drying cycle of the wetland, reduced the overall habitat diversity of the wetland, and increased the abundance of tall reeds. This change in the wetting and drying cycle has also reduced lake productivity and the decay of organic matter that are enhanced during drying events. This in turn has reduced the diversity of macroinvertebrate, fish, frog and waterbird species.

To assist in addressing this issue, a scientific study recommended a drier regime for Reedy Lake. However, due to other values of the site, in particular the commercial eel fishery, a drying regime was not initiated during 2012-13. Additionally, there remains uncertainty as to whether a drying of the wetland may expose metals in the bed sediments of the wetlands. Investigations underway at the site should provide some direction for management of this wetland into the future. Until the results of these are seen, the water management regime will align with historic management of the site.

At Hospital Swamps, water levels in this system have dropped through evaporation during the summer months and risen during filling events over autumn and winter. Wetland vegetation communities have remained largely unchanged since it was Ramsar listed, with healthy vegetation, fish and waterbird populations.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 3.5.1.

The overall environmental objective in 2013-14 is to maintain the ecological character of the wetlands, aligning with the management obligation of Ramsar sites. Ecological character is defined as the combination of ecosystem components, processes, benefits and services that characterised the wetland when it was listed as a Ramsar site in 1983. A change in ecological character is defined as a human-induced adverse alteration of any ecosystem component, process and/or ecosystem benefit or service.

In addition to the environmental objectives, these watering actions will provide opportunities for recreational activities.

Table 3.5.1 Priority watering actions and environmental objectives for the lower Barwon wetlands

Priority watering action	Environmental objectives
Reedy Lake	
Keeping the inlet to the wetland open and the outlet from the wetland closed year round to maintain water levels in the wetland with natural variation resulting from changes in river flows	Promote waterbird breeding events Provide summer feeding for waterbirds in flooded vegetation and the wetland fringe Promote fish breeding and recruitment opportunities Promote the growth of fish and improve conditions for migration and dispersal of fish between the river, lake and estuary
Close the inlet to the wetland and allow minor drawdown in levels if the Barwon River drops below 0.7m AHD	Avoid bank slumping in the Barwon River associated with low flows in the system
Hospital Swamps	
Open the inlet to the wetland during autumn (March to May) to fill the wetland, but close the inlet if Barwon River flows fall below those recorded in summer	Initiate decomposition of organic matter on the wetland bed Create habitat and invertebrate populations Stimulate fish and waterbird breeding Allow fish to colonise the wetland from the river Allow soil and surface water salts to accumulated over summer and be diluted over winter Promote and sustain growth of important wetland vegetation communities
Maintain water levels in the wetland over winter, spring and summer (from June to the end of December).	
Close the inlet to the wetland to allow it to draw down naturally during summer (December to February)	
Close the inlet to the wetland if the Barwon River drops below 0.7m AHD at any time	Avoid bank slumping in the Barwon River associated with low flows in the system.

Table 3.5.2 Priority watering actions for the lower Barwon wetlands under a range of planning scenarios

	Planning scenario		
	Dry	Average	Wet
Expected availability of Water Holdings	N/A – use of water based on river levels	N/A – use of water based on river levels	N/A – use of water based on river levels
Reedy Lake			
Priority watering actions	Open inlet and maintain water in wetland over winter Close inlet to wetland if water levels in Barwon River fall below 0.7m AHD	Open inlet and maintain water in wetland throughout season Close inlet to wetland if water levels in Barwon River fall below 0.7m AHD	Open inlet and maintain water in wetland throughout season Overbank flows likely during winter, inundating the wetland
Hospital Swamps			
Priority watering actions	Open inlet to wetland when flows in Barwon River increase in autumn Allow wetland water level to draw down over summer Close inlet to wetland if water levels in Barwon River fall below 0.7m AHD	Open inlet to wetland when flows in Barwon River increase in autumn Allow wetland water level to draw down over summer Close inlet to wetland if water levels in Barwon River fall below 0.7m AHD	Open inlet to wetland when flows in Barwon River increase in autumn (overbank flows likely to inundate the wetland during winter)

General triggers for undertaking watering actions have been included in the regional overview for the Central Region (refer to section 3).

The most important trigger for management decisions in the lower Barwon wetlands relates to the flows in the lower Barwon River. When river flows drop below 0.7m AHD, there is a risk of bank slumping. Should this occur, the inlets to the wetlands will be closed to maintain water in the river and assist in risk minimisation.

Inflows to Hospital Swamps are dependent on flows in the Barwon River increasing above levels recorded over summer. This is to promote variability between years and mimic natural conditions in the catchment.

If high river levels are observed due to rainfall and localised flooding, the inlets and outlets to Reedy Lake and Hospital Swamps may be opened or closed to assist flood mitigation functions. These actions are beyond the scope of the priority watering actions identified in this plan.

Risk assessment and management

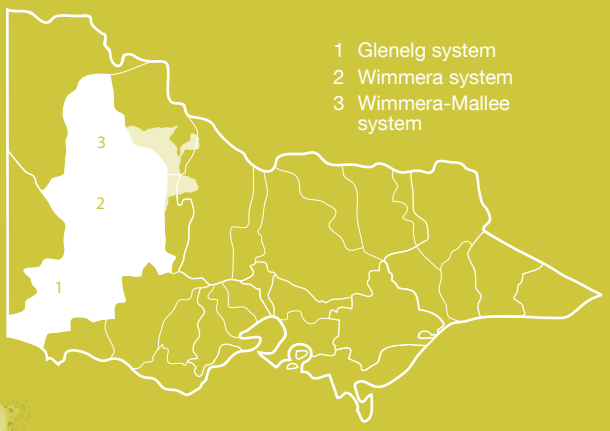
In the lower Barwon wetland system, a number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 3.5.3 summarises these risks, and the mitigating strategies identified by the Corangamite Catchment Management Authority.

Table 3.5.3 Risk management in the lower Barwon wetlands

Risk type	Mitigating strategies
Inability to achieve management recommendations	Monitor Barwon River flow and water levels in the wetlands; results will be used to inform future seasonal watering proposals The watering regime identified for 2013-14 is favourable to tall reeds in Reedy Lake, but it is unlikely that it will cause irreversible harm to the wetland if implemented for this year
Current recommendations on environmental flow inaccurate	Undertake ongoing evaluation of monitoring results and implementation of flow recommendations; results will be used to inform future seasonal watering proposals Further investigations are also underway to inform future management
Maintenance works affect ability to deliver water	Schedule structure upgrades to coincide with wetland drying where possible
Improved conditions for non-native species	Carp screens have been installed on the inlet to Reedy Lake
Blue green algae	Independent expert advice is that if the growth conditions in Reedy Lake or Hospital Swamps are conducive to blue green algae, it will bloom irrespective of connectivity to the Barwon River There is no plan to disconnect the wetlands from the Barwon River in the event of an algal bloom
Environmental releases cause inundation of private land	Ongoing consultation and consents put in place with impacted landholders The inlet to Hospital Swamps will be closed and the outlet from Hospital Swamps may be opened if water levels exceed 0.7m AHD
Unable to provide evidence in meeting ecological objective	Ongoing evaluation of monitoring results and implementation of recommendations Tall reed monitoring currently underway
Key stakeholders unsupportive of environmental water release	Community Advisory Committee established Stakeholder involvement in monitoring activities Ongoing stakeholder engagement
Environmental releases cause personal injury to river user	High flow rates are not expected as a result of infrastructure operation
Releases cause water quality issues	Monitor water quality and take action if necessary/possible based on best available information
Environmental releases cause flooding to public infrastructure	Any inundation of public infrastructure will be the result of natural flood events
Environmental releases cause inundation of Crown land	Work closely with and seek endorsement from the public land manager, Parks Victoria
Environmental water management impacts on other users	Continue to work with and assess impact to commercial users of the lower Barwon Wetlands; as there is no proposal to dry Reedy Lake in 2013-14 the risk of impacting other users is low

Section 4

Western Region



Western Region overview

The Wimmera-Glenelg headworks system interconnects three major river basins, the Wimmera-Avon, Avoca and Glenelg. The complex network of channels in the Wimmera-Glenelg system enables water to be shifted between storages, including from the Glenelg to the Wimmera system.

Environmental water is provided under the Wimmera and Glenelg Rivers Environmental Entitlement 2010. Water available under this entitlement is shared between the Wimmera and Glenelg systems, and the Wimmera-Mallee wetlands. The specific waterways that can receive water from the Water Holdings include sections of the Glenelg, Wimmera and MacKenzie rivers, Mount William, Burnt and Bungalally Creeks, in addition to priority wetlands formerly supplied by the Wimmera-Mallee channel system.

Water Holdings available for use in western Victoria are held in the Wimmera-Glenelg headworks system, which consists of several storages and release points across the two catchments. The headworks system contains many storages that can capture water across the catchment, including Moora Moora and Rocklands reservoirs in the Glenelg catchment, and Lake Wartook, Lake Lonsdale, Lake Bellfield and offstream storages including Taylor's Lake and Lake Fyans in the Wimmera system.

Water Holdings in the Western Region

Table 4.0.1 Water Holdings available for use in the Western Region

Entitlement	Description
Wimmera and Glenelg systems	
Wimmera and Glenelg Rivers Environmental Entitlement 2010	40,500 ML of regulated entitlement 1,000 ML of regulated entitlement specifically to supply former channel-fed wetlands Passing flows in the Wimmera and Glenelg Rivers and Mount William Creek, with some ability to vary rates Passing flows in Fyans Creek and the Wannon River
Commonwealth Water Holdings	
Wimmera system	28,000 ML of regulated entitlement (formerly irrigation product)

Consultation

The Glenelg Hopkins, Wimmera, Mallee and North Central catchment management authorities have engaged with key stakeholders and other relevant individuals in the preparation of the seasonal watering proposals for the Glenelg system, Wimmera system and Wimmera-Mallee wetlands. These stakeholders are listed in Table 4.0.2.

Table 4.0.2 Key stakeholders involved in the development of the seasonal watering proposals

Glenelg system
Grampians-Wimmera-Mallee Water
Wimmera Catchment Management Authority
VEWH
Wimmera system
Grampians-Wimmera-Mallee Water
Glenelg Hopkins Catchment Management Authority
VEWH
Wimmera-Mallee wetlands
Wetland Evaluation Team (WET) – including representatives from:
Grampians-Wimmera-Mallee Water Board, Office and Customer Committee, Mallee Catchment Management Authority (on behalf of all Mallee, North Central and Wimmera catchment management authorities), Mallee Catchment Management Authority land and water advisory committee, Department of Sustainability and Environment (now Department of Environment and Primary Industries) and Birchip Landcare Group
Parks Victoria
North Central Catchment Management Authority
Wimmera Catchment Management Authority
Mallee Catchment Management Authority
VEWH

Triggers for action

Factors considered for the delivery of priority watering actions in western Victoria include:

- seasonal conditions and weather forecasts
- river and system operations, including unregulated flows, catchment inflows, storage levels, and any relevant capacity constraints
- ecological risks associated with an action, such as water quality
- the outcomes of scientific studies and monitoring
- other values and identified issues.

Given the complexity of water management in the Wimmera-Glenelg and Wimmera-Mallee systems, there is a need to maintain flexibility in the timing of delivery of priority watering actions; this helps to manage delivery constraints and capacity sharing issues. Glenelg Hopkins, Wimmera, Mallee and North Central catchment management authorities will work closely with Grampians-Wimmera-Mallee Water to best optimise the delivery of environmental water throughout the season.

Releases will be monitored to determine the effectiveness of different delivery approaches in achieving target flow rates and the associated environmental outcomes to improve decision making and future deliveries throughout the system.

Further information

More detailed information can be sought from the Glenelg Hopkins Catchment Management Authority, the Wimmera Catchment Management Authority and the North Central Catchment Management Authority (see section 6.1).

4.1 Glenelg system

Waterway manager – Glenelg Hopkins Catchment Management Authority
Storage manager – Grampians-Wimmera-Mallee Water

The Glenelg River, in south-western Victoria, starts in the Grampian Ranges and runs for over 500 kilometres, making it one of the longest rivers in Victoria. A short stretch of the estuary winds through South Australia before returning to Victoria to enter the sea at Nelson. The Glenelg River is a central feature of the Lower Glenelg National Park and is valued for its high social, economic and environmental attributes. The Glenelg River features a heritage river reach due to the high-value aquatic life it supports, including the endangered Glenelg freshwater mussel and Glenelg spiny crayfish.

System overview

The Glenelg system has two main storages that can capture water from the Glenelg River: Moora Moora and Rocklands reservoirs. Moora Moora Reservoir is a relatively small storage in the headwaters of the Glenelg. Rocklands Reservoir is the largest storage in the Wimmera-Glenelg headwork system and captures inflows from seven creeks and rivers including the Glenelg River. Inter-basin transfers of water occur from Rocklands Reservoir, via the Rocklands-Toloondo Channel, and from Moora Moora Reservoir, via the Moora Moora Channel, to the Wimmera system. These transfers are made by Grampians-Wimmera-Mallee Water to supply water for consumptive and environmental purposes across the Wimmera-Glenelg supply system. These factors have significantly changed the pattern of flows in the Glenelg River, with the greatest impact occurring in the reach directly below Rocklands Reservoir.

Environmental water in the Glenelg system is released from Rocklands Reservoir (through carp screens) and can enter reach 1a via the reservoir outlet, and reach 1b via 5 Mile and 12 Mile outlets which deliver water further downstream. The environmental flow reaches are shown in Figure 4.1.1.

The priority river reaches in the Glenelg system are reaches 1a, 1b and 2. Reach 3 and the Glenelg River estuary will also receive some benefit from environmental watering releases; however reach 1a, 1b and 2 are the only reaches for which environmental water can be adequately released to meet desired flow targets. These reaches are home to platypus and important native fish populations, including river blackfish, estuary perch and galaxid and pygmy perch species. They also support good riparian vegetation, including the endangered Wimmera bottlebrush. The measurement points for target flows are at Harrow for reach 1b and Dergholm for reach 2. A measurement point for reach 1a has not yet been established.

The high-value reach of the Glenelg River above Rocklands Reservoir, reach 0, is being investigated by Glenelg Hopkins Catchment Management Authority as a reach that may benefit from environmental water in the future.

Passing flows are provided from Rocklands Reservoir into the Glenelg River, and are also provided in the Wannon River. Environmental water releases will be combined with passing flows, unregulated flows and the delivery of consumptive water en route to maximise environmental outcomes.

Pictured: Glenelg River at Moree, by Stephen Ryan GHCMA

Figure 4.1.1 The Glenelg system

Current situation

In 2012-13, there was a continuation of improved conditions for a range of flow-dependent ecological values throughout the Glenelg system, including native fish populations. Targeted environmental flow releases have proven critical in enhancing values despite a hot and dry summer throughout the Glenelg catchment. Environmental water supplemented year-round baseflows and provided spring and summer freshes. The combination of these environmental water deliveries and unregulated flows in 2012-13 provided increased opportunities for fish breeding events, and improved water quality and in-stream vegetation communities. This provided critical habitat and food resources for juvenile fish and other aquatic species. The recovery and improvement of fish populations since the drought is evident through fish monitoring, with a high diversity of species and age classes present at all monitoring sites. There has also been an increase in the recruitment of riparian vegetation in recent years, with freshening flows providing important moisture to sustain vegetation on low banks and benches.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 4.1.1.

The environmental objectives for the Glenelg system focus on: maintaining sustainable populations of native and endemic fish species; providing connectivity between reaches to enable fish movement; maintaining appropriate aquatic habitat and food resources for fish; and ensuring water quality is maintained throughout the year.

In addition to the environmental objectives, some of these watering actions will also benefit recreational activities such as fishing.

Table 4.1.1 Priority watering actions and environmental objectives for the Glenelg system

Priority watering action	Environmental objective
Summer/autumn baseflows targeting reaches 1a-1b (varying rates 10-15 ML per day from December to May)	Maintain availability of a diverse range of habitat for platypus, macroinvertebrates and fish Prevent the encroachment of terrestrial species into the river channel and promote the growth of in-stream vegetation
Summer/autumn baseflows targeting reach 2 (25 ML per day from December to May)	
Summer/autumn freshes targeting reaches 1a-1b (two to four freshes of between 60 and 100 ML per day for three to seven days each during December to May)	Provide variable flow during low flow season to support macroinvertebrates (provision of flow over wood debris increases biofilm abundance as a food source), diverse habitats and water quality Facilitate scouring of sand for fish habitat Maintain condition of emergent vegetation by wetting lower banks Wet high flow channels Improve condition of emergent vegetation by wetting lower banks Introduce wetting during summer to increase biofilm abundance on woody debris as a food source for macroinvertebrates Flush pools to prevent water quality decline during low flows
Summer/autumn freshes targeting reach 2 (three to four freshes of between 50 and 150 ML per day for seven to 14 days each during December to May)	
Winter/spring freshes targeting reaches 1b (one to five freshes of between 250 and 550 ML per day for four to seven days during June to November)	Facilitate scouring of sand for fish habitat Provide stimulus and opportunity for upstream and downstream fish migration Maintain pools and inundate benches to improve in-channel diversity Increase the baseflow water depth to provide stimulus for fish movement (not required in drought years, frequently required in wet years) Wet low benches and increased edge habitat to improve diversity of habitat Wet benches to improve condition of emergent vegetation and maintain habitat diversity Increase flow depth for upstream and downstream fish migration reaches to expand populations of native fish
Winter/spring freshes targeting reach 2 (three to four freshes of 300 ML per day for four days during June to November)	
Winter/spring baseflows targeting reaches 1a-1b (60 to 100 ML per day from June to November)[1]	Maintain shallow water habitat availability for macroinvertebrates and facilitate annual dispersal of juvenile platypus Improve habitat diversity by increasing wetted area from summer period
Winter/spring baseflows targeting reach 2 (160 ML per day from June to November)[1]	

1 Passing flows provided under the environmental entitlement provide the majority of winter/spring baseflows, however if passing flows are reduced, managed environmental water releases may be required to supplement them or to ensure appropriate rates of rise and fall and providing appropriate conditions during fresh events.

Winter high flows are also important to the health of the Glenelg River, providing longitudinal connectivity and wetting channel margins and low bars in the river. Due to operational constraints and potential flooding risks, achievement of this flow component relies solely on natural events.

Table 4.1.2 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figure 4.1.2 illustrates the priority watering actions for 2013-14.

Table 4.1.2 Priority watering actions in the Glenelg system under a range of planning scenarios

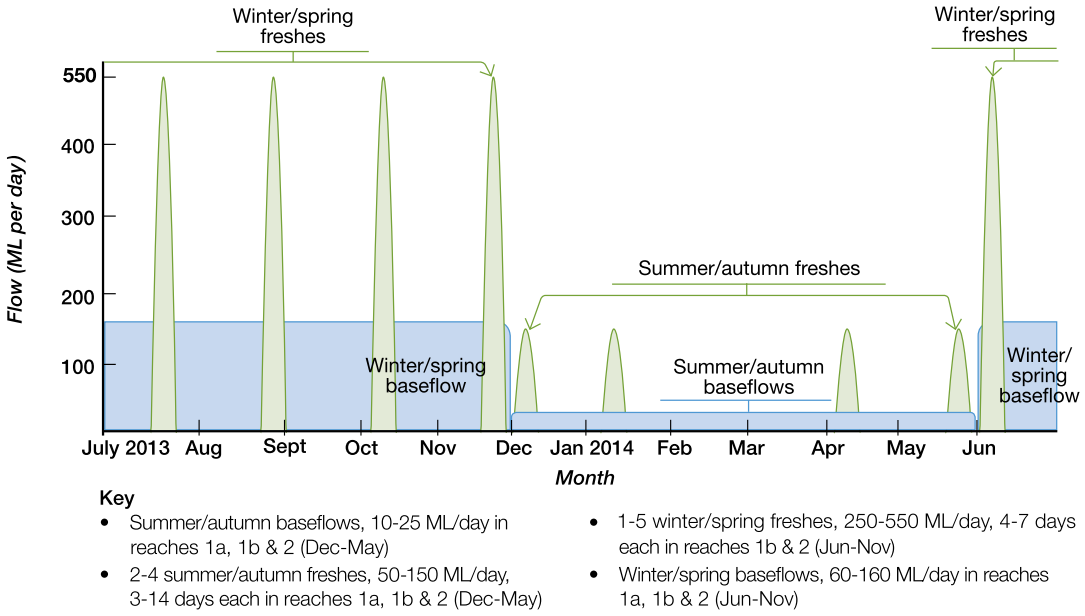
	Planning scenario			
	Drought	Dry	Average	Wet
Expected availability of Water Holdings[1]	30,200 ML carryover 23,300 ML allocation 53,500 ML total	30,200 ML carryover 36,900 ML allocation 67,100 ML total	30,200 ML carryover 40,500 ML allocation 15,200 ML Commonwealth Holdings 85,900 ML total	20,200 ML carryover 40,500 ML allocation 28,000 ML Commonwealth Holdings 98,700 ML total
Priority watering actions	Summer/autumn baseflows Summer/autumn fresh flows Winter/spring fresh flows Winter/spring baseflows	Summer/autumn baseflows Summer/autumn fresh flows Winter/spring fresh flows Winter/spring base flows	Summer/autumn baseflows Summer/autumn fresh flows Winter/spring fresh flows Winter/spring baseflows	Summer/autumn baseflows Summer/autumn fresh flows Winter/spring fresh flows Winter/spring baseflows
Glenelg system				
Possible volume required from the Water Holdings	30,600 ML	31,200 ML	31,600 ML	35,600 ML
Wimmera system				
Possible volume required from the Water Holdings	33,700 ML	39,800 ML	55,100 ML	66,000 ML
TOTAL				
Possible volume required from the Water Holdings[2]	64,300 ML	71,000 ML	96,700 ML	101,600 ML
Possible shortfall in the volume available in the Water Holdings[3]	-10,800 ML	-3,900 ML	-10,800 ML	-2,900 ML

1 Victorian Holdings are shared across the Glenelg and Wimmera systems. Commonwealth Holdings are only available for use in the Wimmera system. Volumes specified indicate the likely availability across the two systems.

2 Figures take into account the possible volume required in both the Glenelg and Wimmera systems.

3 A shortfall in the water required to meet priority watering actions has been identified in the Glenelg and Wimmera systems. A prioritisation process will be undertaken in consultation with the Wimmera and Glenelg Hopkins catchment management authorities to determine the priority watering actions that will be undertaken in each system in the 2013-14 year.

Figure 4.1.2 Priority watering actions in the Glenelg system[1]



[1] This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Western Region (refer to Section 4).

Channel capacity constraints downstream of Rocklands Reservoir at Frasers Swamp impact on flow delivery through reach 1a of the Glenelg River. As a result, flow rates released from the reservoir outlet have been limited to 60 ML per day; this rate still enables the delivery of summer/autumn freshes. The release of higher flow rates to deliver priority watering actions to reaches 1b and 2 will occur via 5 Mile and 12 Mile outlets. Investigations into management of these channel constraints will continue during 2013-14.

Greater flexibility in flow recommendations for the Glenelg River has been identified through a flow study review undertaken for the Wimmera and Glenelg rivers in 2013. The revised flow study identified acceptable ranges in the duration and frequency of flow components required to meet ecological objectives, recognising that achievable objectives vary with seasonal conditions. This means a greater number and duration of freshes will be provided under wetter conditions, reflecting natural variability and improved confidence in achieving the objectives.

Glenelg Hopkins Catchment Management Authority also advises on management of the 'Glenelg River compensation flows' under Grampians-Wimmera-Mallee Water's bulk entitlement. The Glenelg River compensation flow provides up to 3,300 ML, depending upon inflows to the Wimmera-Glenelg headworks system, for domestic and stock use along with other social and environmental benefits. This water will be managed in line with an annual operating plan developed by the Glenelg Hopkins Catchment Management Authority in consultation with Grampians-Wimmera-Mallee Water and the VEWH, maximising environmental benefits where possible.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 4.1.3 summarises these, and the mitigating strategies identified by Glenelg Hopkins Catchment Management Authority.

Table 4.1.3. Risk management in the Glenelg system

Risk type	Mitigating strategy
Storage manager cannot deliver required volume or flow rate	The rationale for prioritising inter-basin transfers over environmental releases will be scrutinised should delivery capacity be constrained due to operations The delivery of large flows may commence earlier in the target season to reduce risks associated with capacity constraints during peak demand periods across the headworks system
Improved conditions for non-endemic species	There are no direct mitigation strategies however carp responses to flow is intended to be monitored in an upcoming program
Current recommendations on environmental flow are inaccurate	The recent flow study update has incorporated learnings from the previous flow study, however recommendations used to guide the development of priority watering actions for 2013-14 are a draft If there are significant discrepancies in the final recommendations, a variation to the Seasonal Watering Plan 2013-14 may be required
Storage manager maintenance works affect ability to deliver water	There are no planned maintenance works impacting the outlets identified for use this year, however emergency repairs may be required at any time The Glenelg Hopkins Catchment Management Authority will maintain communication with the storage manager and develop strategies to work around such an issue should it arise Note: the 12 mile outlet requires repair, but is not required to deliver priority watering actions this year
Limited catchment management authority resources to deliver environmental release	An instrument of delegation has been developed to allow for timely and efficient delivery of environmental releases for the catchment management authority Effective ordering and accounting processes have been established
Cost of delivery exceeds available funding	Release plans are targeted to minimise costs
Environmental releases cause personal injury to river user	Rates of rise and fall are managed to allow people time to adjust to variable river flows Delivery of large flow events during peak recreational periods, such as public holidays, are avoided where possible
Releases cause water quality issues	Delivery of baseflows and regular freshes reduces risks associated with water quality, such as mobilising salt slugs in the upper reaches
Environmental water account is overdrawn	Monthly meetings of the Storage Management Reference Group help Glenelg Hopkins and Wimmera catchment management authorities and the VEWH keep track of deliveries against forecast demand to avoid overdrawing available water This risk is further reduced by the rigour behind the volumes requested in this proposal
Environmental releases causes flooding of private land, public infrastructure and/or Crown land	The release rates proposed for 2013-14 have not caused flooding of private or public land or infrastructure in previous years Larger releases have been ruled out until further work is done to manage areas known or expected to be subject to inundation
Unable to provide evidence in meeting ecological objective	VEFMAP underpins monitoring in the Glenelg and has detected positive responses to the delivery of environmental flows VEFMAP will be reviewed this year to better monitor objectives based on experiences to date
Key stakeholders unsupportive of environmental water release	There is anxiety in some parts of the Balmoral community around the impact of environmental releases and passing flows on water levels and associated recreational opportunities at Rocklands Reservoir In recent times, inter-basin transfers have significantly lowered levels in Rocklands Improving storage management rules through the review of system operations being undertaken by Grampians-Wimmera-Mallee Water, increasing transparency around inter-basin transfers and improving communication around environmental flows to the Glenelg River will to help address this concern

4.2 Wimmera system

Waterway manager – Wimmera Catchment Management Authority
Storage manager – Grampians-Wimmera-Mallee Water

The Wimmera River lies in western Victoria, beginning in the Pyrenees, and flowing into Lake Hindmarsh, the largest freshwater lake in Victoria, and Lake Albacutya, which is listed as a wetland of international significance under the Ramsar Convention. The heritage-listed lower Wimmera River includes middens (sites where Indigenous people left the remains of their meals) and scar trees, evidence of long periods of Indigenous settlement in the area. There are a number of high-value river and creek systems that flow into the Wimmera River, including the MacKenzie River, and Mount William, Burnt and Bungalally creeks. The Wimmera system is also home to many significant plant and animal species and Victoria's only self-sustaining population of freshwater catfish. There is a strong community attachment to waterways in the region, with many recreational activities undertaken across the catchment including fishing, rowing, boating and camping.

System overview

Water in the Wimmera system is stored in three on-stream reservoirs: Lake Wartook on the MacKenzie River; Lake Lonsdale on Mount William Creek; and Lake Bellfield on Fyans Creek. Off-stream storages can harvest water via channels from the Wimmera River, Mount William Creek and Burnt Creek (Taylor's Lake) and Fyans Creek (Lake Fyans). The channel system enables water movement between storages and from the Glenelg to the Wimmera system. Historically, the preferred reservoir for environmental water releases for the Wimmera River is Taylors Lake given its proximity to target reaches. However, low storage levels in Taylors Lake may require releases to be made from Lake Lonsdale. Inter-basin transfers of water can occur from Rocklands Reservoir (in the Glenelg system), via the Rocklands-Toloondo Channel, and from Moora Moora Reservoir, via the Moora Moora Channel, to the Wimmera. These transfers are made by Grampians-Wimmera-Mallee Water to supply water for consumptive and environmental purposes across the Wimmera-Glenelg supply system. The vast number of storages across the Wimmera system has significantly changed the pattern of flows in many streams within the region.

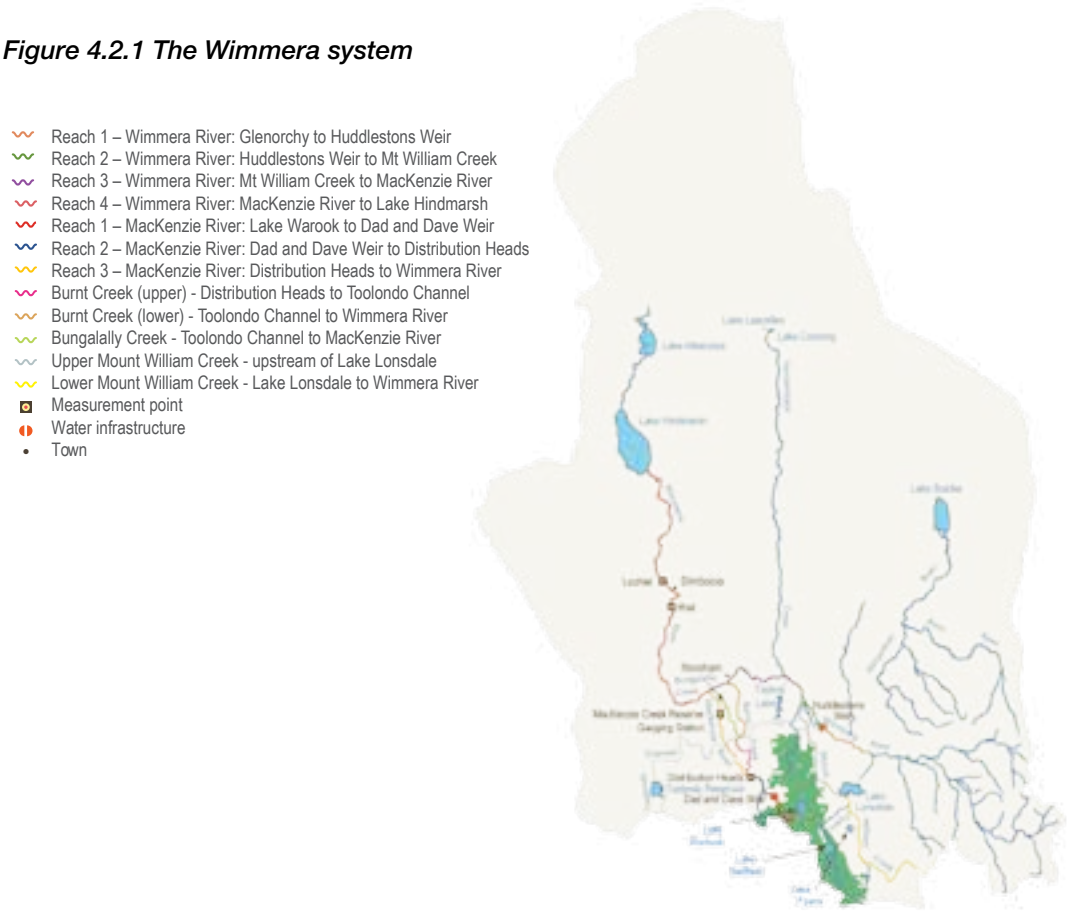
The priority river reaches for environmental water management in the Wimmera River are reach 4 and then the lower section of reach 2 and reach 3 (see Figure 4.2.1). These reaches contain self-sustaining populations of freshwater catfish, and other endemic fish species including flat-headed gudgeon and smelt. These are the only reaches where environmental water can be actively managed, as the upper reaches are mostly unregulated. Mount William Creek can be used to deliver water to the Wimmera River, and is also a priority for the delivery of environmental water to assist in maintaining the creek's healthy populations of endemic fish, in both the upper and lower sections.

The priority river reaches in the MacKenzie River are reaches 2 and 3, with reach 1 receiving consumptive water year-round for Horsham's water supply. The MacKenzie River contains the only long term recorded population of platypus in the Wimmera region and also supports good populations of native fish. Delivery of environmental water to reaches 2 and 3 will also provide benefits to reach 3, and the lower Wimmera River. Protecting and restoring riparian vegetation communities also make Burnt and Bungalally creeks a priority for environmental watering. These creeks provide important habitat corridors for both aquatic and terrestrial species.

Pictured: Wimmera River at Spears Crossing, by Chris Bloink

Passing flows are provided to the Wimmera River, and Mount William and Fyans creeks. Environmental water releases will be combined with passing flows, unregulated flows and the delivery of consumptive water en route to maximise environmental outcomes.

Figure 4.2.1 The Wimmera system



Current situation

The drought-breaking conditions in 2010-11 and complementary environmental water management has led to substantial improvements in river health. However, continued environmental water delivery is required to maintain improvements from the wet conditions in 2010-11. Environmental water provided flows in the Wimmera River throughout 2012-13, excluding a cease to flow period during summer. Summer baseflows and cease to flow events were provided to reach 2 of the MacKenzie River, with winter freshes and reduced winter baseflows provided to reach 3, providing habitat opportunities for fish and platypus populations.

The delivery of environmental water has assisted in maintaining water quality, providing habitat and resources for macroinvertebrate, fish, platypus and vegetation communities for many waterways in the Wimmera system.

Environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 4.2.1.

Environmental objectives focus on: maintaining water quality and supporting the self-sustaining freshwater catfish in the Wimmera River; supporting the health of Wimmera bottlebrush communities; providing suitable habitat for platypus and high-value fish populations in the MacKenzie River and Mount William Creek; and maintaining vegetation condition in Burnt and Bungalally creeks.

In addition to the environmental objectives, these watering actions could provide social opportunities such as fishing competitions, rowing regattas and triathlons through improved water quality and potential enhancement of weir levels. Please note these actions will only be delivered where water is available and is operationally convenient.

Table 4.2.1 Priority watering actions and associated environmental objectives for the Wimmera system

Priority watering action	Environmental objective
Wimmera River (reach 4)	
Year-round baseflows (18 ML per day or natural[1], with one cease to flow event of up to seven days)	Maintain water quality, edge habitats in deeper pools and runs, and shallow water habitat availability for macroinvertebrates Maintain inundated stream channel to protect and restore riparian and floodplain vegetation communities Maintain sufficient areas of pool habitat for catfish and other indigenous fish, and maintain shallow water habitats for small bodied fish Prevent excessive stream-bed colonisation by terrestrial vegetation species
Summer/autumn freshes (three to four events of 100 ML per day for 14 days during December to May)	Provide variable flow during low flow season for macroinvertebrates (inundate woody debris to increase food sources), fish movement and to maintain water quality and diversity of habitat
Winter/spring freshes (three to four events of 100 ML per day for 14 days during June to November)	Increase the baseflow water depth to provide stimulus for fish movement Provide flow variability to maintain water quality and diversity of fish habitats
Spring fresh (one event of 200 ML/day for one to two days in November)	Wet lower benches, entraining organic debris and promoting diversity of habitat
Winter/spring baseflows targeting reaches 2 and 3 (100 ML per day from June to November)	Prevent terrestrialisation of the lower banks by phragmites and provide increased flow to support fish movement and diversity of habitat
MacKenzie River (reaches 2 and 3)	
Year-round baseflows (up to 2-10 ML per day or natural[1])	Maintain edge habitats and deeper pools and runs for macroinvertebrates Maintain inundated stream channel to protect and restore riparian and floodplain vegetation communities, including the Wimmera bottlebrush and support aquatic vegetation for fish habitat Maintain sufficient area of pool habitat for intact fish communities, and shallow water habitats for small-bodied fish Prevent excessive stream-bed colonisation by terrestrial vegetation species
Summer/autumn freshes (three to four events of 5-35 ML per day for four to seven days each during December to May)	Prevent water quality decline by flushing pools during low flows
Autumn/winter/spring freshes (one to four events of 35-55 ML per day for two to seven days during May to November)	Provide spatially and temporally differentially wetted areas within the channel for aquatic vegetation and fish habitat Flow pulses to provide stimulus for fish movement during non-drought periods Achieve shear stress to flush surface sediments from hard substrates to support macroinvertebrates

Table 4.2.1 Priority watering actions and associated environmental objectives for the Wimmera system (continued)

Burnt Creek	
Year-round baseflows targeting reach 1 (1 ML per day [or natural[1]])	Maintain edge habitats and deeper pools and runs for macroinvertebrates Maintain inundated stream channel to protect and restore riparian and floodplain vegetation communities, and prevent excessive stream bed colonisation by terrestrial vegetation species Maintain sufficient area of pool habitat for intact fish communities, and shallow water habitats for small-bodied fish
Summer/autumn freshes targeting reach 1 (three to four events of 10 ML per day for 14 days each during December to May)	Prevent water quality decline by flushing pools during low flows
Year-round freshes targeting reach 2 (one event in November and seven periodic events, all of 55 ML per day for two days each)	Flush sediments from hard surfaces to support macroinvertebrates
Spring fresh targeting reach 1 (one event of 30 ML per day for two days in November)	Flush sediments from hard surfaces to support macroinvertebrates
Autumn/winter fresh targeting reach 1 (one event of 75 ML per day for one day during May to June)	Disturb the algae/bacteria/organic biofilm present on rock or wood debris to support macroinvertebrate communities
Bungalally Creek	
Bankfull flow (one event of 60 ML per day for one to two days anytime during the year)	Inundate riparian zone to maintain condition and facilitate recruitment for riparian vegetation communities Maintain structural integrity of channel and prevent loss of channel diversity through lack of flow variability
Mount William Creek	
Summer/autumn freshes targeting upper Mount William Creek (two events of >1 ML per day for five days during December to May)	Maintain habitat for native fish
Year-round baseflows targeting lower Mount William Creek (5 ML per day [or natural[1]], with one cease to flow event of up to 30 days)	Maintain edge habitats and deeper pools and runs for macroinvertebrates Maintain inundated stream channel to protect and restore riparian and floodplain vegetation communities, and prevent excessive stream bed colonisation by terrestrial vegetation species Maintain sufficient area of pool habitat for intact fish communities, and shallow water habitats for small-bodied fish Prevent excessive stream-bed colonisation by terrestrial vegetation species
Summer/autumn freshes targeting lower Mount William Creek (three to four events of 30 ML per day for seven days during December to May)	Provide variable flow during low flow season for macroinvertebrates (inundate woody debris to increase food source), fish movement and to maintain water quality and diversity of habitat
Winter/spring freshes targeting lower Mount William Creek (five events of 100 ML per day for five days during June to November)	Flush sediments from hard surfaces to support macroinvertebrates

[1] 'Or natural' means that flow rates may be above or below the specified target rates depending upon inflows and climatic conditions.

Bankfull and overbank flows are important for vegetation recruitment, sediment movement and temporary removal of saline pools in the Wimmera River, however these flows cannot be delivered due to storage outlet capacity and risks of flooding private land.

Table 4.2.2 outlines the priority watering actions and expected water usage under a range of planning scenarios. Figures 4.2.2 to 4.2.6 illustrate the priority watering actions for 2013-14.

Table 4.2.2 Priority watering actions under a range of planning scenarios in the Wimmera system

	Planning scenario			
	Drought	**Dry**	**Average**	**Wet**
Expected availability of Water Holdings[1]	30,200 ML carryover 23,300 ML allocation 53,500 ML total	30,200 ML carryover 36,900 ML allocation 67,100 ML total	30,200 ML carryover 40,500 ML allocation 15,200 ML Commonwealth Holdings 85,900 ML total	30,200 ML carryover 40,500 ML allocation 28,000 ML Commonwealth Holdings 98,700 ML total
Wimmera River				
Priority watering actions	Year-round baseflows Summer/autumn freshes Winter/spring freshes	Year-round baseflows Summer/autumn freshes Winter/spring freshes Spring fresh	Year-round baseflows Summer/autumn freshes Winter/spring freshes Spring fresh Winter/spring baseflows (reaches 2 and 3)	Year-round baseflows Summer/autumn freshes Winter/spring freshes Winter/spring baseflows (reaches 2 and 3)
Possible volume required from the Water Holdings	24,500 ML	25,100 ML	40,300 ML	51,200 ML
MacKenzie River				
Priority watering actions	Year-round baseflows (only during June to November) Summer/autumn freshes Autumn/winter/ spring freshes	Year-round baseflows Summer/autumn freshes Autumn/winter/ spring freshes	Year-round baseflows Summer/autumn freshes Autumn/winter/ spring freshes	Year-round baseflows Summer/autumn freshes Autumn/winter/ spring freshes
Possible volume required from the Water Holdings	3,800 ML	5,100 ML	5,100 ML	5,100 ML
Burnt Creek				
Priority watering actions	None	Year-round baseflows Summer/autumn freshes Year-round freshes (reach 2)	Year-round baseflows Summer/autumn freshes Spring fresh Autumn/winter fresh Year-round freshes (reach 2)	Year-round baseflows Summer/autumn freshes Spring fresh Autumn/winter fresh Year-round freshes (reach 2)
Possible volume required from the Water Holdings	0 ML	1,500 ML	1,600 ML	1,600 ML
Bungalally Creek				
Priority watering actions	None	Bankfull flow	Bankfull flow	Bankfull flow
Possible volume required from the Water Holdings	0 ML	200 ML	200 ML	200 ML

Table 4.2.2 Priority watering actions under a range of planning scenarios in the Wimmera system (continued)

	Drought	Dry	Average	Wet
Mount William Creek				
Priority watering actions	Year-round baseflows Summer/autumn freshes	Year-round baseflows Summer/autumn freshes Winter/spring fresh	Year-round baseflows Summer/autumn freshes Winter/spring fresh	Year-round baseflows Summer/autumn freshes Winter/spring fresh
Possible volume required from the Water Holdings	5,400 ML	7,900 ML	7,900 ML	7,900 ML
Wimmera system total				
Possible volume required from the Water Holdings	33,700 ML	39,800 ML	55,100 ML	66,000 ML
Glenelg system				
Possible volume required from the Water Holdings	30,600 ML	31,200 ML	31,600 ML	35,600 ML
TOTAL				
Possible volume required from the Water Holdings[2]	64,300 ML	71,000 ML	96,700 ML	101,600 ML
Possible shortfall in the volume available in the Water Holdings[3]	-10,800 ML	-3,900 ML	-10,800 ML	-2,900 ML

[1] Victorian Holdings are shared across the Glenelg and Wimmera systems. Commonwealth Holdings are only available for use in the Wimmera system. Volumes specified indicate the likely availability across the two systems.

[2] Figures take into account the possible volume required in both the Glenelg and Wimmera systems.

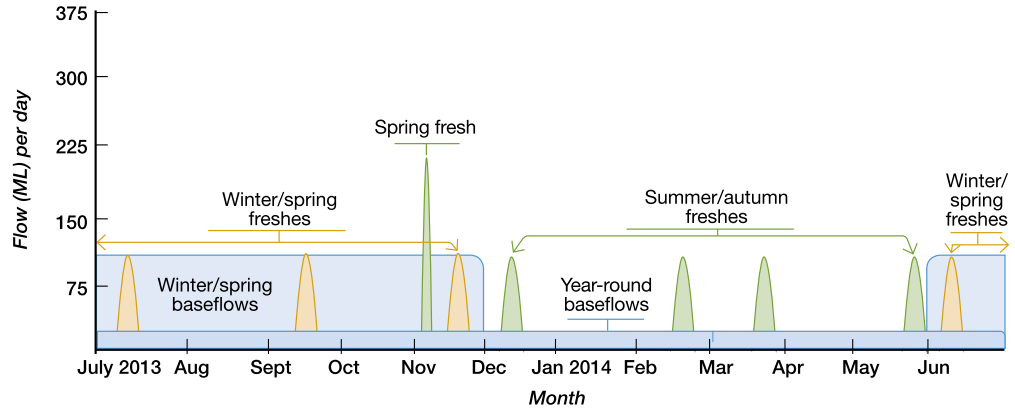
[3] A shortfall in the water required to meet priority watering actions has been identified in the Glenelg and Wimmera systems. A prioritisation process will be undertaken in consultation with the Wimmera and Glenelg Hopkins catchment management authorities to determine the priority watering actions that will be undertaken in each system in the 2013-14 year.

General triggers for undertaking watering actions have been included in the regional overview for the Western Region (refer to section 4).

Water resource management in the Wimmera system is complex, with numerous storages and variable release points for supplying environmental, consumptive, and recreational water. Planning for and delivering environmental water requires flexible and adaptive management. There are supply routes that maximise environmental outcomes throughout the system, although it may be impossible to deliver during certain periods due to storage levels or water quality issues. This may limit the viability of some priority watering actions. Wimmera Catchment Management Authority will work closely with Grampians-Wimmera-Mallee Water to maximise environmental outcomes.

Yarriambiack Creek is a distributary of the Wimmera River, flowing northwards into the Mallee region. Historically, the creek would only receive flows during high flow events in the Wimmera River. The Yarriambiack Creek off-take has since been modified, resulting in flows entering the creek on a more frequent basis. When delivering environmental water to the Wimmera River reach 4, losses are incurred into Yarriambiack Creek. Under some circumstances it may be necessary to block flows entering the creek to ensure priority watering actions in the Wimmera River can occur efficiently.

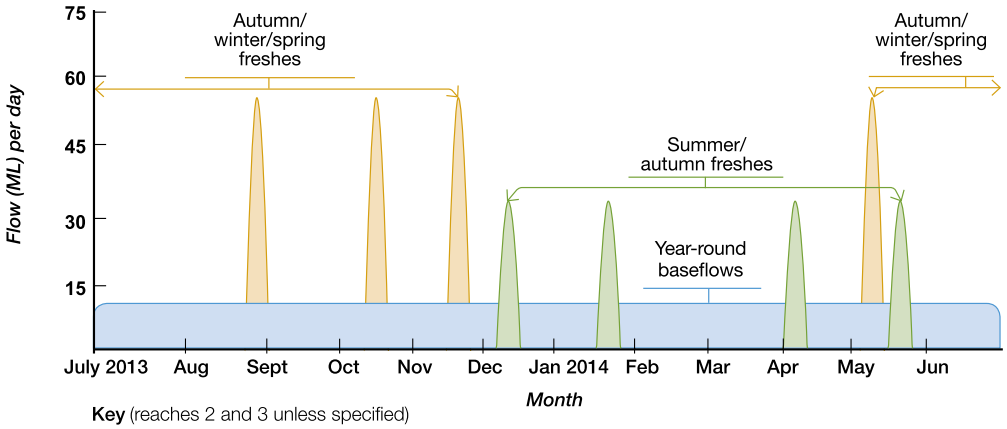
Figure 4.2.2 Priority watering actions in the Wimmera River[1]



Key (reach 4, unless specified)

- Year-round baseflows, 18 ML/day or natural with cease to flow event of up to 7 days
- 3-4 summer/autumn freshes, 100 ML/day, 14 days each (Dec-May)
- 3-4 winter/spring freshes, 100 ML/day, 14 days each (Jun-Nov)
- Spring fresh, 200 ML/day, 1-2 days (Nov)
- Winter/spring baseflows in reaches 2 and 3, 100 ML/day (Jun-Nov)

Figure 4.2.3 Priority watering actions in the MacKenzie River[1]

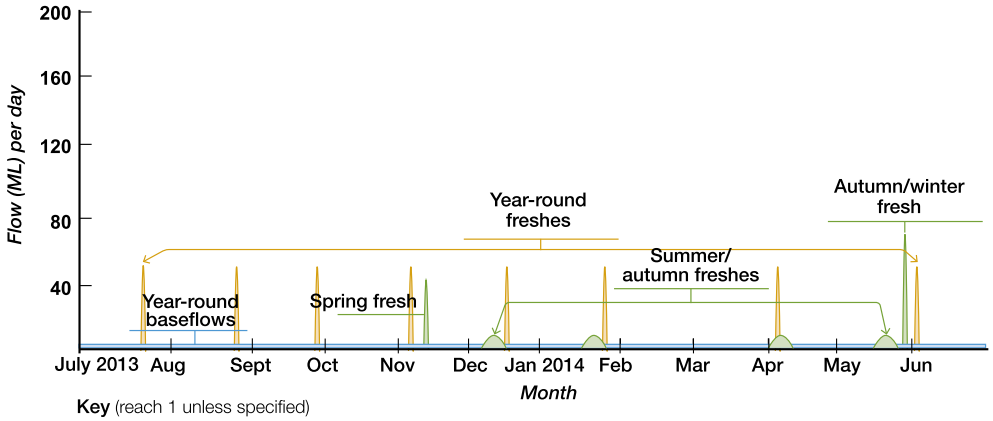


Key (reaches 2 and 3 unless specified)

- Year-round baseflows, 2-10 ML/day or natural
- 3-4 summer/autumn freshes, 5-35 ML/day, 4-7 days each (Dec-May)
- 1-4 autumn/winter/spring freshes, 35-55 ML/day, 2-7 days each (May-Nov)

1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary

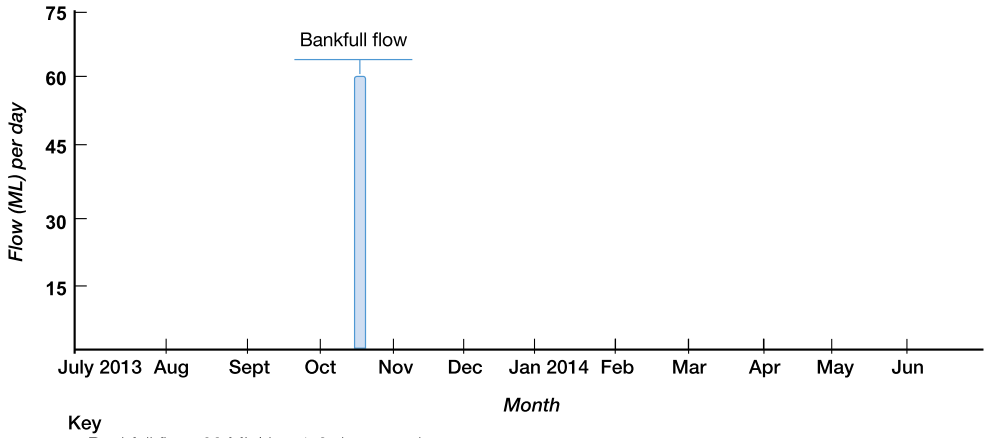
Figure 4.2.4 Priority watering actions in Burnt Creek[1]



Key (reach 1 unless specified)

- Year-round baseflows, 1 ML/day or natural
- 3-4 summer/autumn freshes, 10 ML/day, 14 days each (Dec-May)
- 8 year-round freshes in reach 2, 55 ML/day, 2 days each
- Spring fresh, 30 ML/day, 2 days (Nov)
- Autumn/winter fresh, 75 ML/day, 1 day (May-Jun)

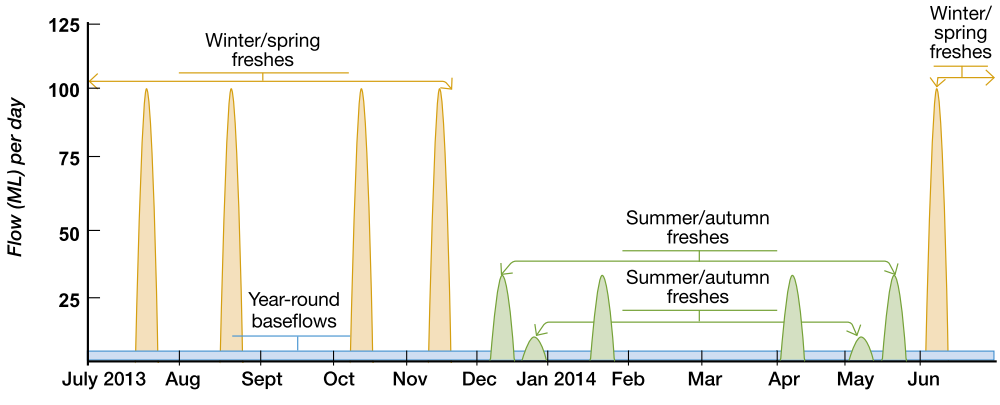
Figure 4.2.5 Priority watering actions in Bungalally creek[1]



Key

- Bankfull flow, 60 ML/day, 1-2 days, anytime

Figure 4.2.6 Priority watering actions in Mount William Creek[1]



Key (Lower Mount William Creek, unless specified)

- 2 summer/autumn freshes in upper Mount William Creek, >1 ML/day, 5 days each (Dec-May)
- Year-round baseflows, 5 ML/day or natural, with a cease to flow event of up to 30 days
- 3-4 summer/autumn freshes, 30 ML/day, 7 days each (Dec-May)
- 5 winter/spring freshes,100 ML/day, 5 days each (Jun-Nov)

Risk assessment and management

A number of risks have been assessed, and mitigation strategies identified, relating to the implementation of priority watering actions. Table 4.2.3 summarises the medium and high risks, and the mitigating strategies identified by the Wimmera Catchment Management Authority.

Table 4.2.3 Risk management in the Wimmera system

Risk type	Mitigating strategy
Key stakeholders (community) unsupportive of environmental water release	Ensure the environmental water reserve management process is rigorous and scientifically based Continue to educate community/other authorities on the importance of releases
Release volume is insufficient in meeting required flow at target point	Visual monitoring and automated gauging assists in altering environmental water releases if necessary Temporarily block Yarriambiack Creek off-take, if required
Construction at Dimboola Weir prevents flow	Wimmera Catchment Management Authority has a position on the steering committee for weir design and construction and has provided recommendations for the project; attend meetings /monitor progress and inform project managers about issues that need to be addressed
New recommendations on environmental flow inaccurate	Conduct monitoring to improve environmental flow recommendations
Storage manager maintenance works affect ability to deliver water	Ongoing dialogue with Grampians-Wimmera-Mallee Water regarding storage status and the development of contingency plans to release water through other points
Storage manager cannot deliver required volume or flow rate (ie. outlet/capacity constraints, insufficient storage volume)	Ongoing dialogue with Grampians-Wimmera-Mallee Water regarding storage status and the development of contingency plans to release water through other points Potential for works to be undertaken to improve delivery rates May require reprioritisation of flows in certain areas (eg. MacKenzie/Burnt/Bungalally) should storage levels remain low
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, etc.)	Monitor salinity and dissolved oxygen Undertake further research into saline pools
Improved conditions for non-native species (eg. carp)	Research species control methods (eg. Daniel Carp Trap)
Environmental water account is overdrawn	Regular consideration of water availability and correct scenario outcomes to determine priority watering actions in consultation with storage manager, Glenelg Hopkins Catchment Management Authority and VEWH
Environmental releases causes flooding of private land, public infrastructure or Crown land	Monitor upstream inflows and cease releases when high flows are occurring or substantial rainfall forecast
Unable to provide evidence in meeting environmental objective	Undertake monitoring (eg. through the Victorian Environmental Flows Monitoring and Assessment Program)
Limited catchment management authority resources to deliver environmental release	Multiple Wimmera Catchment Management Authority staff to implement the seasonal watering plan, thereby reducing the resourcing risk
Cost of delivery exceeds available funding	No costs associated with delivery
Environmental releases cause personal injury to river user	Releases occur within moderate volumes described, public communication (SMS service) of environmental releases

4.3 Wimmera-Mallee wetland system

Waterway managers – Mallee Catchment Management Authority, Wimmera Catchment Management Authority and North Central Catchment Management Authority

Storage manager – Grampians-Wimmera-Mallee Water

The Wimmera-Mallee wetlands system is made up of over 40 small wetlands including freshwater meadows, open freshwater lakes and freshwater marshes located on public and private land in western Victoria. The wetlands vary in size and consist of a diverse range of vegetation communities, which are home to a huge variety of native waterbirds and other animals. In addition, these wetlands provide a wide range of social values, with the presence of water in the landscape highly valued by the community, providing places for recreational activities including canoeing and bird watching.

System overview

Water delivery infrastructure modernisation throughout the Wimmera-Mallee region has seen a shift from open channel systems to a highly-efficient piped water supply system. This change has resulted in significant water savings, which have been redirected to deliver economic, social and environmental benefits in the region. A number of important wetlands in the Wimmera-Mallee region periodically received outflows from the open channel system in addition to localised inflows during very wet periods, supporting various environmental values. The need for water to support these values was recognised through the creation of a 1,000 ML entitlement to supply wetlands that formally received intermittent inflows via the channel system.

There is great variation in the character of the wetlands, which provide habitat, feeding and breeding opportunities for a variety of native waterbird populations, including brolgas, egrets, blue-billed ducks, freckled ducks, Australian painted snipe and glossy ibis. They also provide a valuable source of water for other native animals such as the vulnerable growling grass frog. Important vegetation communities are present in wetlands, such as spiny lignum, ridged water milfoil and cane grass, providing diverse habitat for a myriad of animal species.

42 high-value wetlands have been prioritised for connection to the Wimmera-Mallee pipeline (see Figure 4.3.1). These wetlands were assessed by the environmental importance of the wetland, its hydrology, land management, feasibility of connection and delivery capacity. The progressive connection of wetlands to the pipeline should be completed in 2013-14. Additional sites have been identified and their connection is subject to funding. Environmental water available under the wetland component of the entitlement is supplied by the Wimmera-Mallee pipeline.

The Wimmera-Mallee wetlands are located in parts of the Mallee, Wimmera, and North Central catchment management authority areas.

Pictured: Bull Swamp by MCMA

Figure 4.3.1. The Wimmera-Mallee wetland system

Mallee Catchment Management Authority

1 Barbers Swamp
2 Beulah Weir Pool
3 Broom Tank
4 Bull Swamp
5 Chiprick
6 Clinton Shire Dam
7 Cokym Busland Reserve
8 Considines
9 Coundons Wetland
10 Cronomby Tanks
11 D Smith
12 Lake Danahur Bushland Reserve
13 Goulds Reserve
14 Greens Wetland (2)
15 Homelea
16 J Ferrier Wetland
17 John Ampt
18 Kath Smith Dam
19 Towma (Lake Marlbed)
20 Tchum Lake Reserve
21 Mahoods Corner
22 Moreton Plains Reserve
23 Pam Juergens Dam
24 Part of Gap Reserve
25 Paul Barclay
26 Poyner
27 R Ferriers Dam
28 Rickard Glenys Dam
29 Roselyn Wetland/Reids Dam
30 Round Swamp Bushland Reserve
31 Shannons Wayside

Wimmera Catchment Management Authority

32 Carapugna
33 Challambra Swamp
34 Harcoans
35 Mutton
36 Pinedale
37 Sawpit Swamp
38 Wal Wal Swamp
39 Krong Swamp
40 Crow Swamp
41 Opie's Dam
42 Fieldings Dam
43 Tarkedia Dam
44 Russell Schultz/Brian Koschitzke

North Central Catchment Management Authority

45 Creswick Swamp
46 Cherrip Swamp
47 Davis
48 Corack Lake
49 Jeffcott Wildlife Reserve
50 Falla Dam
51 Jesse Swamp

Current situation

The recent watering history for the wetlands depended on factors including: whether the wetland was supplied from the south (Grampians channel system) or north (Waranga channel system); whether the wetland received water during drought; and how much of the wetland was inundated. Most of the wetlands dried completely during the late 1990s and 2000s, though some received inflows during the 2010-11 floods.

Catchment conditions throughout 2012-13 have been dry, with water in most wetlands completely evaporating or seeping. Although the cycle of wetting and drying maintains the wetland's ecological character, this drying resulted in some wetlands experiencing stress.

Since 2011, environmental water has been delivered to five wetlands in the Mallee region, including Barbers Swamp, Roslyn Wetland, Morton Plains, Bull Swamp and Beulah Weir Pool, in addition to Sawpit Swamp in the Wimmera region. This water delivery improved the condition of wetland vegetation communities, increased waterbird activity, and provided an important water source for native animals.

Priority watering action and environmental objectives

Potential priority watering actions along with their associated environmental objectives are provided in Table 4.3.1.

The overarching environmental objectives are to: provide habitat for waterbirds, reptiles and frogs; and maintain the condition of fringing wetland vegetation. Improving the condition of aquatic and terrestrial wetland vegetation ensures that animal species have habitat and water resources available in a predominantly dry landscape.

In addition to the environmental objectives, some of these watering actions may also provide recreational opportunities such as yabbying, bird watching and camping.

Table 4.3.1 Priority watering actions for the Wimmera-Mallee wetland system

Catchment management authority area	Priority sites to receive environmental water in 2013-14	Maximum volume (ML)
Total expected availability of Water Holdings		1,278 ML carryover 480 - 1,000 ML allocation 1,758 - 2,278 ML total
Mallee	Barbers Swamp; Beulah Weir Pool; Broom Tank; Bull Swamp; Chiprick; Clinton Shire Dam; Cokym Busland Reserve[1]; Considines[1]; Coundons Wetland; Cronomby Tanks; Lake Danahur Bushland Reserve; Goulds Reserve; Greens Wetland (2); Homelea; J Ferrier Wetland; John Ampt; Kath Smith Dam; Towma (Lake Marlbed); Tchum Lake Reserve; Mahoods Corner; Moreton Plains Reserve; Pam Juergens Dam; Part of Gap Reserve; Poyner[1]; R Ferriers Dam; Rickard Glenys Dam; Roselyn Wetland/Reids Dam; Round Swamp Bushland Reserve; Shannons Wayside. Possible wetlands to be connected: D Smith; Paul Barclay;	1,167 ML
Wimmera	Carapugna; Challambra Swamp; Harcoans; Mutton; Pinedale; Sawpit Swamp; Wal Wal Swamp; Krong Swamp; Crow Swamp Possible wetlands to be connected: Opie's Dam; Fieldings Dam; Tarkedia Dam; Schultz/ Koschitzke.	400 ML
North Central	Creswick Swamp; Cherrip Swamp; Davis; Corack Lake; Jeffcott Wildlife Reserve Possible wetlands to be connected: Falla Dam; Jesse Swamp	147 ML
Possible volume required from the Water Holdings		1,714 ML
Possible carryover into 2013-14		44 - 564 ML

1 These wetlands have been connected to the Northern Mallee supply system, rather than the Wimmera-Mallee pipeline supply system. Therefore, it is uncertain whether these wetlands can be supplied under the Wimmera and Glenelg Rivers Environmental Entitlement 2010, as water needs to be supplied from the Murray system. Mallee Catchment Management Authority and the VEWH will work with Grampians-Wimmera-Mallee Water to resolve this supply issue.

General triggers for undertaking watering actions have been included in the regional overview for the Western Region (refer to section 4).

Most Wimmera-Mallee wetlands are considered off-stream wetlands as they do not receive water from a recognised watercourse. Unlike connected floodplain wetlands, catchment conditions should not strongly influence environmental water requirements unless there is flooding event that reduces the need for water in the wetlands.

Environmental water delivery to the wetlands relies on completed infrastructure and capacity in the Wimmera-Mallee pipeline system. Catchment management authorities will work closely with Grampians-Wimmera-Mallee Water and land managers (including Parks Victoria and landowners) to implement water management throughout the season.

Environmental water deliveries will occur in each catchment management authority area, depending upon the volume delivered and capacity available in the pipeline. In most cases, wetlands will be filled from empty; in some cases, the wetlands will only require a top up. In all cases, the aim is to maintain and improve vegetation condition to promote development as water levels recede.

Risk assessment and management

In the Wimmera-Mallee wetland system, a number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 4.3.2 summarises these risks, and the mitigating strategies identified by the relevant catchment management authority.

Table 4.3.2 Risk management in the Wimmera-Mallee wetland system

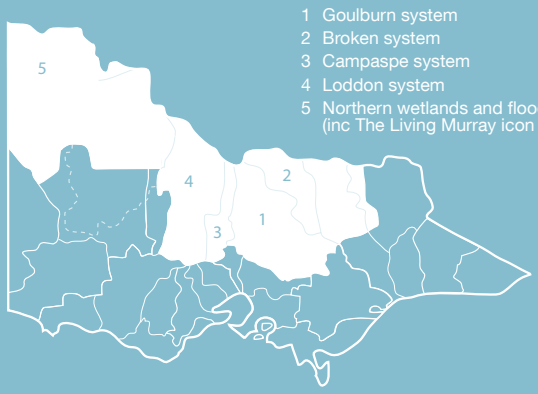
Risk type	Mitigating strategy	Catchment Management Authority
Current recommendations on environmental flows are inaccurate	Base decisions on best available science Adopt a 'learn-by-doing' approach to water management Research flow requirements and ecological values of sites Review watering actions with relevant stakeholders to ensure recommendations are adaptively managed over time	Mallee, North Central, Wimmera
Unable to provide evidence in meeting ecological objective	Define ecological objectives, through development of environmental water management plans for each site Seek funding to establish and undertake monitoring and condition assessments Seek funding to undertake a bathymetry/hydraulic study to understand required volumes and behaviour of the water	Mallee, North Central, Wimmera
Storage manager cannot deliver required volume or flow rate (ie. outlet/capacity constraints, insufficient storage volume)	Engage Grampians-Wimmera-Mallee Water throughout watering season to assist with timing of releases when there is sufficient capacity to meet requirements	Mallee, North Central, Wimmera
Environmental water account is overdrawn	Water orders are lodged with Grampians-Wimmera-Mallee Water who manage the delivery in accordance with the delivery plan Ensure outlets are locked to prevent public from operating valves	Mallee

Table 4.3.2 Risk management in the Wimmera-Mallee wetland system (continued)

Risk type	Mitigating strategy	Catchment Management Authority
Release volume is insufficient to meet target flow	Ongoing dialogue with storage manager regarding demand in the system, to assist in timing releases when there is available capacity to meet desired flow rates Initial calculations show delivery rates will be insufficient to provide required volumes at some wetlands to meet watering objectives, therefore delivery over multiple years may be required to achieve desired watering outcomes	Mallee, North Central, Wimmera
Limited catchment management authority resources to deliver environmental release	Ensure environmental water management within catchment management authority adequately resourced for delivery tasks Seek funding if required	Mallee, North Central, Wimmera
Storage manager maintenance works affect ability to deliver water	Adaptively managing according to possible limitation (ie. that not all wetlands will be connected to the Wimmera-Mallee Pipeline by spring 2013-14) Ongoing dialogue with storage manager regarding potential maintenance works and likely effect on delivery of water	Mallee, North Central, Wimmera
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid sulphate soils etc.)	Undertake relevant water quality monitoring activities at wetlands to ensure any water quality issues are observed in a timely manner, and can be managed appropriately	Mallee, North Central, Wimmera
Improved conditions for non-native species (eg. gambusia)	Observe condition and salinity levels of wetlands and manage accordingly, through actions such as flushing	North Central
Environmental releases cause flooding of private land	Work with land manager to ensure one (or more) agencies are monitoring wetland level and water movement during environmental water deliveries (particularly important in the first fill event undertaken at each wetland) Landholder agreement (ie. deed of agreement) to be sought for all private land wetlands to be inundated Slow delivery rates allow adequate time to mitigate/ assess potential impact Development of delivery plans outlining details associated with watering for endorsement by VEWH	Mallee, North Central, Wimmera
Environmental releases cause flooding of Crown land	Agreement obtained from land manager for flooding on Crown land	Mallee, Wimmera
Key stakeholders unsupportive of environmental water release	Regular community updates regarding watering plans and actions	Wimmera

Section 5

Northern Region



1 Goulburn system
2 Broken system
3 Campaspe system
4 Loddon system
5 Northern wetlands and floodplains (inc The Living Murray icon sites)

Northern Region overview

There are nine systems that can receive water from the Water Holdings in northern Victoria (see sections 5.1 - 5.6). These include the Goulburn, Broken, Loddon and Campaspe river systems; the northern Victorian wetlands and floodplains; and the Living Murray icon sites of Barmah Forest, Gunbower Forest, Hattah Lakes and Lindsay-Wallpolla Islands.

Northern Victoria is part of the Murray-Darling Basin, in which water sharing is governed by the *Murray-Darling Basin Agreement*. This agreement guides how much water is allocated to Victoria, New South Wales and South Australia. Each State then has its own entitlement framework for allocating its share of water to water users.

Northern Victoria is renowned for its irrigated agricultural production that has developed over the past century. The water systems in northern Victoria are highly connected, allowing water to move between systems.

Water Holdings available for use in the northern Victorian systems are held in Murray, Goulburn, Loddon and Campaspe storages. In addition to Victorian Water Holdings, the VEWH also coordinates the delivery of Living Murray and Commonwealth environmental water from Victorian tributaries. The VEWH authorises waterway managers to order Living Murray and Commonwealth water for downstream sites, provided there are no adverse impacts on Victorian waterways. The VEWH will liaise with the Murray-Darling Basin Authority and the Commonwealth Environmental Water Office to maximise the environmental benefits of this water delivery in Victorian systems.

Water Holdings in the Northern Region

Table 5.0.1 Water Holdings available for use in the Northern Region

Entitlement	Description
Murray system	
Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999[1]	28,750 ML high-reliability entitlement 40,000 ML unregulated entitlement
	Barmah-Millewa Forest Environmental Water Allocation 50,000 ML high-reliability entitlement 25,000 ML low-reliability entitlement
	Living Murray 5,710 ML high-reliability entitlement 101,850 ML low-reliability entitlement 34,300 ML unregulated entitlement
Environmental Entitlement (River Murray – NVIRP Stage 1) 2012	One-third of the total water savings from NVIRP Stage 1 achieved in the Murray component of the Goulburn-Murray Irrigation District, as verified in the latest audit; and any mitigation water available in the Murray system in that year
River Murray Increased Flows[2]	70,000 ML long-term average
Goulburn system	
Environmental Entitlement (Goulburn System – Living Murray) 2007	49,625 ML high-reliability entitlement 156,980 ML low-reliability entitlement
Environmental Entitlement (Goulburn System - NVIRP Stage 1) 2012	One-third of the total phase 4 water savings from NVIRP Stage 1 achieved in the Goulburn component of the Goulburn Murray Irrigation District, as verified in the latest audit; and any mitigation water available in the Goulburn System in that year

Table 5.0.1 Water Holdings available for use in the Northern Region (continued)

Entitlement	Description
Goulburn system	
Goulburn River Environmental Entitlement 2010	1,432 ML high-reliability entitlement for use in the Loddon system, downstream of Loddon Weir
Silver and Wallaby Creeks Environmental Entitlement 2006	Passing flows
Campaspe system	
Environmental Entitlement (Campaspe River – Living Murray Initiative) 2007	126 ML high-reliability entitlement 5,048 ML low-reliability entitlement
Campaspe River Environmental Entitlement 2013[3]	20,583 high-reliability entitlement 2,900 low-reliability entitlement
Loddon system	
Bulk Entitlement (Loddon River – Environmental Reserve) 2005[1]	7,490 ML high-reliability entitlement for use below Loddon Weir 2,024 ML low-reliability entitlement 3,480 ML high-reliability entitlement for use in Boort wetlands Passing flows, including ability to withhold passing flows for release at a later time Access to surplus flows (flows which cannot be captured in storage and pass downstream)
Environmental Entitlement (Birch Creek – Bullarook System) 2009	100 ML entitlement (fully available when allocations for Bullarook high-reliability water shares are at 20%) Passing flows Above cap water
Commonwealth Environmental Water Holdings[5]	
Ovens system[6]	70 ML high-reliability entitlement
Murray system	242,013 ML high-reliability entitlement 11,765 ML low-reliability entitlement
Broken system	117 ML high-reliability entitlement 4 ML low-reliability entitlement
Goulburn system	203,615 ML high-reliability entitlement 11,389 ML low-reliability entitlement
Campaspe system	6,547 ML high-reliability entitlement 395 ML low-reliability entitlement
Loddon system	2,775 ML high-reliability entitlement 527 ML low-reliability entitlement
Other Living Murray entitlements[7]	
Victoria	17,518 ML high-reliability water share
New South Wales	5,620 ML high security entitlement 212,680 ML general security entitlement 350,000 ML supplementary entitlement 12,970 ML unregulated entitlement
South Australia	45,020 ML water licence entitlement high-reliability

1 Entitlement amendment to include the additional 1,150 ML high-reliability entitlement expected to be completed by 30 June 2013.

2 Ability to call on water from Snowy Hydro Scheme to provide increased flows in Hume Reservoir. Entitlement is under development.

3 Entitlement expected to be created by 30 June 2013.

4 Entitlement amendment to include the additional 1,480 ML high-reliability entitlement expected to be completed by 30 June 2013.

5 Commonwealth Environmental Water Holdings as at 31 March 2013.

6 There are no Victorian Water Holdings in the Ovens system, therefore management of this system has not been included in this plan.

7 Living Murray entitlements held by the Murray-Darling Basin Authority or other jurisdictions, as at 7 May 2013.

Consultation

The Mallee, North Central and Goulburn Broken catchment management authorities have consulted stakeholders in the preparation of the seasonal watering proposals for the Broken, Goulburn, Campaspe and Loddon river systems, Barmah Forest, Gunbower Forest, Hattah Lakes, Lindsay-Wallpolla Islands, and the northern Victorian wetlands and floodplains. These stakeholders are shown in Table 5.0.2.

Table 5.0.2 Key stakeholders involved in the preparation of the seasonal watering proposals

Broken system
Broken Environmental Water Advisory Group (made up of community members)
Goulburn-Murray Water
River Murray Water (Murray-Darling Basin Authority)
Goulburn Broken Catchment Management Authority Board
VEWH
Goulburn system
Goulburn Environmental Water Advisory Group (made up of community members)
Yorta Yorta Nation Aboriginal Corporation
Goulburn-Murray Water
Parks Victoria
Goulburn Broken Catchment Management Authority Board
VEWH
Campaspe system
Campaspe Environmental Water Advisory Group (made up of community members, Department of Environment and Primary Industries, Goulburn-Murray Water, Catchment Management Authority staff, and Commonwealth Environmental Water Office)
Goulburn-Murray Water
Coliban Water
North Central Catchment Management Authority Board
Natural Resource Management Committee
VEWH
Loddon system
Loddon Environmental Water Advisory Group (made up of community members, Department of Environment and Primary Industries, Goulburn-Murray Water, Catchment Management Authority staff, Commonwealth Environmental Water Office, Parks Victoria, and Field and Game Victoria)
Bullarook Environmental Water Advisory Group (made up of local community members and Goulburn-Murray Water)
Goulburn-Murray Water
North Central Catchment Management Authority Board
Natural Resource Management Committee
VEWH
The Living Murray icon sites
Barmah Forest
Yorta Yorta Nation Aboriginal Corporation
River Murray Water
New South Wales National Parks and Wildlife Service
Parks Victoria
Department of Environment and Primary Industries
Commonwealth Environmental Water Office
Murray-Darling Basin Authority
Goulburn Broken Catchment Management Authority staff and Board
VEWH

Table 5.0.2 Key stakeholders involved in the preparation of the seasonal watering proposals (continued)

Gunbower Forest
Gunbower Environmental Water Advisory Group (with representation from Goulburn-Murray Water, Parks Victoria, Department Environment and Primary Industries [regional], State Forests New South Wales, North Central Catchment Management Authority and VEWH)
Gunbower Technical Working Group (with representation from Department Environment and Primary Industries [Threatened Flora and Fauna], Goulburn Broken Catchment Management Authority and specialist consultants and ecologists in fish, vegetation and birds)
Gunbower Forest Community Reference Group
Natural Resource Management Committee
North Central Catchment Management Authority Board
VEWH
Hattah Lakes
Mallee Catchment Management Authority community committees
Goulburn-Murray Water
SA Water
Lower Murray Water
Parks Victoria
Murray-Darling Basin Authority
New South Wales Office of Water
VEWH
Lindsay-Wallpolla Islands
Mallee Catchment Management Authority community committees
Goulburn-Murray Water
SA Water
Lower Murray Water
Parks Victoria
Murray-Darling Basin Authority
New South Wales government
VEWH
Northern wetlands and floodplains
Central Murray Wetlands Environmental Water Advisory Group (made up of local community members, Department of Environment and Primary Industries, Goulburn-Murray Water, North Central Catchment Management Authority staff, Commonwealth Environmental Water Office, and Parks Victoria, Field and Game Victoria, and Birdlife Australia)
Goulburn-Murray Water
Lower Murray Water
Murray-Darling Basin Authority
New South Wales Office of Water
Parks Victoria
Private landholders
North Central Catchment Management Authority Natural Resource Management Committee (NRMC)
Goulburn Broken, North Central and Mallee catchment management authority Boards
VEWH

Triggers for action

Factors considered in the delivery of priority watering actions include:

- seasonal conditions, including weather forecasts
- river and system operations, including unregulated flows, catchment inflows, and any relevant capacity constraints
- ecological condition of the sites (eg. presence of breeding waterbirds)
- managing ecological risks associated with an action, such as water quality
- the outcomes of scientific studies and monitoring
- social values and any other identified issues.

5.1 Goulburn system

Waterway manager – Goulburn Broken Catchment Management Authority
Storage manager – Goulburn-Murray Water

The Goulburn is Victoria's largest river basin, covering over 1.6 million hectares or 7.1 percent of the State. The Goulburn River flows for 570 kilometres from the Great Dividing Range upstream of Woods Point to the River Murray east of Echuca. It is an iconic heritage river because of significant environmental, recreational and cultural values. It supports large areas of intact river red gum forest, and provides habitat for threatened and endangered bird and fish species. It also contains important cultural heritage sites, provides water for Victoria's largest irrigation district and supports recreational activities such as fishing and canoeing.

System overview

Lake Eildon and Goulburn Weir have significantly modified the Goulburn River's flow pattern. Lower flows in the mid Goulburn River (Lake Eildon to Lake Nagambie) now occur in winter and spring due to the impact of water harvesting, with higher flows in summer and autumn due to releases to meet irrigation and consumptive demands. However, below Lake Eildon, flows increase progressively downstream due to tributary inflows, particularly in winter and spring. The operation of Goulburn Weir significantly reduces the average annual flow in the lower Goulburn River. Although substantial flows are released in summer and early autumn to supply demand in the Murray system, the lower Goulburn River retains a natural seasonal flow pattern due to the influence of the Broken River and the Seven Creek, and the irrigation water diversion at Goulburn Weir.

The Goulburn River flow regime is also affected by activities within the catchment, including vegetation alterations, and construction of small dams and drainage schemes. In addition, downstream of Shepparton, levees and other structures obstruct water inundating the floodplain.

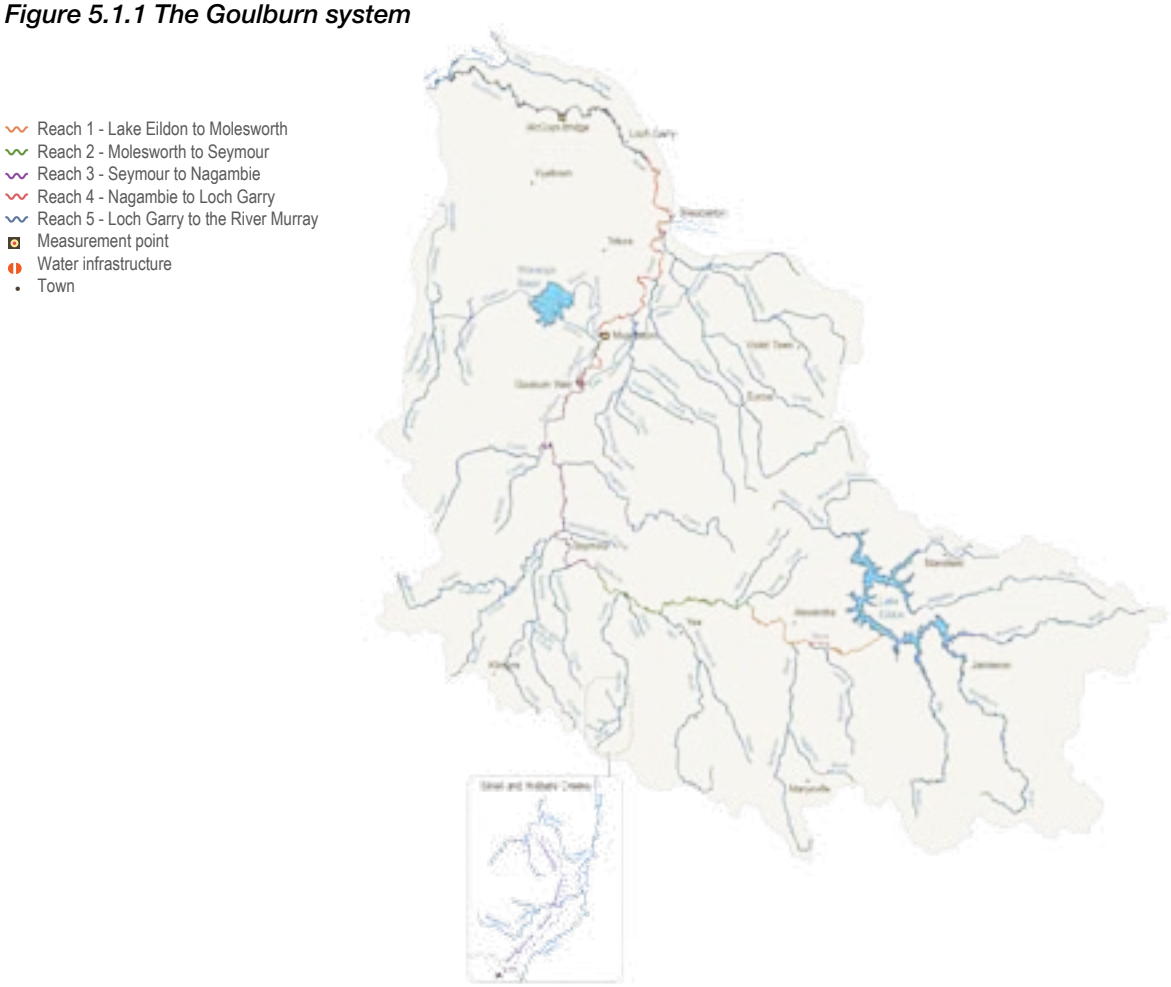
The priority river reaches for environmental watering are reaches 4 and 5 (from Goulburn Weir to the River Murray), with reaches 1, 2 and 3 (between Lake Eildon and Goulburn Weir), benefiting or at least not being adversely impacted from flows passing to the lower reaches. Reaches 4 and 5 of the Goulburn River provide important habitat for native fish communities, including small-bodied fish such as carp gudgeon and large-bodied fish such as golden perch, Macquarie perch, trout cod, Murray cod and freshwater catfish. The measurement points for target flows are at Murchison for reach 4 and McCoys Bridge for reach 5. The environmental flow reaches are shown in Figure 5.1.1.

Water Holdings in the Goulburn system can be released from Lake Eildon for reaches 1 to 3 and Goulburn Weir for reaches 4 and 5. Water can also be traded for use in the Goulburn system from other systems including the Murray, subject to trading rules.

Passing flows are provided under Goulburn-Murray Water's bulk entitlements and consumptive water is delivered down the Goulburn River en route to the River Murray. Consumptive water provides significant environmental benefits if delivered at the right time. High flows in summer can have an adverse effect on the system and need to be limited where possible; the larger and longer the flow, the more potential for ecological damage. Commonwealth and Living Murray Water Holdings are also delivered through the Goulburn to downstream sites. There is significant opportunity to optimise outcomes in the Goulburn River from delivery of all of this water en route.

Pictured: Lower Goulburn River floodplain by GBCMA

Figure 5.1.1 The Goulburn system



Current situation

Between autumn 2011 and autumn 2012, the Goulburn River experienced natural freshes, bankfull and overbank flows as a result of widespread and heavy rainfall. In 2012-13, conditions became relatively dry, particularly during the spring and summer. Targeted environmental releases, combined with natural flows, resulted in almost all of the 2012-13 priority watering actions being provided.

Terrestrial vegetation lost from the lower river bank during the 2010-11 floods began to return in the summer of 2012-13. The recovery of vegetation on the upper river banks of the Goulburn River has improved, and the remaining floodplain vegetation is generally in good condition. Bank slumping and notching has been an issue in 2012-13 requiring careful management.

Targeted golden perch breeding largely did not occur in 2012-13. Murray cod remain absent in the lower Goulburn system since the 2010 blackwater event; however, Murray cod larvae were detected there in 2012-13.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 5.1.1.

The priority environmental objectives are: providing appropriate habitats and cues for fish including for spawning, recruitment and migration; enhancing aquatic vegetation extent and diversity; enhancing riparian vegetation extent and diversity; improving the abundance and diversity of macroinvertebrate communities; and minimising river bank slumping and erosion.

In addition to the environmental objectives, these watering actions will also support social values associated with passive recreation, fishing and boating.

Table 5.1.1 Priority watering actions and environmental objectives for the Goulburn system

Priority watering action	Environmental objective
Winter/spring baseflows (500 ML per day in reach 4 and/or 540 ML per day in reach 5 from July to November)	Provide slow shallow habitat required for larvae/juvenile recruitment and adult habitat for small-bodied fish Provide deep water habitat for large-bodied fish Provide conditions suitable for aquatic vegetation, which provides habitat for macroinvertebrates Submerge snag habitat to provide habitat and food resources for macroinvertebrates Provide slackwater habitat to provide food resources and habitat for macroinvertebrates Make organic matter available as food/habitat source for macroinvertebrates Maintain water quality suitable for macroinvertebrates
Spring/summer extended fresh (up to 15,000 ML per day for two days followed by 14 days at or above 5,600 ML per day in reach 4 and/or reach 5 during October to December)	Initiate spawning and pre-spawning migrations and recruitment of native fish (golden perch) Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat Remove terrestrial vegetation and re-establish amphibious vegetation on river banks
Summer baseflows (500 ML per day in reach 4 and/or 540 ML per day in reach 5 from December to February)	Provide slow shallow habitat required for larvae/juvenile recruitment and adult habitat for small-bodied fish Provide deep water habitat for large-bodied fish Provide conditions suitable for aquatic vegetation, which provides habitat for macroinvertebrates Submerge snag habitat to provide habitat and food resources for macroinvertebrates Provide slackwater habitat to provide food resources and habitat for macroinvertebrates Make organic matter available as food/habitat source for macroinvertebrates Maintain water quality suitable for macroinvertebrates
Autumn/winter baseflows (500 ML per day in reach 4 and/or 540 ML per day in reach 5 from March to June)	Provide slow shallow habitat required for larvae/juvenile recruitment and adult habitat for small bodied fish Provide deep water habitat for large bodied fish Provide conditions suitable for aquatic vegetation, which provides habitat for macroinvertebrates Submerge snag habitat to provide habitat and food resources for macroinvertebrates Provide slackwater habitat to provide food resources and habitat for macroinvertebrates Make organic matter available as food/habitat source for macroinvertebrates Maintain water quality suitable for macroinvertebrates
Spring/summer fresh (up to 15,000 ML per day for two days in reach 4 and/or reach 5 during October to December)	Initiate spawning and pre-spawning migrations and recruitment of native fish (golden perch)
Increased winter/spring baseflows (830 ML per day in reach 4 and/or 940 ML per day in reach 5 from July to November)	Submerge snag habitat to provide habitat and food resources for macroinvertebrates
Winter freshes (two freshes up to 6,600 ML per day in reach 4 and/or reach 5 for 14 days each during June to August)	Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat Remove terrestrial vegetation and re-establish amphibious vegetation

Table 5.1.1 Priority watering actions and environmental objectives for the Goulburn system (continued)

Priority watering action	Environmental objective
Increased summer baseflows (830 ML per day in reach 4 and/or 940 ML per day in reach 5 from December to February)	Submerge snag habitat to provide habitat and food resources for macroinvertebrates
Summer/autumn fresh (up to 5,600 ML per day in reach 4 and/or reach 5 for two days during February to April)	Maintain aquatic macrophyte, macroinvertebrate and fish habitat by mobilising fine sediments, submerging snags and replenishing slackwater habitat Remove terrestrial vegetation and re-establish amphibious vegetation
Increased autumn/winter baseflows (830 ML per day in reach 4 and/or 940 ML per day in reach 5 from March to June)	Submerge snag habitat to provide habitat and food resources for macroinvertebrates
Summer/autumn baseflows/freshes (up to 5,000 ML per day in reach 4 and/or reach 5 from December to April, constant or intermittent flows)	Provide conditions suitable for the establishment of aquatic vegetation (for macroinvertebrate habitat) Provide slackwater habitat favourable for planktonic production (food source) and slackwater habitat. Maintain natural rates of sediment deposition

Table 5.1.2 Priority watering actions for the Goulburn system under a range of planning scenarios

	Planning scenario				
	Drought	Very dry	Dry	Average	Wet
Expected availability of Water Holdings[1]	22,000 ML VEWH Holdings 30,000 ML Living Murray Holdings 140,000 ML Commonwealth Holdings 192,000 ML total	22,000 ML VEWH Holdings 44,000 ML Living Murray Holdings 223,000 ML Commonwealth Holdings 289,000 ML total	22,000 ML VEWH Holdings 44,000 ML Living Murray Holdings 223,000 ML Commonwealth Holdings 289,000 ML total	22,000 ML VEWH Holdings 44,000 ML Living Murray Holdings 223,000 ML Commonwealth Holdings 289,000 ML total	22,000 ML VEWH Holdings 41,000 ML Living Murray Holdings 207,000 ML Commonwealth Holdings 270,000 ML total
Priority watering actions (first-tier)[2]	Winter/spring baseflows Spring/summer extended fresh Summer baseflows Autumn/winter baseflows Increased winter/spring baseflows	Winter/spring baseflows Spring/summer extended fresh Summer baseflows Autumn/winter baseflows Spring/summer fresh Increased winter/spring baseflows Winter/spring baseflows (carryover into 2014-15)	Winter/spring baseflows Spring/summer extended fresh Summer baseflows Autumn/winter baseflows Spring/summer fresh Increased winter/spring baseflows Winter/spring baseflows (carryover into 2014-15)	Winter/spring baseflows Spring/summer extended fresh Summer baseflows Autumn/winter baseflows Spring/summer fresh Increased winter/spring baseflows Winter fresh (2013) Winter/spring baseflows (carryover into 2014-15) Increased summer baseflows Summer/autumn fresh	Winter/spring baseflows Spring/summer extended fresh Summer baseflows Autumn/winter baseflows Spring/summer fresh Increased winter/spring baseflows Winter fresh (2013) Winter/spring baseflows (carryover into 2014-15) Increased summer baseflows Summer/autumn fresh Increased autumn/winter baseflows

Table 5.1.2 Priority watering actions for the Goulburn system under a range of planning scenarios (continued)

	Drought	Very dry	Dry	Average	Wet
Priority watering actions (second tier)[3]	Spring/summer fresh Winter/spring baseflows (carryover into 2014-15)	Increased summer baseflows Summer/autumn fresh Increased autumn/winter baseflows	Increased summer baseflows Summer/autumn fresh Increased autumn/winter baseflows	Increased autumn/winter baseflows Winter fresh (2014) Summer/autumn baseflows and freshes	Winter fresh (2014) Summer/autumn baseflows and freshes
Possible volume required from the Water Holdings	192,000 ML	289,000 ML	289,000 ML	289,000 ML	270,000 ML
Possible carryover into 2013-14[4]	10,000 ML	23,000 ML	23,000 ML	23,000 ML	23,000 ML

1 During water quality emergencies, up to 30,000 ML may also be made available from Goulburn-Murray Water's bulk entitlement to manage water quality issues. Additionally, the delivery of consumptive water en route, such as inter-valley transfers, may contribute to the achievement of some of the identified priority watering actions.

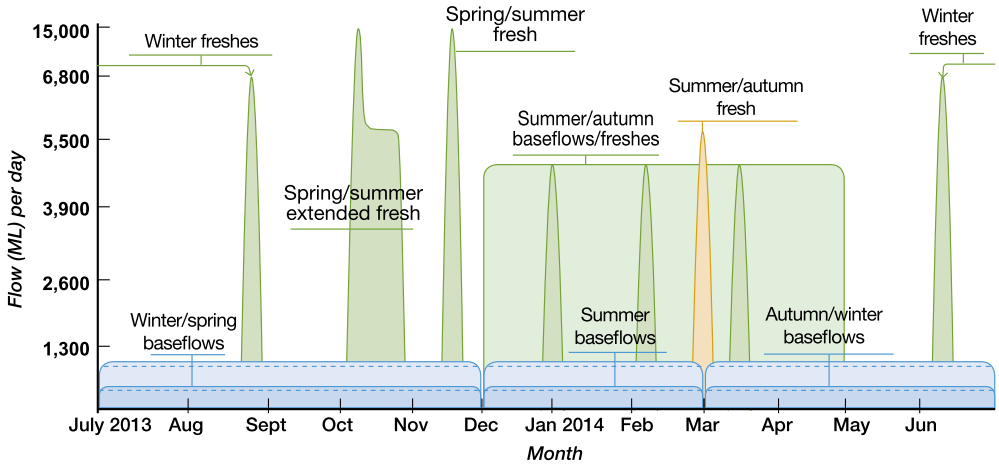
2 In addition to the watering actions identified, environmental water may be used to manage the recession of high flows to minimise any ecological impact of rapid rates of water level fall, such as bank slumping.

3 Second-tier priority watering actions will only be delivered if sufficient water is available to meet first-tier priority watering actions or if they are delivered naturally.

4 The volume identified as possible carryover into 2014-15 is a subset of the possible water required from the Water Holdings, as a result of the greater priority of carrying over water into 2014-15 than delivery of lower priority events in 2013-14.

Bankfull flows are important for maintaining channel shape and preventing in-filling of pools, while overbank flows are important for wetlands and bringing food resources into the river. However, they are not priority watering actions at this stage due to recent high and overbank flows. In addition, the feasibility of delivering overbank flow recommendations, including how best to deliver or supplement flows while avoiding damage to public and private assets, requires further investigation. Therefore, overbank flows will only be achieved if they occur naturally.

Figure 5.1.2 Priority watering actions for the Goulburn system[1]



Key
- Winter/spring baseflows, 500-830 ML/day at Murchison and/or 540-940 ML/day at McCoys (Jul-Nov)
- Spring/summer extended fresh, up to 15,000 ML/day for 2 days then 14 days at or above 5,600 ML/day (Oct-Dec)
- Summer baseflows, 500-830 ML/day at Murchison and/or 540-940 ML/day at McCoys (Dec-Feb)
- Autumn/winter baseflows, 500-830 ML/day at Murchison and/or 540-940 ML/day at McCoys (Mar-Jun)
- Spring/summer fresh, up to 15,000 ML/day, 2 days (Oct-Dec)
- 2 winter freshes, up to 6,600 ML/day, 14 days each (Jun-Aug)
- Summer/autumn fresh, up to 5,600 ML/day, 2 days (Feb-Apr)
- Summer/autumn baseflows/freshes, up to 5,000 ML/day, constant or intermittent (Dec-Apr)

1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary

General triggers for undertaking watering actions have been included in the regional overview for the Northern Region (refer to section 5).

In addition to the priority watering actions outlined above, environmental water may be used to slow the recession of unregulated flows or operational releases, to reduce the ecological damage from rapid drops in water levels. This is particularly important over the next few years given recent bank slumping concerns and lack of vegetation on the lower slopes of the river bank. It will also reduce macroinvertebrates and fish being stranded in small pools on the river banks following higher flows.

In addition, Goulburn-Murray Water's bulk entitlement makes available up to 30,000 ML of water to assist in mitigating water quality emergencies in the Goulburn and lower Broken Creek systems, such as blackwater events.

The focus for 2013-14 is to continue encouraging the long term improvement in the distribution, abundance and diversity of native fish, macroinvertebrates and vegetation. This will be achieved by implementing minimum and fresh flow recommendations, particularly in winter/spring. However, there will be additional emphasis on bank stability and the re-establishment of lower bank vegetation to start the recovery process.

The provision of one or two freshes with the highest possible flow rise (up to 15,000 ML per day) aims to stimulate golden perch breeding. Given the risks associated with providing these higher flow peaks, a risk assessment will consider catchment conditions, rainfall, system operations and other factors prior to the delivery of any managed release. These freshes will also target bank vegetation objectives by maintaining higher flows for a longer duration (up to 5,600 ML per day for 14 days) to encourage riparian vegetation germination on the bank and allow macroinvertebrates to respond to the inundation of snags.

In 2013-14, the need to carry over water to meet potential needs for 2014-15 was considered. Prior to delivering increased baseflows and a summer/autumn fresh in 2013-14, water should be carried over to deliver some winter/spring baseflows in early 2014-15 to target fish-related objectives.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 5.1.3 summarises these risks, and the mitigating strategies identified by the Goulburn Broken Catchment Management Authority.

Table 5.1.3 Risk management in the Goulburn system

Risk type	Mitigating strategy
Current recommendations on environmental flow inaccurate	Monitor outcomes from flow management and reassess recommendations as necessary
Improved conditions for non-native species (eg. carp)	None available
Unable to provide evidence in meeting environmental objective	Seek involvement in, and contributions and results from monitoring and research programs
Environmental release interfere with irrigation pumps and pumping	Provide public information on environmental water release intentions, and alter environmental water release management if possible
Environmental releases cause flooding of private land	Consider potential catchment runoff from forecast rainfall in deciding when to commence releases and whether to prematurely cease releases
Key stakeholders unsupportive of environmental water release	Keep key stakeholders aware of environmental water release plans and timing
Limited catchment management authority resources to deliver environmental release	Seek resources to manage flows

5.2 Broken system

Waterway manager – Goulburn Broken Catchment Management Authority
Storage manager – Goulburn-Murray Water

The Broken Creek flows from the Broken River at Casey's Weir north-west to the River Murray, just downstream of Barmah Forest. It supports threatened plant and animal species, including six native fish species of State and National conservation significance, and icon species such as the Murray cod. The Broken Creek also supports riparian vegetation, especially in the lower reaches. It forms an important part of the irrigation distribution system, delivering water from the Murray and Goulburn systems into the Murray Valley and Shepparton irrigation districts. It is also an important area for recreational fishing and bushwalking.

System overview

The lower Broken and Nine Mile creeks have been regulated for over 50 years, significantly altering their flow regimes. Under natural conditions the creeks would have flowed in response to significant rainfall (mainly in winter/spring) and would have ceased to flow for extended periods during summer and autumn. Today, significant flows are maintained throughout summer and autumn to supply water for irrigation, domestic and stock use.

From east of Nathalia downstream, the Broken Creek has eight shallow weirs providing a near-constant water level that facilitates the extraction of irrigation and consumptive water. While the weir pools provide important native fish habitat, their water quality is often poor in summer and autumn. Dissolved oxygen levels and azolla build-up are water quality issues that also require careful management.

The VEWH does not have Water Holdings in the Broken system itself. Environmental water for the lower Broken Creek can be released from the Goulburn system through the East Goulburn Main Channel, and from the Murray system through the Yarrawonga Main Channel.

The priority river reach for environmental watering is reach 3 (from Nathalia Weir Pool to the River Murray), with flows also benefiting reaches 1 and 2. The measurement point for target flows for reach 3 is at Rices Weir. The environmental flow reaches in the lower Broken Creek are shown in Figure 5.2.1.

Pictured: Lower Broken Creek, by GBCMA

Figure 5.2.1 The lower Broken Creek system

Current situation

A dry winter was experienced in 2012-13 with flows passing Rices Weir falling to zero in August 2012. Local rainfall and subsequent catchment runoff in late September and early October 2012 generated two substantial but short-lived freshes. From September to December 2012, Commonwealth environmental water, inter-valley transfers and unregulated flows from the Murray system contributed to achieving the environmental flow target of 250 ML per day, to increase large-bodied native fish habitat during migration and breeding seasons. Flows were then provided (progressively reducing from 250 to 150 ML per day) from January to May 2013, to maintain water quality, aiming to keep dissolved oxygen levels above 5 mg/L. Due to irrigation supply issues, these targets were not always met and dissolved oxygen levels fell below 5 mg/L for extended periods; however, no resulting impacts on native fish populations were detected. There was no significant azolla growth during the year and therefore no flows were required to manage this.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 5.2.1.

The priority environmental objectives are to: provide native fish passage; provide suitable water quality conditions for native fish; and improve fish habitat during migration and breeding seasons.

In addition to the environmental objectives, these watering actions will also provide benefits to consumptive users through improvements in water quality.

Table 5.2.1 Priority watering actions and environmental objectives for the lower Broken Creek

Priority watering action	Environmental objective
Year-round low flows (40 ML per day from August to May)	Provide native fish passage
Winter/spring medium flows (120 ML per day from August to November)	Minimise azolla growth
Spring/summer/autumn medium flows (150-250 ML per day from October to May)	Maintain water quality, including dissolved oxygen levels above 5 mg/L
Winter/spring freshes (120-250 ML per day for up to 14 days as required during August to November)	Remove large azolla blooms
Spring/summer high flows (250 ML per day from September to December)	Increase native fish habitat during migration and breeding seasons

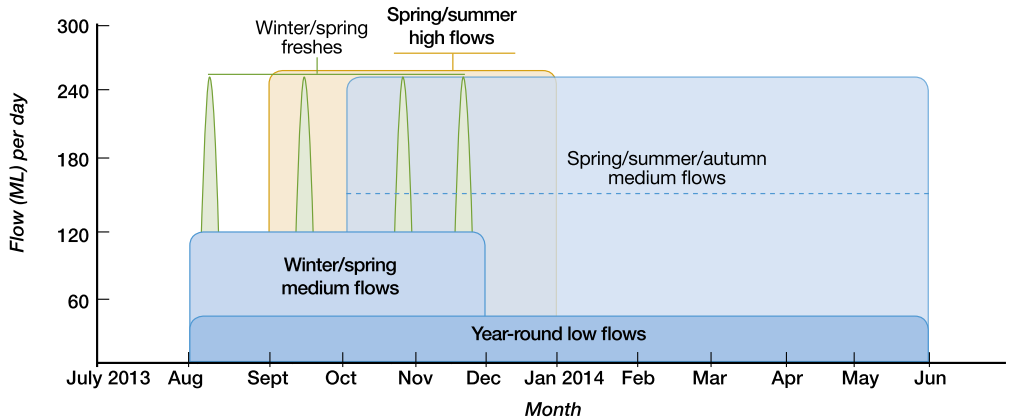
Table 5.2.2 Priority watering actions for the Broken system under a range of planning scenarios

	Planning scenario		
	Very dry	Average	Wet
Expected availability of Water Holdings[1]	Water can be accessed from VEWH Holdings, Commonwealth Holdings and consumptive water en route	Water can be accessed from VEWH Holdings, Commonwealth Holdings and consumptive water en route	Water can be accessed from VEWH Holdings, Commonwealth Holdings and consumptive water en route
Priority watering actions	Year-round low flows Winter/spring medium flows Spring/summer/autumn medium flows Winter/spring fresh Spring/summer high flows	Year-round low flows Winter/spring medium flows Spring/summer/autumn medium flows Winter/spring fresh Spring/summer high flows	Year-round low flows Winter/spring medium flows Spring/summer/autumn medium flows Winter/spring fresh Spring/summer high flows
Possible volume required from the Water Holdings[2]	Up to 68,500 ML	Up to 68,500 ML	Up to 68,500 ML
Possible carryover into 2013-14	N/A	N/A	N/A

1 During water quality emergencies, up to 30,000 ML is also available from Goulburn-Murray Water's bulk entitlement to manage water quality issues.

2 Possible volumes required from the Water Holdings are maximum volumes and may be reduced if met through unregulated flows from the River Murray or the delivery of consumptive water en route (inter-valley transfers).

Figure 5.2.2 Priority watering actions for the Broken system[1]



Key

- Year-round low flows, 40 ML/day (Aug-May)
- Winter/spring medium flows, 120 ML/day (Aug-Nov)
- Spring/summer/autumn medium flows, 150-250 ML/day (Oct-May)
- Winter/spring freshes, as required,120-250 ML/day, up to 14 days (Aug-Nov)
- Spring/summer high flows, 250 ML/day (Sep-Dec)

1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Northern Region (refer to section 5).

The lower Broken Creek has relatively fixed environmental watering needs, largely independent of annual climatic conditions. Catchment runoff may contribute to early year-round low flows and winter/spring freshes; however, for the most part, flows must be delivered from the Murray and Goulburn rivers to achieve priority watering actions. Some of these priority watering actions can be met through the delivery of consumptive water en route from the Goulburn system (inter-valley transfers), or through unregulated flows from the Murray system.

The environmental watering needs of the lower Broken Creek are variable throughout the year, and are largely determined by ongoing water quality and azolla monitoring. Flows will be managed in response to drops in water quality (if dissolved oxygen levels fall towards 5mg/L) and if azolla growth increases. Flows will be managed to maximise native fish movement and provide habitat opportunities throughout the year.

Goulburn-Murray Water's bulk entitlement makes available up to 30,000 ML of water to assist in mitigating water quality emergencies in the Goulburn River and lower Broken Creek systems, such as blackwater events.

As the lower Broken Creek is part of the irrigation distribution system, channel capacity constraints can restrict the amount of water delivered for environmental purposes, particularly during spring and autumn. Goulburn Broken Catchment Management Authority will work with Goulburn-Murray Water to optimise the delivery of water to the lower Broken Creek by using available capacity from both the Murray and Goulburn systems.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 5.2.3 summarises these risks, and the mitigating strategies identified by the Goulburn Broken Catchment Management Authority.

Table 5.2.3 Risk management in the Broken system

Risk type	Mitigating strategy
Storage manager cannot deliver require volume	Have environmental water available from both the Murray and Goulburn systems
Improved conditions for non-native species (eg. carp)	None available
Current recommendations on environmental flow inaccurate	Monitor outcomes from flow management and reassess recommendations as necessary
Unable to provide evidence in meeting environmental objective	Seek involvement, contributions and results from monitoring and research programs

5.3 Campaspe system (including Coliban River)

Waterway manager – North Central Catchment Management Authority
Storage managers – Goulburn-Murray Water; Coliban Water

The Campaspe system extends from the Great Diving Range in the south, to the River Murray at Echuca in the north. Major waterways in the catchment include the Campaspe River and the Coliban River.

The Campaspe River downstream of Lake Eppalock supports iconic river red gum communities and a wide range of healthy native fish populations. The high density of in-stream wood provides ideal habitat for aquatic animals, including the nationally significant Murray cod and many species of state significance such as silver perch and crimson spotted rainbowfish. The Coliban River, upstream of Lake Eppalock, provides habitat for a range of native aquatic species, including platypus and water rats. Local communities of Malmsbury, Taradale and Metcalfe have a strong sense of stewardship of the river, due to its environmental, aesthetic and recreational values, such as camping, fishing and bird watching.

System overview

Lake Eppalock was constructed in 1965. It has traditionally secured water for the Campaspe Irrigation District and safeguarded the Coliban supply system for Bendigo. Regulation has significantly altered river flows and has reversed the seasonal river flows in many of the reaches (that is, there are now lower flows in winter and higher flows in summer). In 2010, the decommissioning of Campaspe Irrigation District significantly reduced irrigation demand in the system. The resulting water entitlements are being allocated to the VEWH.

In the Campaspe River, the priority river reaches for environmental watering are between Lake Eppalock and the Campaspe Weir (reach 2) and the Campaspe Siphon to the River Murray confluence (reach 4). Flows are measured at the Lake Eppalock Outlet (reach 2), and Campaspe Siphon (reach 4). These reaches have significant populations of Murray cod, in-stream habitat for fish species including Murray cod, silver perch, golden perch and flatheaded-gudgeon, as well as a highly-connected, intact river red gum canopy along the river banks. These reaches are also the most influenced by water releases. The environmental flow reaches in the Campaspe system are shown in Figure 5.3.1.

Water Holdings in the Campaspe River can be delivered from two locations: Lake Eppalock and the Campaspe Siphon. In addition, water can be transferred from the Goulburn system through the Waranga Western Channel to the Campaspe Siphon, or traded into the Campaspe from other systems including the Murray, subject to trading restrictions.

In addition to the Water Holdings, passing flows are provided under Goulburn-Murray Water's bulk entitlement. There are also opportunities to achieve environmental benefit from consumptive water from the Goulburn through the lower Campaspe (reach 4) en route to meeting irrigation needs in the River Murray. This requires prior agreement with Goulburn-Murray Water and the Murray-Darling Basin Authority.

The Coliban River upstream of Lake Eppalock is also a priority reach for environmental water management. The stretch of river from Malmsbury Reservoir to Lake Eppalock provides habitat for small native fish, platypus and water rats.

Pictured: Campaspe River, North Central CMA

Figure 5.3.1 The Campaspe system

Current situation

The Campaspe system was in drought for an extended period from the early 2000s, with 2003-04 being the last year full irrigation allocations were made. In 2010-11, rainfall was well above average, resulting in substantial streamflows, inflows to Lake Eppalock and Malmsbury Reservoir, and flooding. As a result, Lake Eppalock spilled in November 2010 and has remained at high levels since, leading to further spills and pre-release flows to the Campaspe River downstream.

Management of the Campaspe River following the flooding in 2010-11 focused primarily on system recovery through a combination of high unregulated flows and active releases of environmental water. For the first time in a decade, the entire winter flow regime was provided up to bankfull flows, resulting in a healthy riparian river red gum condition and the recovery of bank vegetation following stripping that occurred in the floods.

In the Coliban River, following the widespread flooding that occurred in 2010-11, the 2011-12 season opened with full storages and spilling of Malmsbury Reservoir. As per Coliban Water's Campaspe bulk entitlement, environmental water is the first to spill from the storage and 'withheld passing flows' accumulated earlier in the season were lost. Therefore, 2012-13 started with full storages and no environmental water in storage. The focus shifted to preparing for emergency events by withholding passing flows, releasing water to maintain water quality and to provide base flows.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 5.3.1.

The focus for the Campaspe system for 2013-14 is to build the environmental resilience of the system. The priority environmental objectives are: maintaining pool habitat and water quality for fish populations; improving the potential for fish movement; maintaining macroinvertebrate populations; reducing encroachment of terrestrial vegetation in-stream; maintaining aquatic vegetation; and enhancing river red gum recruitment.

In addition to the environmental objectives, these watering actions will also provide opportunities for motorised boating, kayaking, recreational fishing, swimming, sightseeing, bush walking and bird watching which all provide economic benefits for local towns.

Table 5.3.1 Priority watering actions and environmental objectives for the Campaspe system

Priority watering actions	Environmental objective
Campaspe River	
Summer/autumn low flows (10-16 ML per day in reach 2 and 10-20 ML per day in reach 4 from December to May)	Maintain aquatic vegetation Maintain fish habitat and reinstate slack waters (areas with minimal water movement) Limit the effect of cold water releases from Lake Eppalock on fish Maintain access to riffle habitat and water quality for macroinvertebrates Maintain permanent connectivity for water quality
Winter/spring high flows (four events of 1,000 ML per day for four days each in reach 2, and two events of 1,500 ML per day for four days each in reach 4, during June to November)	Reduce encroachment of exotic and terrestrial vegetation Enhance river red gum recruitment Stimulate fish movement and allow movement to downstream reaches Flush and mix river pools for improved water quality Respond to blackwater events as required Mix and flush river pools for macroinverbrates Inundate additional snags and flush sediment off biofilms (groups of microorganisms) for macroinvertebrates
Winter/spring low flows (100 ML per day [or natural[1]] in reach 2 and 200 ML per day [or natural[1]] in reach 4, from June to November)	Provide longitudinal connectivity for fish Limit effect of cold water releases on fish Maintain access to riffle habitat and water quality for macroinvertebrates Maintain permanent longitudinal connectivity of river for improved water quality
Summer/autumn freshes (three freshes of 100 ML per day for five days each in reach 2, and one fresh of 100 ML per day for six days in reach 4, during December to May)	Maintain riparian and in-channel vegetation recruitment Provide longitudinal connectivity for fish during periods of low flow Respond to blackwater events as required
Coliban River	
Summer/autumn pulsed flows (5-15 ML per day for up to 14 days during December to May)	Maintain water quality including dissolved oxygen levels, and habitat for aquatic animals
Summer/autumn low flows (2.5-5 ML per day from December to May)	Maintain aquatic vegetation Maintain fish habitat for survival and spawning Maintain permanent longitudinal connectivity of river for improved water quality Maintain aquatic habitat for macroinvertebrates
Summer/autumn freshes (one fresh of 100 ML per day and one fresh of 200 ML per day for three days each during December to May)	Maintain riparian and in-channel recruiting vegetation Provide longitudinal connectivity for fish during periods of low flow Stimulate upstream and downstream fish movement and or spawning Maintain water quality for macroinvertebrates

1 'Or natural' means that flow rates may be above or below the specified target rates depending upon inflows and climatic conditions.

Bankfull flows and overbank flows are also important flow components ecologically. However, these cannot be actively delivered due to infrastructure constraints and the risk of inundating private land. Delivery of these events relies on natural flows.

Table 5.3.2 Priority watering actions in the Campaspe system under a range of planning scenarios

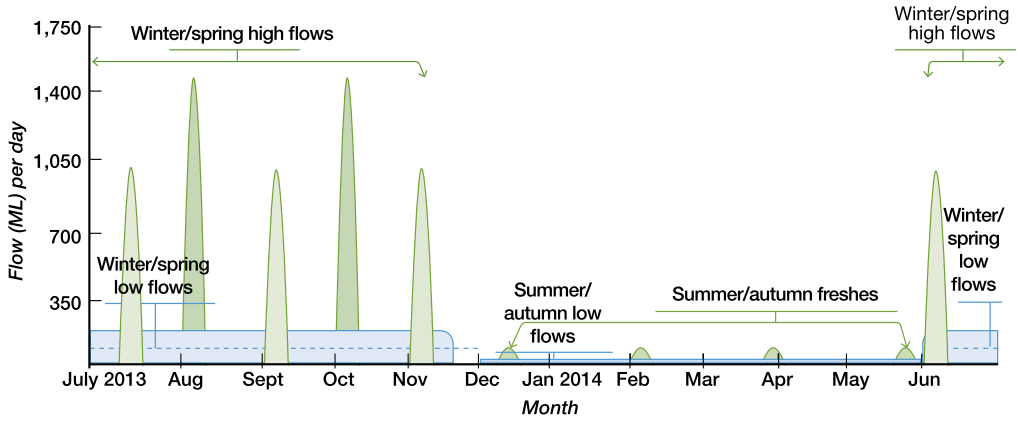
	Planning scenario		
	Drought	**Dry**	**Average/wet**
Campaspe River			
Expected availability of Water Holdings[1]	22,300 ML VEWH Holdings[2] 126 ML Living Murray Holdings 6,900 ML Commonwealth Holdings 29,326 ML total	22,300 ML VEWH Holdings[2] 3,380 ML Living Murray Holdings 7,153 ML Commonwealth Holdings 32,833 ML total	22,300 ML VEWH Holdings[2] 5,211 ML Living Murray Holdings 7,295 ML Commonwealth Holdings 34,806 ML total
Priority watering actions	Summer/autumn low flow in reach 4 Summer/autumn low flow (carryover into 2014-15) Winter/spring high flow in reach 4 (one event) Winter/spring low flow in reach 2 Summer/autumn freshes in reach 4 (three events)	Summer/autumn low flow in reach 4 Winter/spring high flow in reach 4 (two events) Winter/spring low flow in reach 2 Summer/autumn freshes in reach 4 (three events)	Winter/spring low flow in reach 4 Summer/autumn freshes in reach 4 (three events) Winter/spring high flow in reach 2 (four events) Winter/spring high flow in reach 4 (two events)
Possible volume required from the Water Holdings	29,500 ML	31,372 ML	34,151 ML
Possible carryover into 2014-15[3]	N/A	N/A	N/A
Coliban River			
Expected availability of Water Holdings	28 ML Commonwealth Holdings Withheld passing flows for use at other times in the season	28 ML Commonwealth Water Holdings Withheld passing flows for use at other times in the season	28 ML Commonwealth Water Holdings Withheld passing flows for use at other times in the season
Priority watering actions	Summer/autumn pulsed flows Summer/autumn low flows Withhold passing flows for 2014-15	Summer/autumn pulsed flows Summer/autumn low flows Withhold passing flows for 2014-15	Withhold passing flows for 2014-15 Summer/autumn freshes
Possible volume required from the Water Holdings	1,500 ML	1,500 ML	1,120 ML
Possible carryover into 2014-15	Nil	Nil	Nil

1 Under all scenarios, the Campaspe system will receive a 100% allocation to high-reliability entitlements on 1 July 2013. Water availability estimates do not include water available in the Goulburn and Murray systems, which could be traded into the system if required, subject to trading rules.

2 Entitlement expected to be created by 30 June 2013.

3 Volume able to be carried over depends on how Living Murray and Commonwealth Holdings are used.

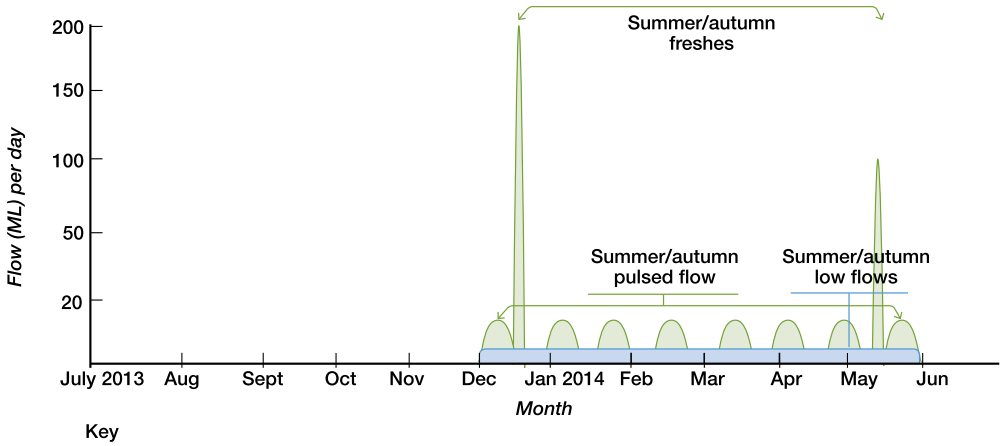
Figure 5.3.2 Priority watering actions in the Campaspe River[1]



Key

- Summer/autumn low flows, 10-16 ML/day in reach 2 and 10-20 ML/day in reach 4 (Dec-May)
- Winter/spring high flows, 4 events of 1,000 ML/day, in reach 4 and 2 events of 1,500 ML/day in reach 2, 4 days each (Jun-Nov)
- Winter/spring low flows, 100 ML/day in reach 2 and 200 ML/day in reach 4 (Jun-Nov)
- Summer/autumn freshes, 3 freshes of 100 ML/day, for 5 days each in reach 2 and one fresh of 100 ML/day for 6 days in reach 4 (Dec-May)

Figure 5.3.3 Priority watering actions in the Coliban River[1]



Key

- Summer/autumn pulsed flow, 5-15 ML/day, up to 14 days (Dec-May)
- Summer/autumn low flows, 2.5-5 ML/day (Dec-May)
- Summer/autumn freshes, one fresh of 100 ML/day and one fresh of 200 ML/day, 3 days each (Dec-May)

1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary.

General triggers for undertaking watering actions have been included in the regional overview for the Northern Region (refer to section 5).

Based upon key leanings from the Millennium drought, the North Central Catchment Management Authority has developed principles for prioritising flow deliveries. Ecologically, the summer period is the highest risk period due to water quality issues and the potential for a fish death event. The priority is to manage this through provision of summer baseflows and a pre-emptive winter high flow event to flush organic material from the river during the relatively lower risk winter period. Initially the focus is to provide flow to the upper reach due to the existence of large deep pools as native fish habitat. The focus moves to the lower reaches of the river as more water becomes available. A high priority is to carry over water to underpin the 2014-15 summer low flows.

The storage volume of Lake Eppalock will need to be monitored closely over the winter/autumn period to assess the likelihood and timing of any storage spills. If the storage begins to spill early in the season, management will focus on ensuring winter baseflows are maintained between spills, which may provide the required winter high flow events. Unlike other systems in northern Victoria, the topping up or prolonging of unregulated storage spills will not be attempted due to the 'peaky' nature of unregulated flows in this system (exacerbated by tributary inflows) and risk of flooding private land.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 5.3.3 summarises these risks, and mitigating strategies identified by the North Central Catchment Management Authority.

Table 5.3.3 Risk management in the Campaspe system

Risk type	Mitigating strategy Campaspe River	Mitigating strategy Coliban River
Current recommendations on environmental flow inaccurate	Undertake ongoing ecological monitoring of releases to assist in refining flow recommendations over time Use annual operational monitoring to inform annual priority watering actions	Undertake ongoing ecological monitoring of releases to assist in refining flow recommendations over time Use annual operation monitoring to inform annual priority flow components Undertake review of watering actions with relevant stakeholders to ensure watering recommendations are adaptively managed over time
Storage manager maintenance works affect ability to deliver water	Ongoing dialogue with Goulburn-Murray Water regarding maintenance schedule, to assist in timing releases when there is available capacity to meet desired flow rates	N/A
Limited catchment management authority resources to manage environmental releases	Ensure that environmental water management within the North Central Catchment Management Authority is adequately resourced to undertake required delivery tasks	Ensure that environmental water management within the North Central Catchment Management Authority is adequately resourced to undertake required delivery tasks
Releases cause water quality issues (eg. blackwater, low dissolved oxygen levels, mobilisation of saline pools, acid sulphate soils, etc.)	Summer freshes not to be delivered unless high winter flows have been provided to flush organic material from the river Summers freshes not to be delivered unless there is sufficient water available to follow up the freshes and overcome the reduced dissolved oxygen levels through dilution and re-aeration from flow Funding for maintenance of equipment to monitor dissolved oxygen levels through the Victorian Environmental Flow Monitoring and Assessment Program is required to undertake this monitoring and needs to be secured	N/A
Improved conditions for non-native species (eg. Gambusia)	There is no strategy to mitigate this risk other than the implementation of the full environmental flow regime to provide a competitive advantage to native species	There is no strategy to mitigate this risk other than the implementation of the full environmental flow regime to provide a competitive advantage to native species

Table 5.3.3 Risk management in the Campaspe system (continued)

Risk type	Mitigating strategy Campaspe River	Mitigating strategy Coliban River
Environmental releases cause flooding of private land or public infrastructure	Restrict water orders to a regulated release volume of 1,500 ML per day from Lake Eppalock, which is within normal system operations Ensure on-ground monitoring of water levels is undertaken for every high flow event Work closely with storage manager and cease regulated release if high catchment runoff flows are predicted Engage the community and undertake local media prior to releases Work with local Goulburn-Murray Water office to reduce potential flooding of diverters' infrastructure	Malmsbury Reservoir infrastructure limits environmental flow releases to maximum of approximately 150ML per day, which is well within the channel capacity of about 6,000 ML per day
Unable to provide evidence in meeting ecological objective	Undertake ongoing ecological monitoring of releases to assist in refining flow recommendations over time; use this monitoring data to strengthen the link between flow components and environmental objectives Seek funding through Department of Environment and Primary Industries to undertake baseline monitoring and determine best use of additional environmental entitlements for the system	Environmental water management plan under development Undertake ongoing ecological monitoring of releases to assist in refining flow recommendations over time; use this monitoring date to strengthen the link between flow components and environmental objectives
Key stakeholders unsupportive of environmental water release	Engage the community in the development of seasonal watering proposals Undertake local media prior to releases	Engage the community in the development of seasonal watering proposals. Undertake local media prior to releases Media release to be made prior to the ceasing of any summer flows

5.4 Loddon system (including Birch's Creek and Pyramid Creek)

Waterway manager – North Central Catchment Management Authority
Storage manager – Goulburn-Murray Water

The Loddon system rises on the northern slopes of the Great Dividing Range and flows north to the River Murray. It includes the Loddon River, Tullaroop Creek, Birch's Creek and Pyramid Creek. The Loddon system is home to native fish species, and supports an active tourism industry due to its intact forests and high-value vegetation. Birch's Creek in the upper catchment of the Loddon system contains a population of river blackfish which are the focus of environmental water management and complementary works programs. Pyramid Creek is a tributary of the Loddon River that enters the system near Kerang. As well as the lower Loddon River, Pyramid Creek provides important habitat for fish in northern Victoria. Fish species known to use this system include the bony herring, golden perch and Murray cod. Pyramid Creek is also an important natural carrier for irrigation water in the Torrumbarry Irrigation Region.

System overview

Major storages in the system include Cairn Curran and Tullaroop reservoirs in the upper catchment and Laanecoorie Reservoir in the mid-catchment. Newlyn Reservoir and Hepburn Lagoon are storages on Birch's Creek, while Kow Swamp on the Pyramid Creek regulates flows from the River Murray via the National Channel. Environmental water can be delivered to the Loddon River below Cairn Curran Reservoir, Birch's Creek, Tullaroop Creek and Pyramid Creek.

The upper reaches of the Loddon system flow through forested and cleared areas that were severely impacted by gold mining activities during the 1800s, while the lower part is characterised by incised channels and a broad floodplain intersected by flood runners. Irrigation water is delivered from upper catchment storages, Laanecoorie Reservoir and the Waranga Western Channel (Goulburn system) to Loddon Weir, then to the Boort Irrigation District.

In the Loddon River, the priority river reach for environmental watering is between Loddon Weir and Kerang Weir (reach 4), as its in-stream and riparian habitat has been most affected by river regulation. The measurement point for this reach is Loddon Weir. The remainder of the river upstream of Loddon Weir benefits from flows being passed to the lower reaches, providing habitat for macroinvertebrates and native fish such as the Murray cod, golden perch and silver perch. Pyramid Creek enters the Loddon River just upstream of Kerang Weir. Therefore, the river between Kerang Weir and the River Murray (reach 5) benefits from flows from the Pyramid Creek as well as the Loddon River and is an important habitat for fish species such as Murray cod, golden and silver perch. The environmental flow reaches are shown in Figure 5.4.1.

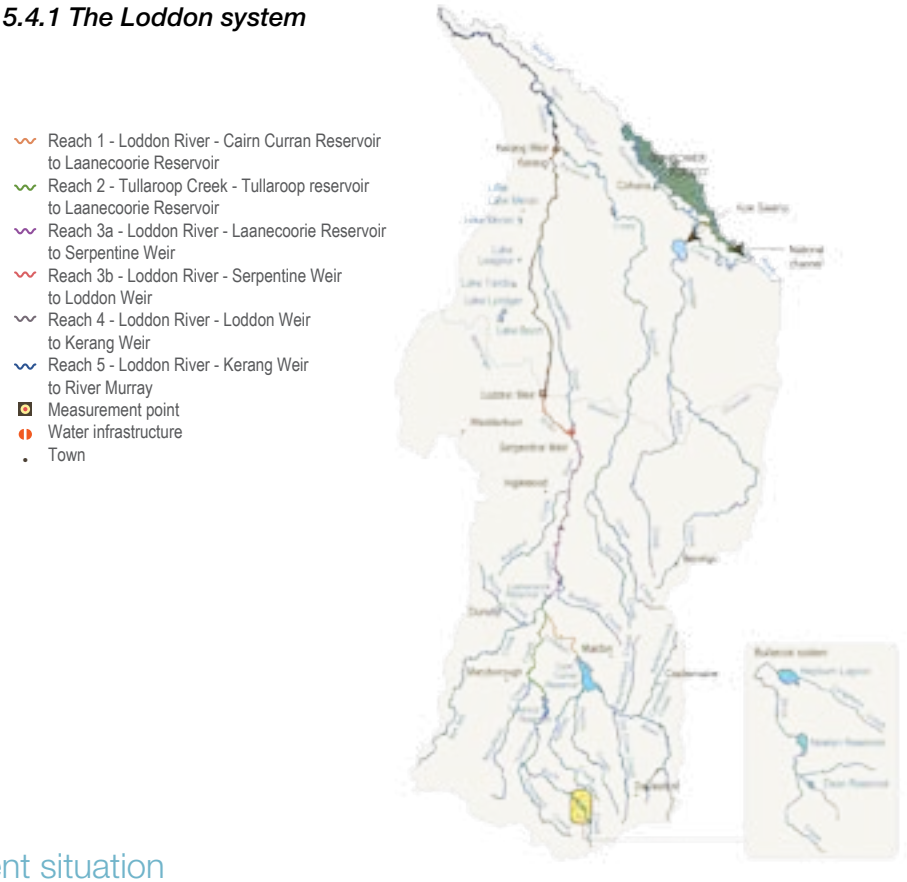
Tullaroop Creek (reach 2) and Birch's Creek are home to populations of regionally significant river blackfish. The provision of environmental water in these systems assists with achieving habitat requirements for these fish populations.

Water Holdings in the Loddon system are released from: Cairn Curran, Tullaroop and Lannecoorie Reservoirs on the Loddon River; Newlyn Reservoir and Hepburn Lagoon on Birch's Creek; and from the River Murray via the National Channel and Kow Swamp. In addition, water in the Goulburn system can be delivered through the Waranga Western Channel to the Loddon Weir for delivery downstream. Water can also be traded from other systems into the Loddon, subject to trading rules.

Pictured: The Loddon River at Appin South by NCCMA

In addition to the Water Holdings, passing flows are provided under Goulburn-Murray Water's bulk entitlement, and consumptive water is delivered down the Loddon to meet downstream irrigation needs. Environmental water releases will be combined with passing flows, consumptive water and unregulated flows to maximise environmental outcomes.

Figure 5.4.1 The Loddon system



Current situation

2012-13 was the first season in which all identified watering actions for the Loddon River between Loddon Weir and Kerang Weir (reach 4) were provided. A bankfull flow was naturally provided in August 2012, with other components delivered using environmental water. The combined benefits of flood and environmental water have been significant over the past two to three years, with the condition of the river improving compared to during the drought. Frog and bird numbers have increased, and riparian and aquatic vegetation (including river red gums, phragmites, water ribbons and black box) have all shown signs of increased growth and coverage. While fish numbers are still low, the conditions in the lower Loddon are conducive to recolonisation, and this will be monitored over coming years.

A fresh was provided to Pyramid Creek in November 2012 to coincide with the Loddon River spring fresh. Golden perch were observed through the lower Loddon and Pyramid Creek system as a result of this flow.

During July to October 2012, water regularly spilt from Newlyn Reservoir due to high inflows into the system. This resulted in large flows in Birch's Creek for the first part of the season (during winter and spring). Water held in the environmental entitlement was lost to spills. The summer and autumn periods were much drier, with little rainfall recorded. Irrigation flows have maintained flows in the river and provided opportunities for maintenance of river blackfish habitat.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 5.4.1.

The focus of environmental watering is to enhance the condition of riparian vegetation and provide appropriate conditions for fish and macroinvertebrate colonisation.

In addition to the environmental objectives, these watering actions will also provide social benefits through improved opportunities for fishing and passive recreation pursuits.

Table 5.4.1 Priority watering actions and environmental objectives for the Loddon system

Priority watering action	Environmental objective
Loddon River (reach 4)	
Autumn/winter/spring low flows (100 ML per day from May to October)	Rehabilitate in-stream aquatic vegetation and reinstate ecological processes in main channel Control terrestrialisation of main channel by non-aquatic species Maintain or rehabilitate flood-dependent riparian and floodplain 'ecological vegetation classes' Reinstate ecological interactions between the floodplain and the river, and ecological processes on the floodplain
Spring fresh (650 ML per day for six to 10 days during September to December)	Provide fish movement and breeding cues Maintain channel form and geomorphological processes along the main channel of the Loddon and its system of distributaries, such as Kinypanial Creek, Bannacher Creek and Venables Creek
Summer/autumn freshes (two freshes of 100 ML per day for 10-14 days each during December to April)	Improve water quality Reduce the incidence and severity of blackwater events Limit impacts associated with acid sulphate soils Maintain channel form and geomorphological processes along the main channel of the Loddon and its system of distributaries, such as Kinypanial Creek, Bannagher Creek and Venables Creek Maintain habitat quality for macroinvertebrates
Spring/summer/autumn low flows (25 ML per day from November to April)	Maintain habitat quality for macroinvertebrates Improve water quality Reduce the incidence and severity of blackwater events Limit impacts associated with acid sulphate soils Rehabilitate in-stream aquatic vegetation and reinstate ecological processes in main channel Control terrestrialisation of main channel by non-aquatic species Maintain or rehabilitate flood-dependent riparian and floodplain 'ecological vegetation classes' Reinstate river-floodplain ecological interactions and ecological processes on floodplain
Pyramid Creek	
Spring fresh (500 ML per day for up to 10 days during September to October)	Improve flow and habitat characteristics to facilitate native fish recruitment and growth Improve native fish migration by providing connectivity with adjoining waterways Provide suitable in-stream habitat and food resources for native fish and other species
Birch's Creek	
Spring/summer/autumn freshes in reach 2 (15 ML per day for three days each, once during November to December and once during March to April)	Support native fish (including river blackfish) population structure, composition, age classes and abundance Minimise low dissolved oxygen and temperature risks for fish
Autumn fresh in reach 3 (27 ML per day for three to four days during March to May)	Support native fish (including river blackfish) population structure, composition, age classes and abundance Flush sediment from riffles to restore or maintain macroinvertebrate communities Allow movement between pools to maintain native fish populations and abundance Create disturbance to rehabilitate the diversity of habitat, ecological diversity and physical diversity of in-stream vegetation Rehabilitate riparian vegetation extent, diversity and population structure and composition Minimise low dissolved oxygen and high temperature risks for fish

Bankfull flows are important to the health of the Loddon River and are recommended to occur three to four times per decade. Bankfull flows of approximately 3,500 ML per day downstream of Loddon Weir have occurred during each of the last three years. In addition, they require a large volume of water, and pose the risk of inundating private land. For these reasons, this flow component has not been prioritised for active management during the 2013-14 season.

Table 5.4.2 Priority watering actions in the Loddon system under a range of planning scenarios

	Planning scenario		
	Drought	Average	Wet
Loddon River			
Expected availability of Water Holdings[1]	9,064 - 10,586 ML VEWH Holdings 1,443 - 2,775 ML Commonwealth Holdings 10,507 - 13,361 ML total	8,922 - 10,885 ML VEWH Holdings 1,748 - 2,775 ML Commonwealth Holdings 10,670 - 13,660 ML total	8,922 - 11,229 ML VEWH Holdings 2,414 - 2,775 ML Commonwealth Holdings 11,336 - 14,004 ML total
Priority watering actions	Winter low flow Spring fresh One summer fresh	Winter low flow Spring fresh Two summer freshes Summer low flows	Winter low flow Spring fresh Two summer freshes Summer low flows
Possible volume required from the Water Holdings[2]	10,815 - 13,217 ML	7,810 - 10,287 ML	4,506 - 7,112 ML
Possible carryover into 2014-15	0 ML (VEWH Holdings)	0 - 3,075 ML (VEWH Holdings)	1,810 - 6,723 ML (VEWH Holdings)
Pyramid Creek			
Priority watering actions	N/A	Spring fresh	Spring fresh
Possible volume required from the Water Holdings	0 ML	6,700 ML	6,700 ML
Birch's Creek			
Expected availability of Water Holdings	100 ML	100 ML	100 ML
Priority watering actions	Two spring/summer/ autumn freshes	One autumn fresh	One autumn fresh
Possible volume required from the Water Holdings	0 - 100 ML	0 - 100 ML	0 - 100 ML

1 Does not include water available in the Goulburn and Murray systems, which could be traded into the system if required, subject to trading rules.

2 Assumes passing flows are provided, but no unregulated flows occur, therefore volumes are upper limits.

Figure 5.4.2 Priority watering actions in the Loddon River[1]

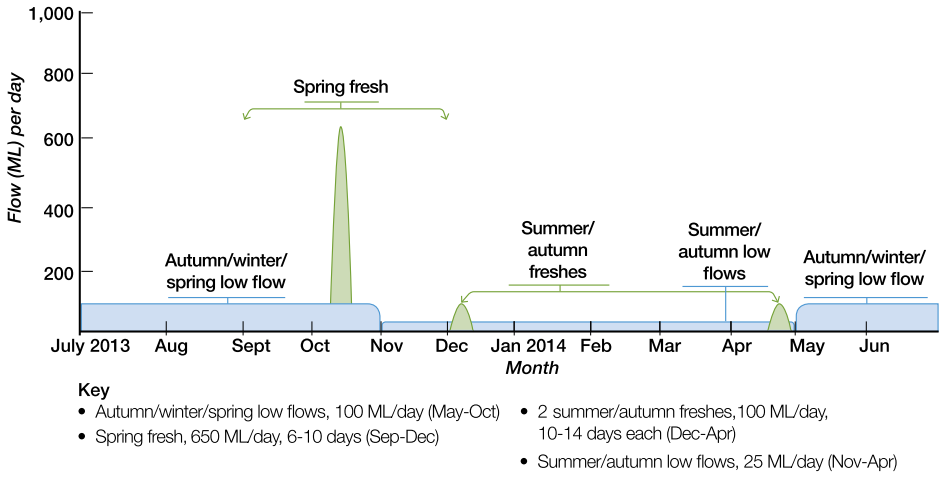


Figure 5.4.3 Priority watering actions in Pyramid Creek[1]

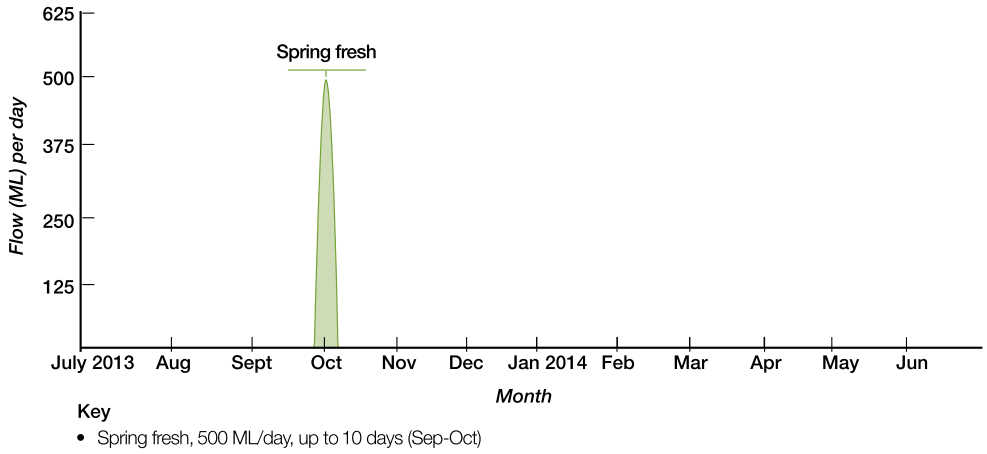
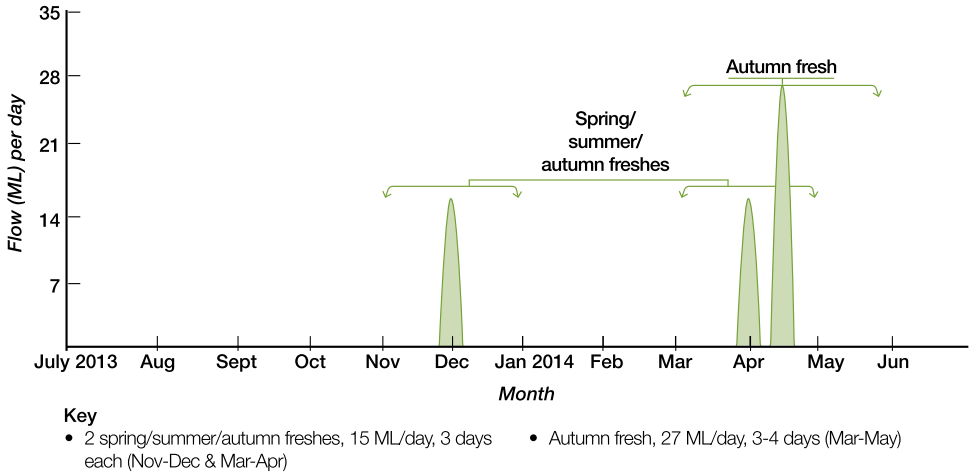


Figure 5.4.4 Priority watering actions in Birch's Creek[1]



1 This figure is for illustrative purposes only. Scheduling and delivery of particular watering actions within the stated timeframes will vary

General triggers for undertaking watering actions have been included in the regional overview for the Northern Region (refer to section 5).

There are decisions to be made throughout the season regarding the delivery of priority watering actions. For example, if there are dry catchment conditions, a spring fresh may be delivered in the first half of October. However, if it is wet and there are unregulated flows through the catchment, the delivery of this fresh may be delayed to see if it is achieved naturally.

There is likely to be increased flexibility in the management of the Loddon River entitlement during 2013-14. Amongst other changes to the entitlement, there is expected to be a provision to withhold passing flows below Loddon Weir for delivery at a later date. This change allows for management of the system to focus on providing the highest priority watering actions.

As well as the river itself, a component of the Loddon entitlement can be used in the Boort wetlands. These sites are considered under the northern wetlands and floodplains system (see section 5.5).

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 5.4.3 summarises these risks, and the mitigating strategies identified by the North Central Catchment Management Authority.

Table 5.4.3 Risk management in the Loddon system

Risk type	Mitigating strategies Loddon River and Pyramid Creek	Mitigating strategies Birch's Creek
Limited catchment management authority resources to deliver environmental releases	Limited funding may result in some systems being outside the scope of environmental water reserve officers therefore unable to be actively managed by the catchment management authority	
Environmental releases cause personal injury to river users	Keep community informed and advise to minimise river access during flows Ensure staff are accompanied and follow field work occupational health and safety procedures Spot trackers taken in field when working alone	
Current environmental flow recommendations are inaccurate	Review cross sections on which models of flow inundation are based to ensure the targeted channel inundation is achieved	Review flow recommendations for the system to inform future watering events
Improved conditions for non-native species (eg. carp)	Mitigation difficult: uncertain how to control carp in reach 4	N/A
Unable to provide evidence of meeting ecological objective	Victorian Environmental Flow Monitoring and Assessment Program monitoring and review will be used to demonstrate longer term evidence in meeting ecological objectives	Flow gauge required for reach 3 Increase ecological and condition monitoring if funding and resources allow Regular site visits during and outside of flow deliveries to monitor conditions in the creek and make observations using photopoints
Release volume is insufficient to meet target flows	Consult with Goulburn-Murray Water on minimising operational issues during environmental water deliveries	Flow gauge required for reach 3 Monitor fresh in reach 3 to ensure objectives are met
Storage manager maintenance works affect ability to deliver water	Coordinate with Goulburn-Murray Water to ensure timing of flow delivery does not coincide with maintenance and channel shut down Deliver from the Loddon system when required (rather than through the Waranga Western Channel from the Goulburn system) to ensure flows are not disrupted	N/A
Cost of delivery exceeds available funding	N/A	Limited funding may result in some means of delivery (ie. Goulburn-Murray Water infrastructure) being inaccessible
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid sulphate soils, etc.)	Avoid releases of low flow rates in summer where higher priority watering actions are not delivered Ensure spring flow is preceded by winter low flow	N/A
Environmental water account is overdrawn	Close monitoring of water usage through Goulburn-Murray Water reports	Monitor account during event; reduce timing to three days if required
Environmental releases cause flooding of private land	Monitor flows; restrict water orders to 650 ML per day Notification to landholders and stakeholders of flow delivery in advance of it commencing Minor mitigation works (eg. earthworks) if required Engage landholders and keep them informed Monitor rainfall forecasts for likelihood of rainfall >20mm or that will cause run-off in the relevant catchments	Incised creek bed and low flow rates make the risk of flooding low for these small volumes of water
Environmental releases cause flooding to public infrastructure	Monitor flows; restrict water orders to 650ML per day	Incised creek bed and low flow rates make the risk of flooding low for these small volumes of water

5.5 Northern wetlands and floodplains

Waterway manager – Goulburn Broken Catchment Management Authority; North Central Catchment Management Authority; Mallee Catchment Management Authority

Storage manager – Goulburn-Murray Water; River Murray Water

The northern Victorian wetlands and floodplains are made up over 50 wetlands covering the Mallee, North Central, and Goulburn Broken catchment management authority regions. The system contains individual wetlands that are part of the Kerang Wetlands Ramsar Site, recognised as wetlands of international importance, as well as a number of nationally and regionally significant sites. The system provides a wide range of habitat types that support rare and threatened waterbird species including the painted snipe, brolga, royal spoonbill and white-bellied sea eagle. They are also home to the endangered Murray hardyhead fish. In addition, they support a variety of recreational activities such as camping, fishing, water sports, bird watching and recreational hunting and Indigenous cultural heritage values such as scar trees, middens, burial sites, artefacts and ovens.

System overview

The northern Victorian wetlands and floodplains are within the southern-connected Murray-Darling Basin, and include wetland complexes in the Goulburn Broken, North Central and Mallee catchment management authority regions (see Figure 5.5.1). This system is highly regulated and water can be delivered from storages including: Lake Victoria, Hume and Dartmouth Reservoirs on the River Murray system; Lake Eildon on the Goulburn River; Cairn Curran and Tullaroop Reservoirs in the Loddon system; and Kow Swamp near Kerang. The Ovens and Kiewa systems are also within the southern-connected Murray-Darling Basin; however, they contain no wetlands or floodplains that can receive regulated environmental water.

The Goulburn Broken wetlands consist of nine wetlands that can be managed with environmental water between Yarrawonga, Benalla, Murchison and Echuca. They contain vegetation communities ranging from river red gum dominated swamps to cane-grass wetlands. Providing environmental water to these wetlands relies on irrigation infrastructure within the Shepparton, Central Goulburn and Murray Valley irrigation districts.

Wetlands within the North Central region include those that are part of the Central Murray wetland complex between Echuca and Swan Hill, and part of the Boort wetland complex between Boort and Kerang on the Loddon River floodplain. The region includes three wetlands of the Kerang Wetlands Ramsar Site. The wetland types range from naturally saline environments to freshwater marshes. There are 13 wetlands that can be managed with environmental water. These depend on infrastructure and channel operations in the Torrumbarry and Pyramid-Boort irrigation districts.

Habitats of the Mallee wetlands include saline wetlands and freshwater marsh environments. Environmental water delivery can occur at a number of wetlands within the system from Nyah to the South Australian border, relying on a combination of irrigation infrastructure and direct pumping from the river.

Pictured: Heywood Lake by Louise Searle

Figure 5.5.1 The northern wetlands and floodplains system

Current situation

Above average and unseasonal rainfalls between 2010 and 2012 resulted in inundation of many wetlands in the Goulburn Broken region. As many of the wetlands had been dry for 10 years, this was a welcome reprieve. However, a majority of these wetlands then experienced prolonged inundation. This can alter wetland vegetation communities by favouring species adapted to extended inundation, reducing the diversity and structure of habitat. Of particular concern, river red gums can die as a result of waterlogging; a mature hollow bearing river red gum may take over 100 years to grow. Black, Kinnairds, Moodie, One Tree, Two Tree, Mansfield and Wallenjoe swamps are dry after having held water for approximately 30 months. Reedy Swamp recently filled prematurely after an unseasonal rainfall event during summer and regulating infrastructure is being used to augment the natural drawdown of the wetland.

There is a long history of environmental water management in the wetlands of north-central Victoria. Between 2001 and 2010, Victoria experienced severe drought without historical precedent. The provision of environmental water during this time maintained key refuges, and avoided catastrophic events or irreversible loss (such as local extinction of the Murray hardyhead). During 2010-11, widespread flooding and the provision of environmental water resulted in the inundation of most wetlands in north-central Victoria, some for the first time in many years. As major flooding hit the region during January and February 2011, most of the wetlands held water throughout 2011-12 and some into 2012-13. Therefore, the management intention for the wetlands in 2012-13 was to allow them to naturally draw down. Only Round Lake, McDonalds Swamp and Richardson's Lagoon were prioritised for environmental water delivery.

Wetlands in the Mallee region also have a long history of environmental water management. Environmental water was delivered to River Murray wetlands in the Mallee region throughout the drought, to prevent catastrophic ecosystem collapse and promote ecosystem resilience for post-drought recovery. The high Murray flows in 2010 and 2011 inundated vast areas of wetlands and floodplains that helped to improve ecosystem health. Some highly-elevated wetlands, including Liparoo East, Heywoods Lake and Robertson Wetland, were not naturally inundated during the high flow events. Robertson Wetland received environmental water in 2012-13; as a result, five species of bat inhabited the wetland, waterbird activity increased and black box seedlings emerged. Aside from the wetlands, creeks in the region have also received environmental water. Sandilong Creek has received water since 2010-11 with a significant reduction in the dominance of cumbungi and improvements in riparian vegetation health. Complementary works to remove fish barriers occurred, allowing the freshwater catfish population greater access to reaches of the creek. The carp population has also decreased since environmental water delivery commenced.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 5.5.1.

In addition to the environmental objectives, these watering actions will also provide economic benefits through ecosystem services such as groundwater recharge, nutrient treatment and carbon storage. Recreational values such as swimming, camping, fishing, boating, four wheel driving, picnicking, barbequing, trail bike riding, horse riding and walking also provide economic and social benefit to local towns.

Table 5.5.1 Priority watering actions and environmental objectives for the northern wetlands and floodplains system

Priority watering action[1]	Environmental objectives
Goulburn Broken wetlands	
Black Swamp (maintain dry condition of the wetland during spring and summer and provide filling flows during autumn; if a natural event inundates the wetland before May 2014 and stimulates a significant bird breeding event, deliver additional water during spring/summer/ autumn; ensure appropriate ponding duration [ideally six months] by providing water during winter/spring)	Maintain or improve the condition of river red gum 'ecological vegetation classes' and protect the vulnerable river swamp wallaby grass Maintain water levels within wetlands if waterbirds nesting to ensure waterbirds do not abandon nest sites
Kinnairds Swamp (maintain dry condition of the wetland during spring and summer and provide filling flows during autumn; if a natural event inundates the wetland before May 2014 and stimulates a significant bird breeding event, deliver additional water during spring/summer/autumn; ensure appropriate ponding duration [ideally six months] by providing water during winter/spring)	Maintain or improve the condition of red gum swamp and plains grassy wetland 'ecological vegetation classes' and protect the vulnerable rigid water milfoil and protected slender water milfoil Maintain water levels within wetlands if waterbirds nesting to ensure waterbirds do not abandon nest sites
Doctors Swamp (maintain dry condition of the wetland throughout the season; if a natural event inundates the wetland before May 2014 and stimulates a significant bird breeding event, deliver additional water during spring/summer/ autumn)	Maintain river red gum 'ecological vegetation class' health and condition Maintain water levels within wetlands if waterbirds nesting to ensure waterbirds do not abandon nest sites
Reedy Swamp (promote natural drawdown and drying of the wetland throughout the season; if a significant waterbird breeding event occurs, deliver water during spring/summer)	Maintain river red gum health and giant rush health to ensure waterbirds can utilise vegetation for breeding Maintain water levels within wetlands if waterbirds nesting to ensure waterbirds do not abandon nest sites
North Central wetlands	
Round Lake (permanent inundation with top up flows throughout the season)	Maintain the lake as a permanent saline lake with habitat suitable for Murray hardyhead Provide suitable waterbird habitat
McDonalds Swamp (provide filling flows during winter/spring)	Support a diversity of plant and animal populations typical of a shallow freshwater marsh, including key waterbird habitat
Hird Swamp [west] (provide filling flows during spring and top-up over summer)	Support a diversity of habitat types for waterbird resting, nesting and feeding
Lake Elizabeth (provide filling flows during spring if translocation of Murray hardyhead is deemed feasible and maintain at target level through top-up deliveries; otherwise, allow the lake to continue to dry)	Provide conditions suitable for Murray hardyhead translocation Support submerged salt-tolerant aquatic plant assemblage
Lake Meran (provide top up flows during spring/summer/autumn)	Maintain emergent aquatic plant communities Maintain health of the fringing intermittent swampy woodland Restore open water/submerged aquatic macrophyte communities and tall marsh communities Restore habitat and breeding opportunities for waterbirds, fish, frogs and invertebrates Restore connectivity between river, floodplain and wetland

Table 5.5.1 Priority watering actions and environmental objectives for the northern wetlands and floodplains system (continued)

Priority watering action[1]	Environmental objectives
North Central wetlands	
Lake Yando (provide low level inundation of channels within wetland during spring/summer/autumn)[2]	Support diverse aquatic and amphibious plant species communities within the gilgai channels of the wetland Provide feeding opportunities for waterbirds
Mallee wetlands	
Brickworks Billabong (provide top up flows during spring)	Maintain the sites as permanent saline lakes which provide habitats suitable for endangered Murray hardyhead and saline aquatic meadow vegetation Provide suitable waterbird habitat
Cardross Lakes (provide top up flows during spring)	
Lake Koorlong (provide top up flows during spring)	
Narrung wetlands (provide filling flows during autumn/winter)[3]	Maintain and improve health of river red gum communities
Butlers Creek (continue drying phase then provide filling flows during spring and autumn/winter)	Maintain and improve health of river red gum communities
Kings Billabong (partially dry the wetland, with option to provide top up flows during spring)	Increase diversity of macrophytes, especially emergent macrophytes
Liparoo East (provide filling flows during spring and autumn/winter)	Maintain health of river red gum communities
Sandilong Creek (provide top up flows during spring and autumn/winter)	Support open water habitat; reduce dominance by cumbungi
Heywoods Lake (provide filling flows during winter/spring)	Restore open water/submerged aquatic assemblage for the deeper/lower sections of the lake
Margooya Lagoon (continue drying phase then provide filling flows during spring)	Improve health of river red gum communities Improve native fish population of the lagoon; reduce carp population in the lagoon
Robertson Wetland (provide filling flows during spring)	Improve health of black box communities
J1 Creek (provide top up flows during spring)	
Bridge Creek (provide top up flows during spring)	
Connors Wetland (provide filling flows during spring)	Maintain health of river red gum communities
Burra Creek South (provide top up flows during spring)	Improve health of black box communities
River Murray reach 9 and 10 (provide top up flows during spring)	Improve ecological function by rehabilitating from the effects of salinisation

1 Only sites that have been prioritised to receive environmental water during 2013-14 have been included.

2 The option of providing low level inundation within the gilgai channels of Lake Yando will be subject to completing a detailed ecological investigation at the site to ensure that this type of watering will not adversely impact other environmental values at the site. This investigation will be undertaken prior to any water delivery occurring.

3 Permanent infrastructure has been designed for the site to manage environmental water into the future. The works are unfunded and would need to be built prior to environmental water delivery.

Table 5.5.2 outlines the priority watering actions and expected water usage under a range of planning scenarios.

Table 5.5.2 Priority watering actions for the northern wetlands and floodplains system under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Goulburn Broken wetlands				
Priority watering sites	Black Swamp Kinnaird Swamp Doctors Swamp Reedy Swamp	Black Swamp Kinnaird Swamp Doctors Swamp Reedy Swamp	Black Swamp Kinnaird Swamp Doctors Swamp Reedy Swamp	Black Swamp Kinnaird Swamp Doctors Swamp Reedy Swamp
Possible volume required from the Water Holdings[1]	804 - 2,213 ML	804 - 2,213 ML	402 - 3,017 ML	402 - 1,509 ML
North Central wetlands				
Priority watering sites	Round Lake McDonalds Swamp Hird Swamp Lake Elizabeth Lake Meran Lake Yando	Round Lake McDonalds Swamp Hird Swamp Lake Elizabeth Lake Meran Lake Yando	Round Lake McDonalds Swamp Hird Swamp Lake Elizabeth Lake Meran Lake Yando	Round Lake McDonalds Swamp Hird Swamp Lake Elizabeth Lake Meran Lake Yando
Possible volume required from the Water Holdings[1]	11,100 ML	11,100 ML	11,100 ML	11,100 ML
Mallee wetlands				
Priority watering sites	Brickworks Billabong Cardross Lakes Lake Koorlong	Brickworks Billabong Cardross Lakes Lake Koorlong Butlers Creek Kings Billabong Liparoo East Sandilong Creek Heywoods Lake Margooya Lagoon Robertson Wetland	Brickworks Billabong Narrung wetlands Cardross Lakes Lake Koorlong Butlers Creek Kings Billabong Liparoo East Sandilong Creek Heywoods Lake Margooya Lagoon Robertson Wetland J1 Creek Bridge Creek Connors wetland Burra Creek South River Murray reach 9 and 10	Brickworks Billabong Narrung wetlands Cardross Lakes Lake Koorlong Butlers Creek Kings Billabong Liparoo East Sandilong Creek Heywoods Lake Margooya Lagoon Robertson Wetland J1 Creek Bridge Creek Connors wetland Burra Creek South River Murray reach 9 and 10
Possible volume required from the Water Holdings[1]	550 ML	9,600 ML	19,400 ML	19,400 ML
Total				
Possible volume required from the Water Holdings[1]	12,454 - 13,863 ML	21,504 - 22,913 ML	30,782 - 33,517 ML	30,782 - 32,009 ML

1 Volumes are based on the maximum number of sites and volumes of water required.

General triggers for undertaking watering actions are included in the regional overview for the Northern Region (see section 5).

Multi-year planning for these sites has been undertaken to allow for landscape-scale management of the wetlands. A particular driver for placing more emphasis on landscape-scale management stems from the effective 'reset' of watering regimes experienced during the 2010-11 floods. While a number of wetlands have a recommended watering regime of one in five or one in three years, it is likely that in future years multiple wetlands will require environmental water during the same year. If not managed, there is a risk that increased pressure will be placed on environmental water resources, particularly if there is a return to drought conditions. The reverse is the potential impact on waterbird populations if multiple wetlands require drying at the same time. This would reduce suitable refuge for breeding, feeding and nesting across northern Victoria.

At a number of sites, the decision to deliver environmental water will be based on the hydrological condition, waterbird breeding activity and the potential impact environmental water delivery may have on wetland vegetation. For example, waterbird abundance has significantly declined across Victoria and much of the Murray-Darling Basin. Providing waterbird breeding opportunities is therefore important, particularly for threatened species. For more abundant species, 100 breeding pairs or more may be considered important to support. However, one pair of breeding brolga may be considered important to support due to their small population size. If waterbirds are nest building and feeding, drawdown and drying of the wetland could be promoted to discourage breeding. However, the drawdown and drying of wetlands in later phases of bird breeding (eg. during egg laying, incubation, nesting and fledging) poses a risk to the survival of chicks.

The wetland water level and the bird breeding phase will influence the need for environmental water and the amount of water required. For example, if a wetland is relatively full and waterbird breeding is at the nesting phase, environmental water may not be required to ensure waterbirds fledge. The length of each breeding phase can vary between waterbird species and will be considered in the decision making process.

Wetland vegetation is also critical to many wetland functions. Therefore, environmental water will not be delivered to a wetland to support waterbird breeding if it may result in long-term and significant changes to the structure and composition of the vegetation.

As well as the ecological considerations, system operations are also important in prioritising watering actions. For example, to service Robertson Wetland, flow at Lock 9 on the Murray River needs to be surcharged 150 mm above full supply level, and flow past Heywoods Lake (measured at Lock 15) needs to be at least 20,000 ML per day with an optimal flow of 40,000 ML for effective pumping. The Murray River reach 9 and 10 sites will only be considered for watering when flows in the River Murray are high (20,000 ML per day to 40,000 ML per day). Further investigation regarding salt discharge also needs consideration.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 5.5.3 summarises these risks, and the mitigating strategies identified by the Goulburn Broken, North Central and Mallee catchment management authorities.

Table 5.5.3 Risk management in the northern wetlands and floodplains

Risk type	Mitigating strategies Goulburn Broken wetlands	Mitigating strategies North Central wetlands	Mitigating strategies Mallee wetlands
Release volume is to meet target flows	N/A	Ensure delivery channels have sufficient spare capacity to undertake delivery prior to starting watering event (liaise with Goulburn-Murray Water) Ongoing dialogue with storage manager regarding consumptive demand in the system, to assist in timing releases when there is available capacity to meet desired flow rates Ensure infrastructure and delivery channels are functional and in working order to deliver at the required rate	Ongoing dialogue with storage manager and water holders to make sure there are sufficient water levels for extraction
Current environmental flow recommendations are inaccurate	N/A	Ensure proposed deliveries (including timing and rates) are undertaken in accordance with relevant environmental water management plans and Goulburn-Murray Water Connections Project environmental watering plans Undertake review of watering actions with relevant stakeholders to ensure watering recommendations are adapted over time as appropriate Undertake ongoing ecological monitoring to assist in refining recommendations over time Use annual operational monitoring to inform annual priority flow components	Base decisions on best available knowledge Environmental water management plans have been developed for some sites
Storage manager maintenance works affect ability to deliver water	N/A	Ongoing dialogue with storage manager regarding potential maintenance works and the likely effect of such works on delivery of water	Continue communication with storage managers
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Ongoing dialogue with Goulburn-Murray Water regarding consumptive demand in the system, to assist in timing releases when there is available capacity to meet desired flow rates	Early and ongoing engagement with Goulburn-Murray Water regarding consumptive demand in the system, to assist in timing releases when there is available capacity to meet desired flow rates Ensure channels and pumps are in good working order (regular maintenance) so that water can be delivered at required rates	Engage storage manager throughout the watering season to assist with timing of releases when there is sufficient capacity to meet requirements
Limited catchment management authority resources to deliver environmental release	N/A	Ensure environmental water management within the North Central Catchment Management Authority is adequately resourced to undertake required delivery tasks	Ensure environmental water management within the Mallee Catchment Management Authority region is adequately resourced to undertake required delivery tasks
Cost of delivery exceeds available funding	N/A	N/A	Only lift water once through pumping (single lift) and keep earth works to a minimum

Table 5.5.3 Risk management in the northern wetlands and floodplains (continued)

Environmental releases cause personal injury to river users	N/A	Engage the community (ie. letter drops and door knocks) and undertake local media and public notice releases prior to event Liaise with land manager regarding public communication activities	Ensure appropriate safety measures around pump outlets and any access that may become inundated
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid-sulphate soils, etc.)	N/A	Undertake relevant water quality monitoring activities at wetlands to ensure any water quality issues are observed in a timely manner, and can be managed appropriately (eg. with the addition of additional water at Round Lake)	Understand salinity discharge loads and the ability to manage through controlling release to allow adequate dilution downstream
Improved conditions for non-native species (eg. carp)	There is no strategy to mitigate this risk; however, minimising summer inundation and placing carp screens on inlet channels can reduce the risk	Ensure water level and salinity are closely monitored and managed at Round Lake so that salinity does not drop low enough for gambusia to thrive and predate on Murray hardyhead If Lake Elizabeth is deemed appropriate for Murray hardyhead, initial invasive species management will be required prior to translocation of the species. Ongoing monitoring to be undertaken to ensure predators are managed	Avoid delivery throughout summer and continued inundation
Environmental water account is overdrawn	Ongoing dialogue with Goulburn-Murray Water regarding the volume of water delivered so additional water uses can be identified in advance and negotiated with the VEWH	N/A	Weekly communication of volumes being delivered to ensure sufficient water is traded into accounts
Environmental releases cause flooding of private land	N/A	Work closely with the land manager to ensure one (or more) agencies are monitoring the wetland level and water movement during the environmental water deliveries Work closely with Goulburn-Murray Water and cease regulated deliveries if high catchment runoff conditions are expected Use SWET models and bathymetry to predict potential inundation at different volumes	Landholder agreements undertaken for flooding on private land. Delivery plans will be developed by the Mallee Catchment Management Authority and endorsed by VEWH
Environmental releases cause flooding of public infrastructure			Some access tracks may be inundated; appropriate road closures will be established to prevent damage
Unable to provide evidence in meeting ecological objective	N/A	Ensure monitoring activities are undertaken as specified in relevant delivery plans to demonstrate ecological outcomes in association with the provision of environmental water Regularly update environmental water management plans with knowledge of ecological outcomes Support the Department of Environment and Primary Industries in undertaking the regular monitoring of the Murray hardyhead population at Round Lake (and possibly Lake Elizabeth)	Ensure monitoring activities are undertaken as specified in relevant delivery plans to demonstrate ecological outcomes in association with the provision of environmental water
Key stakeholders unsupportive of environmental water releases	N/A	At this early stage, support from key stakeholders regarding translocation of Murray hardyhead to Lake Elizabeth is unknown; this will be included as part of the feasibility investigations for Lake Elizabeth	Communicate early about the delivery with stakeholders

5.6 The Living Murray icon sites

Waterway managers – Goulburn Broken Catchment Management Authority; North Central Catchment Management Authority; Mallee Catchment Management Authority

Storage manager – Goulburn-Murray Water; River Murray Water; South Australian Water Corporation; State Water Corporation

The Living Murray Initiative is one of Australia's most significant long-term river restoration programs. It aims to achieve a healthy working River Murray system for the benefit of all Australians. Victoria has four sites as part of the Living Murray program, known as 'icon sites': Barmah Forest; Gunbower Forest; Hattah Lakes; and Lindsay-Wallpolla islands. Barmah Forest and Gunbower Forest are Australia's largest river red gum forests. These forests together with Hattah Lakes and Lindsay-Wallpolla islands are recognised as wetlands of international importance under the Ramsar Convention. The Living Murray icon sites have many important environmental and Indigenous values, supporting a wide range of plant and animal species, and contain many historical sites of Indigenous cultural significance.

System overview

The Living Murray Initiative is a partnership of the Victorian, New South Wales, South Australian, Australian Capital Territory and Commonwealth governments, coordinated by the Murray-Darling Basin Authority.

The Living Murray icon sites are part of the highly-regulated, southern-connected Murray-Darling Basin. Sources that can deliver water include the upper Murray system (Hume Reservoir and Dartmouth Reservoir), Goulburn system (Eildon Reservoir and Goulburn Weir), Campaspe system (Lake Eppalock), Murrumbidgee system (Burrinjuck Dam) and Darling system (Menindee Lakes). Environmental water releases can be combined with unregulated flows and the delivery of consumptive water en route to maximise environmental outcomes.

The icon sites are: Barmah-Millewa Forest; Gunbower-Koondrook-Perricoota Forest; Hattah Lakes and Chowilla Floodplain; Lindsay and Wallpolla Islands; Lower Lakes-Coorong-Murray Mouth; and the River Murray Channel. Of the six icon sites, four are partly or fully located in Victoria (see Figure 5.6.1). The sites were chosen for their high environmental value and their cultural significance to Indigenous people and the broader community.

The Barmah-Millewa Forest is the most upstream icon site and is the largest river red gum forest in Australia. It covers 66,000 ha and straddles the Murray and Edwards rivers between the townships of Tocumwal, Deniliquin and Echuca. The Victorian component is the Barmah National Park and River Murray Regional Park consisting of 28,500 ha of forest and wetlands. The forest is a significant breeding site for waterbirds including egrets, spoonbills and night herons, as well as significant frog and turtle populations. When flows are above 15,000 ML per day at Yarrawonga Weir, both sides of the forest are managed as a whole. When flows are below this, each side of the forest can be managed separately through regulators. Barmah Forest already possesses water regulating structures; however, there are opportunities to construct or upgrade structures to further improve environmental water delivery.

Pictured: Wetland view of Barmah Forest, by Keith Ward

The Gunbower-Koondrook-Perricoota Forest covers around 50,000 ha, making it one of Australia's largest river red gum forests. It straddles the River Murray downstream of Torrumbarry Weir, between Echuca and Swan Hill. The Victorian component is 19,450 ha of which 10,988 ha has been declared National Park, while the remainder is listed as State Forest. Gunbower Creek is an integral part of the Gunbower system as it is a natural irrigation carrier that supplies water to the Torrumbarry Irrigation District as well as to the Gunbower Forest. The creek also provides habitat for native fish such as Murray cod, trout cod and freshwater catfish. A structural works program in the lower forest has been completed that allows up to 2,500 ha of wetland within the forest to be actively watered. Further large-scale works are scheduled for completion by September 2013. These will allow active watering of approximately 4,000 ha of the floodplain. Collectively, the works aim to enable watering of the forest through the Torrumbarry irrigation system, to maintain wetland and floodplain condition and provide water to the forest that allows waterbirds to fledge.

The Hattah Lakes are adjacent to the River Murray between Mildura, Robinvale and Ouyen. They consist of over 20 semi-permanent freshwater lakes that cover an area of 48,000 ha, and form part of the Hattah-Kulkyne National Park. The Hattah Lakes are important due to their extent, condition, diversity and habitat values as well as their social and cultural significance. They are important habitat for colonial waterbird species including spoonbills, egrets, night herons, bitterns and migratory bird species. Under natural conditions, the lakes were fed from high River Murray flows, influenced by all major Murray tributaries from the Murrumbidgee upwards. Large-scale works are due for completion in mid-2013 that will allow water to be pumped into the Hattah Lakes to meet the environmental watering requirements that river regulation has rendered impossible.

The Chowilla Floodplain and Lindsay-Wallpolla Islands span parts of Victoria, New South Wales and South Australia. The Victorian component of the icon site includes Lindsay, Wallpolla and Mulcra islands covering over 26,100 ha downstream of Mildura. It is fed by high River Murray flows that are influenced by the upper Murray tributaries and flows in the Darling River. A combination of structural works and weir manipulation allows Mulcra Island to be watered, whereas Lindsay and Wallpolla rely on very large floods or temporary pumping to water low-level wetlands. Structural works at Lindsay Island (stage 1), including inlet regulators, are due for construction in 2013-14. Repair works at Mulcra Island are due for completion prior to 2013-14.

Figure 5.6.1 The Living Murray icon sites

Current situation

Barmah Forest

Barmah Forest experienced widespread flooding throughout 2011-12. For many low-lying Barmah Forest wetlands, flooding has been continuous for 28 months (due to ponding between periods of overbank flows). Monitoring showed approximately 500 ibis nests at Boals Deadwoods wetland and 600 at Keyes Point wetland in spring 2012. The extent of open moira grassplains has declined over time, falling from 13.5 percent in 1930 (4,050 ha) to 0.5 percent in 2013 (154 ha). This continued decline in the moira grass community at Barmah Forest is thought to be due to extended drought followed by recent prolonged and unseasonal flooding. At current rates of decline, moira grass may be extinct from the plains in a matter of years. The forest is experiencing seasonal drying conditions, which are expected to continue until early winter 2013. This is desirable for moira grass as part of its preferred wet/dry seasonal flooding requirement.

The floods and freshes experienced from July 2010 to October 2012 provided much-needed water to a system that was strongly exhibiting drought stress and declining health. The floods also provided nutrients, carbon and organic matter to the river and an exchange of sediments and biota between the channel, floodplain and wetlands. The floods and freshes connected regions of the Barmah floodplain not inundated for 10 years, and greatly enhanced wetland vegetation health. It also stimulated the largest waterbird breeding event (in terms of numbers of species and individuals) for 40-60 years (depending on the species), and promoted native fish breeding.

However, the relative poor response of moira grass to the recent flooding remains a key concern. The lack of an annual wet-dry regime for the two previous years is likely to be a strong contributing factor; although prior to this, the extended drought and continued grazing pressure from feral horses may also have weakened the species' ability to respond.

Furthermore, a blackwater event in December 2010 resulted in substantial fish and crayfish deaths in the River Murray downstream of Barmah Forest. While some of the more mobile fish species have since returned, there appears to have been a complete loss of crayfish downstream of the forest.

On a positive note, the prolonged flooding of the past three years appears to have reversed some encroachment of species such as giant rush and river red gum onto the moira grass plains and from areas of open water, especially Barmah Lake.

Gunbower Forest

From 2000 to 2010, dry climatic conditions resulted in below average forest inflows and therefore lower availability of environmental flows. Prior to the natural flood event in 2010-11, only small areas (less than 2,000 ha) of Gunbower Forest had been inundated since 2001. River red gum communities had remained dry throughout the forest and terrestrial species had begun invading the understorey. Inundated areas included semi-permanent and permanent wetlands connected to Gunbower Creek via regulating structures. Relatively small volumes of environmental water were delivered to create critical refuge areas in the landscape for waterbirds and to maintain wetland vegetation communities.

Gunbower Forest received its first extensive natural flooding in over a decade during 2010-11. Overbank flooding of the River Murray occurred through three major flooding peaks of over 45,000 ML per day; these passed through the forest between September 2010 and January 2011 inundating about 9,000 ha, with the forest remaining relatively full well into winter 2011.

In spring 2011, environmental water was delivered as a minor top up, and a medium-sized bird breeding event was monitored which included 50-60 pairs of great egrets and 100 pairs of cormorants. Between December 2011 and February 2012, environmental water was used to maintain water levels under the colony until the event completed. In March 2012, additional flooding occurred but waterbird breeding was not observed.

Overbank flooding also occurred in July to September 2012. Waterbird monitoring in the Little Gunbower Wetland Complex in November 2012 detected about 100 little pied and black cormorant nests and 10 white ibis nests.

While flooding between 2010 and 2012 represented the largest hydrological event in over 16 years for the forest, few of the monitored sites assessed in 2012 had sufficient time to respond to the autumn 2012 flood. The recent wet conditions have not yet restored the forest's canopy to 2005 levels, nor increased plant diversity in the wetlands surveyed. Also, as considerable sections of the forest remained dry during the 2010-2011 and 2012 floods, more water and time is necessary for full vegetation recovery from the 14-year dry period (1997-2010).

The recent flood events in Gunbower Forest have resulted in the inundation of a number of its wetlands for two consecutive years. The widespread overbank flooding facilitated carp movement into the wetlands. Prolonged inundation with warm summer temperatures resulted in water quality issues. These factors produced a poor response from both aquatic and terrestrial vegetation associated with the wetlands.

Recent monitoring found that native fish in Gunbower Creek and associated lagoons may act as 'source' populations for the recovery of native fish into the forest wetlands, and are therefore important for fish sustainability at a whole-of-site scale. The 2012 survey found a decline in the number of large-bodied native fish species, possibly as a result of the blackwater event in the River Murray system following large-scale flooding in 2010-11.

Hattah Lakes

Between 1998 and December 2010, flow in the River Murray was insufficient for water to enter the Hattah Lakes system. Without environmental water delivery, the lakes would have dried for an extended period of time, with the result being catastrophic ecological consequences for the wetlands, including large-scale river red gum deaths and changes in ecological character.

Prior to 2011, water last inundated parts of the floodplain in 1998. Environmental water was supplied to the lakes via Chalka Creek in the 2011 natural flood event. The water inundated some of the lowest-lying river red gum woodland in the Lake Hattah area, but did not reach the higher elevation black box woodland. The flood did not push water into the lakes furthest along the flow path (eg. Lake Bitterang and Lake Nip Nip) or onto the floodplain further from Lake Hattah. Since 2011, water has been deliberately excluded from the lakes system to facilitate major structural works construction.

Monitoring results since 2006-07 suggest wetland condition has been maintained, and in some cases improved, in lakes where environmental water has been supplied. In addition, river red gum condition improved between 2006 and 2012. The greatest change in condition was recorded at sites that naturally flooded in 2010-11. The latest condition monitoring has shown the richest diversity of plant species at these sites since monitoring started, and suggests that floodplain inundation is important in restoring diverse mosaics of floodplain communities. Black box communities have shown a slower response to recovery. This may be a result of only receiving water from rainfall in 2010 and 2011, rather than from inundation. This is a key target area for environmental water as the higher elevation black box communities have not been inundated since 1993.

Native fish diversity has remained the same in lakes that have retained water. Anecdotal evidence suggests that environmental pumping excluded carp from the lakes system, with carp returning to the lakes with the natural floods.

Lindsay-Wallpolla Islands

The Lindsay, Mulcra and Wallpolla islands are influenced by River Murray flows downstream of the Darling River junction. With the exception of parts of Mullaroo and Wallpolla creeks, which are permanently inundated, the wetlands have not received complete inundation in the last decade, with only minor wetting of some sites since 2005.

In 2010-11, flows in excess of 50,000 ML per day downstream of the Darling anabranch inundated the lower-lying parts of the site, and provided strong flows through the anabranches and creeks. These high flows also delayed the repair and reinstatement of the Lower Potterwalkagee Creek Regulator.

Under normal weir operating heights, water will flow into the larger anabranches and maintain flows through the icon site. However, under drought conditions, flows through these anabranches may not maintain connectivity for large fish. The water regulatory structures constructed and proposed will help manage flows through the anabranches, and allow inundation of wetlands and floodplain communities. One of the important ecological features of this icon site is the flowing habitat that supports large-bodied fish including Murray cod and silver perch.

Two water control regulators were installed at Lake Wallawalla in 2006, and have facilitated the delivery of environmental water since 2010. Black box and river red gum communities at Lake Wallawalla have responded to the watering with increased foliage health and recruitment. However, the response of aquatic vegetation has been poorer than expected, which is thought to result from the invasion of carp from the natural flood event in 2011. The effects of carp on vegetation responses will continue to be monitored.

Priority watering actions and environmental objectives

Potential priority watering actions along with their associated environmental objectives, are provided in Table 5.6.1.

In addition to the environmental objectives, these watering actions will also provide opportunities for water-based activities including boating, bird watching, bushwalking and fishing.

Table 5.6.1 Priority watering actions and environmental objectives for the Living Murray icon sites

Priority watering action	Environmental objectives
Barmah Forest	
Spring/summer pulsed flow in the River Murray channel (1,500 ML per day for 14 days during November to December)	Provide native fish recruitment opportunities
Spring/summer baseflow in Gulf, Big, Woodcutter and Boals creeklines (500 ML per day for two months during October to February)	Improve water quality, provide connectivity and maintain drought refuge for fish and turtles
Spring/summer inundation of Boals Deadwoods wetland (100 ML per day for three and a half months during September to January) ***Note: this action would only occur if natural flooding triggered a bird breeding event***	Maintain breeding of ibis and spoonbill colonies (if initiated naturally) Facilitate a proposed experiment to investigate the relationship between open water, giant rush and ibis nesting
Spring/summer inundation of Barmah Forest wetlands (variable flow rates to maintain appropriate inundation extent for up to three and a half months during August to December) ***Note: this action would only occur if natural flooding triggered a bird breeding event***	Maintain appropriate flood depth and duration to wetlands supporting a significant colonial waterbird breeding event (if initiated naturally) Provide native fish recruitment opportunities
Winter/spring/summer inundation of Barmah Forest (variable flow rates to maintain appropriate inundation extent for four months during August to December followed by drawdown and drying of floodplain)	Increase (greater than 0.5 m depth) and extend (four months) natural spring flooding to maximise benefit for moira grass plains and river red gum forest
Gunbower Forest	
Promote natural drying of forest (year-round)	Improve wetland health by removing blackwater and carp threat
Winter/spring/summer inundation of Little Gunbower Wetland Complex and/or Little Reedy Lagoon Complex (variable flow rates to maintain appropriate inundation extent during August to January) ***Note: this action would only occur if natural flooding triggered a bird breeding event***	Support a significant bird breeding event if triggered by natural flooding Allow fish passage onto the floodplain and into wetlands
Commissioning of Hipwell Road Offtake Regulator (timing dependant on completion of structural works and commissioning plan)	Commissioning the new Hipwell Road Offtake Regulator
Gunbower Creek	
Winter/spring low flow (100 ML per day during July and September)	Provide a base flow during the winter shut down period to maintain habitat quality for threatened large bodied native fish
Spring high flow (350 to 450 ML per day during September to November)	Inundate spawning areas and stimulate fish movement
Spring/summer bankfull flow (up to 700 ML per day from October to January)	Stimulate spawning, hatching and larval dispersal
Summer/autumn/winter low flow (200 to 300 ML per day during December and June)	Provide connectivity for fish migration and to maintain habitat quality

Table 5.6.1 Priority watering actions and environmental objectives for the Living Murray icon sites (continued)

Priority watering action	Environmental objectives
Hattah Lakes	
Winter/spring floodplain inundation and filling of Lake Bitterang (target water level of 43.5m AHD during July to November)	Increase the diversity, extent and abundance of wetland and floodplain vegetation communities, particularly river red gum woodlands Restore and maintain wetlands and floodplain habitat to support fish communities and waterbird breeding
Spring/summer floodplain inundation (target water level of 45m AHD during September to December)	Increase inundation extent to improve the health of vegetation communities, particularly black box Increase productivity of the lakes and provide feeding and breeding opportunities for waterbirds and fish
Lindsay-Wallpolla and Mulcra islands	
Winter floodplain inundation of Mulcra Island (target surcharging of Murray River Lock 8 to 600mm above full supply level during June to October)	Provide a diversity of structural aquatic habitats Increase the 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 Increase abundance, diversity and extent of distribution of native fish Provide habitat suitable for migratory birds, especially species listed under the JAMBA, CAMBA and ROKAMBA Provide occasional breeding and roosting habitat for colonial waterbirds
Winter/spring floodplain inundation of Wallpolla Island, including Horseshoe Lagoon (target surcharging of Murray River Lock 9 to 250mm above full supply level during August to October)	Increase the diversity, extent and abundance of wetland vegetation

Table 5.6.2 Priority watering actions for the Living Murray icon sites under a range of planning scenarios

	Planning scenario			
	Drought	Dry	Average	Wet
Barmah Forest				
Priority watering actions	Spring/summer pulsed flow in the River Murray channel (21,000 ML, with 20,000 ML return flows) Spring/summer baseflow in Gulf, Big, Woodcutter and Boals creeklines (30,000 ML, with 15,000 ML return flows)	Spring/summer inundation of Boals Deadwoods wetland (10,000 ML, with 7,000 ML return flows) Spring/summer inundation of Barmah Forest wetlands (usage dependent upon inundation requirements)	Winter/spring/ summer inundation of Barmah Forest	N/A[1]
Possible volume required from the Water Holdings[2]	51,000 ML (with 35,000 ML return flows)	>10,000 ML (with 7,000 ML return flows)	970,000 ML (680,000 ML return flows)	0 ML

Table 5.6.2 Priority watering actions and environmental objectives for the Living Murray icon sites (continued)

	Drought	Dry	Average	Wet
Gunbower Forest and Gunbower Creek				
Priority watering actions	Commissioning of Hipwell Road Offtake Regulator (400 ML) Winter/spring low flow in Gunbower Creek Summer/autumn/ winter low flow in Gunbower Creek	Commissioning of Hipwell Road Offtake Regulator (400 ML) Winter/spring low flow in Gunbower Creek Spring high flow in Gunbower Creek Spring/summer bankfull flow in Gunbower Creek Summer/autumn/ winter low flow in Gunbower Creek	Commissioning of Hipwell Road Offtake Regulator (400 ML) Winter/spring/ summer inundation of Little Gunbower Wetland Complex and/or Little Reedy Lagoon Complex (4,400 ML) Winter/spring low flow in Gunbower Creek Spring/summer high flow in Gunbower Creek Spring/summer bankfull flow in Gunbower Creek Summer/autumn/ winter low flow in Gunbower Creek	Commissioning of Hipwell Road Offtake Regulator (400 ML) Winter/spring/ summer inundation of Little Gunbower Wetland Complex and/or Little Reedy Lagoon Complex (4,400 ML) Winter/spring low flow in Gunbower Creek Spring high flow in Gunbower Creek Spring/summer bankfull flow in Gunbower Creek Summer/autumn/ winter low flow in Gunbower Creek
Possible volume required from the Water Holdings	13,900 ML (plus 31,500 ML consumptive water en route)	35,400 ML (plus 80,000 ML consumptive water en route)	39,400 ML (plus 80,000 ML consumptive water en route)	39,400 ML (plus 80,000 ML consumptive water en route)
Hattah Lakes				
Priority watering actions	Winter/spring floodplain inundation and filling of Lake Bitterang (64,000 ML, with 7,000 ML return flows) Spring/summer floodplain inundation (50,000 ML, with 35,000 ML return flow)	Winter/spring floodplain inundation and filling of Lake Bitterang (64,000 ML, with 7,000 ML return flow) Spring/summer floodplain inundation (50,000 ML, with 35,000 ML return flow)	Winter/spring floodplain inundation and filling of Lake Bitterang (60,000 ML, with 6,500 ML return flow) Spring/summer floodplain inundation (40,000 ML, with 24,500 ML return flow)	Winter/spring floodplain inundation and filling of Lake Bitterang (50,000 ML, with 5,400 ML return flow) Spring/summer floodplain inundation (30,000 ML delivered, 21,000 ML return flow)
Possible volume required from the Water Holdings	114,000 ML (with 42,000 ML return flows)	114,000 ML (with 42,000 ML return flows)	100,000 ML (with 31,000 ML return flow)	80,000 ML (with 26,400 ML return flow)
Lindsay-Wallpolla islands				
Priority watering actions	Winter floodplain inundation of Mulcra Island (40,000 ML, with 35,000 ML return flow) Winter/spring floodplain inundation of Wallpolla Island, including Horseshoe Lagoon (3,000 ML)	Winter floodplain inundation of Mulcra Island (40,000 ML, with 35,000 ML return flow) Winter/spring floodplain inundation of Wallpolla Island, including Horseshoe Lagoon (3,000 ML)	Winter floodplain inundation of Mulcra Island (40,000 ML, with 35,000 ML return flow) Winter/spring floodplain inundation of Wallpolla Island, including Horseshoe Lagoon (3,000 ML)	N/A
Possible volume required from the Water Holdings	8,000 ML usage (plus 35,000 ML consumptive water en route)	8,000 ML usage (plus 35,000 ML consumptive water en route)	8,000 ML usage (plus 35,000 ML of consumptive water en route)	0 ML

1 Under a wet scenario, a seasonal dry will be implemented at Barmah Forest, to reduce the impact of unseasonal summer flooding of the forest and further decline in the extent of moira grassplains (see page 148 for further information).

2 Possible volumes required from the Water Holdings in Barmah Forest are estimates, with actual volumes required highly dependent on natural conditions (see page 148 for further information).

General triggers for undertaking watering actions have been included in the regional overview for the Northern Region (refer to Section 5).

As the icon sites are located off the River Murray, water delivery can achieve outcomes in one system, with the water then returned to the Murray system for use further downstream (ie. as part of a multi-site watering). This depends on factors including river levels and flow rates in the River Murray, available environmental water, environmental responses, channel capacity constraints and the delivery of water to meet downstream demand.

Environmental water requirements vary significantly in Barmah Forest depending upon the factors outlined above, ranging from maintenance of appropriate river and creek conditions to sustain fish movement and recruitment in dry conditions, to full-scale forest flooding under wet conditions. Natural factors will also dictate the delivery of water in the system. If natural flooding stimulated a significant colonial bird breeding event in Barmah Forest, environmental water will be delivered to support this event. As conditions become wetter, or water is being delivered through the Murray system to achieve objectives downstream, environmental watering will aim to provide larger-scale benefits, including flooding of river red gum forests and moira grassplains.

A late-winter and spring flood is now required to re-invigorate the severely depleted moira grassplains and assist in expanding its distribution in Barmah Forest. The chance of natural flooding in spring is relatively high; however the need to augment this with additional water releases is likely to be required to maintain flood depth during spring. Following any winter/spring flooding, the provision of a summer drying cycle will be critical to vegetation recovery. However, if wet conditions persist over summer, there are arrangements that balance the potential impacts of unseasonal summer flooding across both Barmah and Millewa forests. These arrangements involve alternating, on an annual basis, the diversion of unseasonal flows to either Barmah or Millewa forest. Rather than both forests receiving undesirable outcomes for their moira grassplains, the arrangement allows for deeper flooding in one forest whilst the other remains dry. In 2013-14, the Millewa Forest will receive any unseasonal flows.

Environmental water management at Gunbower Forest will focus on providing a drying cycle for wetlands, aimed at improving health by removing the blackwater and carp threat, in preparation for planned environmental watering of the river red gum community and wetlands beginning in winter 2014-15. However, similar to the case at Barmah, if natural flooding triggers colonial breeding in Gunbower Forest, some water may be required to maintain water levels. The volume of environmental water required to sustain an event will be dependent on the significance of the breeding event, timing, and the extent of water level reduction.

Specific flow rates and lock heights in the River Murray are required to facilitate environmental water deliveries to Hattah, Lindsay-Walpolla and Mulcra Islands. As such, the ability to manage environmental water into these wetlands will be dependent upon sufficient flows being delivered down the Murray system. Management of flows into these wetlands is planned under most climatic scenarios. Under a wet scenario, high flows in the Murray system are likely to naturally inundate the wetlands, or significantly contribute to achieving the desired watering regimes.

A number of large-scale works are due for completion in 2013-14, that will enable water levels in Gunbower Forest, Hattah and Mulcra Island to be manipulated. In addition to providing the environmental objectives identified above, commissioning of the structures will also be undertaken in the delivery of environmental water to these sites.

Risk assessment and management

A number of risks have been assessed, and mitigating strategies identified, relating to the implementation of priority watering actions. Table 5.6.3 summarises these risks, and the mitigating strategies identified by the Goulburn Broken, North Central and Mallee catchment management authorities.

Table 5.6.3 Risk management in the Living Murray icon sites

Risk type	Mitigating strategies Barmah (Goulburn Broken Catchment Management Authority)	Mitigating strategies Gunbower (North Central Catchment Management Authority)	Mitigating strategies Hattah and Lindsay-Wallpolla (Mallee Catchment Management Authority)
Release volume is insufficient to meet target flow	Maintain River Murray flows downstream of Yarrawonga below 10,500 ML per day during winter to dry wetlands; however, if an Ovens River fresh or Hume spill results in river flows downstream of Yarrawonga exceeding 10,500 ML per day, then progressively open Barmah Forest regulators with priority to those structures that divert water to non-moira grass wetlands	N/A	N/A
Storage manager cannot deliver required volume or flow rate (outlet/capacity constraints, insufficient storage volume)	Environmental water is planned to be used to primarily fill in gaps of low flow between natural flood events; available volumes of environmental water are considered and continuously reviewed along with weather forecasts when assessing conditions and determining the likely success of watering actions	N/A	Engage storage manager throughout the watering season to assist with timing of releases when there is sufficient capacity to meet requirements
Improved conditions for non-native species (eg. carp)	Flooding of wetlands in spring coincides with most breeding strategies for native plants and animals, and can reduce pest plant invasion Carp have the ability to breed over a broader range of season and water temperatures than many native fish species that will only breed in spring/early summer; various trade-offs between good and bad results for non-native species, while other native species (fish eating birds such as cormorants) can utilise pests such as carp	N/A	Avoid delivery throughout summer

Table 5.6.3 Risk management in the Living Murray icon sites (continued)

Risk type	Mitigating strategies Barmah (Goulburn Broken Catchment Management Authority)	Mitigating strategies Gunbower (North Central Catchment Management Authority)	Mitigating strategies Hattah and Lindsay-Wallpolla (Mallee Catchment Management Authority)
Environmental water account is overdrawn	The Barmah-Millewa Operational Advisory Group will be active for the duration of any environmental watering event, enabling agencies to continuously monitor environmental water availability versus the forecast requirements and relate this to the watering strategy objectives	N/A	N/A
Unable to provide evidence in meeting ecological objective	N/A	Some ecological outcomes will require many years of data to determine the success of water management Monitoring of bird breeding events will provide immediate information about the success of breeding activities Annual fish monitoring provides information about change of community dynamics over time	Ensure monitoring activities are undertaken Establish monitoring framework
Community backlash if environmental releases impact on access to the forest and restricts commercial activities	N/A	Provide regular updates to the Department of Environment and Primary Industries and Parks Victoria land managers about environmental water releases so as they can provide notice to forest users Submit a public notice prior to environmental watering Consult with the community reference group in the development and implementation of the seasonal watering plan	N/A
Environmental releases restrict access to commercial forestry plots	N/A	Liaise with the Department of Environment and Primary Industries during the seasonal watering plan planning phase to schedule (as far as possible) commercial forestry plots around the areas that will be impacted by environmental watering events	N/A

Table 5.6.3 Risk management in the Living Murray icon sites (continued)

Risk type	Mitigating strategies Barmah (Goulburn Broken Catchment Management Authority)	Mitigating strategies Gunbower (North Central Catchment Management Authority)	Mitigating strategies Hattah and Lindsay-Wallpolla (Mallee Catchment Management Authority)
Current recommendations on environmental flow inaccurate	N/A	N/A	Base decisions on best available knowledge An environmental water management plan has been developed for most sites
Storage manager maintenance works affect ability to deliver water	N/A	N/A	Continue communication with storage managers
Limited catchment management authority resources to deliver environmental release	N/A	N/A	Ensure that environmental water management within the Mallee Catchment Management Authority is adequately resourced to undertake required delivery tasks
Cost of delivery exceeds available funding	N/A	N/A	Delivery undertaken in most cost-effective manner (with single lift and minimal earth works)
Environmental release cause personal injury to river user	N/A	N/A	Ensure appropriate safety measures around pump outlets and any access that may become inundated
Releases cause water quality issues (eg. blackwater, low dissolved oxygen, mobilisation of saline pools, acid-sulphate soils etc.)	N/A	N/A	Observe the quality of the water throughout the watering season and manage accordingly
Environmental releases cause flooding of private land	N/A	N/A	Ensure landholder agreements are undertaken for flooding on private land. Delivery plans will be developed and approved by VEWH
Environmental releases cause flooding of Crown land	N/A	N/A	Agreements undertaken with land manager for flooding on Crown land

Section 6

Further information

6.1 Contact details

For further information on the Seasonal Watering Plan 2013-14, please contact the VEWH office:

15/8 Nicholson St, East Melbourne, Victoria, 3002
PO Box 500, East Melbourne, Victoria, 3002
T: (03) 9637 8951
E: general.enquiries@vewh.vic.gov.au

For specific information about each system, and details about specific seasonal watering proposals, please contact the relevant waterway manager:

Corangamite CMA

64 Dennis Street, Colac, Victoria, 3250
PO Box 159, Colac, Victoria, 3250
T: (03) 5232 9100
E: Info@ccma.vic.gov.au
W: www.ccma.vic.gov.au

East Gippsland CMA

574 Main Street, Bairnsdale, Victoria, 3875
PO Box 1012, Bairnsdale, Victoria 3875
T: (03) 5152 0600
E: egcma@egcma.com.au
W: www.egcma.com.au

Glenelg Hopkins CMA

79 French Street, Hamilton, Victoria, 3300
PO Box 502, Hamilton, Victoria, 3300
T: (03) 5571 2526
E: ghcma@ghcma.vic.gov.au

Goulburn Broken CMA

168 Welsford Street, Shepparton, Victoria, 3630
PO Box 1752, Shepparton, Victoria, 3630
T: (03) 5820 1100
E: reception@gbcma.vic.gov.au
W: www.gbcma.vic.gov.au

Mallee CMA

DPI Complex, Corner Koorlong Avenue and Eleventh Street, Irymple, Victoria, 3502
PO Box 5017, Mildura, Victoria, 3502
T: (03) 5051 4377
W: www.malleecma.vic.gov.au

Melbourne Water

990 La Trobe Street, Docklands, Victoria 3008
PO Box 4342, Melbourne, Victoria, 3001
T: 131 722
E: enquiry@melbournewater.com.au
W: www.melbournewater.com.au

North Central CMA

628-634 Midland Highway, Huntly, 3551
PO Box 18, Huntly, 3551
T: (03) 5448 7124
E: info@nccma.vic.gov.au
W: www.nccma.vic.gov.au

West Gippsland CMA

16 Hotham Street, Traralgon, Victoria, 3844
PO Box 1374, Traralgon, Victoria, 3844
T: 1800 094 262
E: westgippy@wgcma.vic.gov.au
W: www.wgcma.vic.gov.au

Wimmera CMA

24 Darlot Street, Horsham, Victoria, 3400
PO Box 479, Horsham, Victoria, 3402
T: (03) 5382 1544
E: wca@wcma.vic.gov.au
W: www.wcma.vic.gov.au

For specific information about the other environmental water holders, please contact.

Murray-Darling Basin Authority

Level 4, 51 Allara Street, Canberra, ACT, 2601
GPO Box 1801, Canberra, ACT, 2061
T: (02) 6279 0100
W: www.mdba.gov.au

Commonwealth Environmental Water Office

John Gorton Building, King Edward Terrace, Canberra, ACT, 2601
GPO Box 787, Canberra, ACT, 2061
T: (02) 6275 9246
E: ewater@environment.gov.au
W: www.environment.gov.au/ewater/index.html

6.2 Glossary

Allocation bank account – water share owners and some other entitlement holders hold allocation bank accounts (ABAs), which are credited as water allocations are made throughout the season

Australian Height Datum (AHD) – height above sea level

Carryover – allows entitlement-holders to retain ownership of unused water into the following season (according to specified rules)

Catchment management authority – statutory authorities established to manage regional and catchment planning, waterways, floodplains, salinity and water quality

Commonwealth Environmental Water Office – (part of the Department of Sustainability, Environment, Water, Populations and Communities) holds and manages the water entitlements purchased through the Restoring the Balance water recovery program

Environmental flow regime – the timing, frequency, duration and magnitude of flows for the environment

Environmental flow study – a scientific study of the flow requirements of a particular basin's river and wetlands systems used to inform decisions on the management and allocation of water resources

Environmental water entitlement – an entitlement to water to achieve environmental objectives in waterways (could be an environmental entitlement, environmental bulk entitlement, water share, section 51 licence or supply agreement)

Flow component – components of a river system's flow regime that can be described by magnitude, timing, frequency and duration (for example, cease to flow and overbank flows).

Gigalitre (GL) – one billion (1,000,000,000) litres

Heritage rivers – are listed under the ***Heritage Rivers Act 1992***, and are particular parts of rivers and river catchment areas in Victoria which have significant nature conservation, recreation, scenic or cultural heritage attributes

High-reliability entitlement – legally recognised, secure entitlement to a defined share of water (full allocations are expected in most years)

Low-reliability entitlement – legally recognised, secure entitlement to a defined share of water (full allocations are expected only in some years)

OLARIS – a website that displays real-time data for various reservoirs and lakes including Yarra and Tarago systems. It is used to assess the water quality at the reservoir outlet prior to releasing environmental water into the river. Visit rtm.cwr.uwa.edu.au/olaris/olaris/index.php

Macroinvertebrates – those animals that have no backbone and can be seen with the naked eye; includes worms, snails, mites, bugs, beetles, dragonflies and freshwater crayfish

Macrophytes – aquatic plants that are either emergent (growing out of the water; for example, phragmites), submergent (growing under water; for example, ribbonweed), or floating (for example, floating pond weed)

Megalitre (ML) – one million (1,000,000) litres

Midden – a site of cultural significance, where Indigenous people left the remains of their meals

Monthly Water Report – a report produced by the Department of Environment and Primary Industries, which provides a summary of the status of Victoria's water resources and water supplies at the end of the reporting month

Northern Victoria Irrigation Renewal Program – an irrigation modernisation project, involving upgrading irrigation infrastructure in the Goulburn Murray Irrigation District, which will provide water to irrigators, Melbourne and the environment

Passing flow – water released out of storages to operate river and distribution systems (to deliver water to end users), provide for riparian rights and maintain environmental values and other community benefits

Permanent trade – transfer of ownership of a water share or licence

Resource manager – appointed by the Minister for Water to manage and allocate water resources in a particular river basin

Restoring the Balance water recovery program – a Commonwealth Government program to return water to the environment through the purchase of water entitlements from irrigators

Seasonally adaptive approach – a planning approach which incorporates the likely availability of environmental water based on recent climate history and outlook, and determines the priority environmental objectives as a result

Seasonal allocation – the volume of water allocated to a water share in a given season, expressed as a percentage of entitlement volume

Storage manager – appointed by the Minister for Water to operate major water storages in a particular river basin to deliver to entitlement holders

Temporary trade – transfer of a seasonal allocation

The Living Murray – an intergovernmental program, which holds an average of 500,000 ML of environmental water per year, for use at six icon sites along the River Murray

Unregulated entitlement – an entitlement to water declared during periods of unregulated flow in a river system, that is, flows that are unable to be captured in storages

Victorian Environmental Flow Monitoring and Assessment Program – assesses the effectiveness of environmental flows in delivering ecological outcomes

Victorian Environmental Water Holder – an independent statutory body responsible for holding and managing Victorian environmental water entitlements and allocations (Victorian Water Holdings)

Victorian Water Register – a public register of water-related entitlements in Victoria

Waterways – can include rivers, wetlands, creeks, floodplains and estuaries

Water entitlement – the right to a volume of water that can (usually) be stored in reservoirs and taken and used under specific conditions

Water Holdings – environmental water entitlements held by the Victorian Environmental Water Holder

Waterway manager – agency responsible for the environmental management of catchments and waterways (includes catchment management authorities and Melbourne Water)

6.3 List of acronyms

CAMBA – China-Australia Migratory Bird Agreement

CEWO – Commonwealth Environmental Water Office

CEWH – Commonwealth Environmental Water Holder

CMA – Catchment Management Authority

EWR – Environmental Water Reserve

JAMBA – Japan-Australia Migratory Bird Agreement

MDBA – Murray-Darling Basin Authority

NVIRP – Northern Victoria Irrigation Renewal Project

ROKAMBA – Republic of Korea-Australia Migratory Bird Agreement

VEFMAP – Victorian Environmental Flow Monitoring and Assessment Program

VEWH – Victorian Environmental Water Holder


CORANGAMITE CMA


EAST GIPPSLAND
CATCHMENT
MANAGEMENT
AUTHORITY


GOULBURN
BROKEN
CATCHMENT
MANAGEMENT
AUTHORITY


Glenelg Hopkins
CMA


mallee
catchment management authority


Melbourne
Water


NORTH CENTRAL
Catchment Management Authority


Wimmera
Catchment Management
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VICTORIAN ENVIRONMENTAL WATER HOLDER

State Government Victoria