Australian Government
Commonwealth Environmental Water Office

# Commonwealth Environmental Water

Portfolio Management Plan

# Victorian Rivers

2019–20

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## Acknowledgement of the traditional owners of the Murray-Darling Basin

The Commonwealth Environmental Water Office respectfully acknowledges the traditional owners, their Elders past and present, their Nations of the Murray-Darling Basin, and their cultural, social, environmental, spiritual and economic connection to their lands and waters.



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# Commonwealth environmental water portfolio management planning

## Commonwealth Environmental Water Holder

The Commonwealth Environmental Water Holder is a statutory position established under the *Water Act 2007* and is responsible for managing the Commonwealth's environmental water holdings. This water must be managed to protect and restore the rivers, wetlands and floodplains (and the native animals and plants they support) of the Murray–Darling Basin. Ms Jody Swirepik is the current Commonwealth Environmental Water Holder. She is supported by staff of the Commonwealth Environmental Water Office, which employs six local engagement officers who live and work in regional centres across the Murray–Darling Basin.

## Commonwealth environmental water

Commonwealth environmental water holdings are water entitlements that have been acquired by the Australian Government through investments in water-saving infrastructure and purchases on the water market. The holdings are a mix of entitlement types held across 19 catchments. The rules governing the entitlements vary across states and across catchments. Commonwealth environmental water entitlements are subject to the same fees, allocations, carryover and other rules as equivalent entitlements held by other water users.

There are broadly three options for managing Commonwealth environmental water:

- delivering water to a river or wetland to meet an identified environmental demand
- leaving water in storage and carrying it over for use in the next water year (referred to as 'carryover')
- trading water, that is, selling water and using the proceeds to buy water in another catchment or in a future year, or investing in complementary 'environmental activities'.

## Purpose of the document

This document sets out the plans for managing the Commonwealth environmental water portfolio in the Victorian rivers in the Murray-Darling Basin for 2019–20. Efficient and effective management of Commonwealth environmental water requires the utilisation of all portfolio management options. By taking a multi-year approach to planning, portfolio management tools such as use, carryover and trade can be managed for maximising environmental outcomes.

The portfolio management plans support transparent, coordinated and adaptive management of Commonwealth environmental water, consistent with the Basin-wide environmental watering strategy and having regard to the Basin annual environmental watering priorities.

To learn more about the planning approach see *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2019–20* (available at: http://www.environment.gov.au/water/cewo/publications under 'Planning approach').

## Delivery partners

Commonwealth environmental water is managed in conjunction with and delivered by a range of partners. This portfolio management plan has been developed in consultation with our delivery partners, including the Victorian Environmental Water Holder, Murray-Darling Basin Authority, Goulburn Broken Catchment Management Authority, North Central Catchment Management Authority, North East Catchment Management Authority, Wimmera Catchment Management Authority, Goulburn Murray Water, Grampians Wimmera Mallee Water and scientists engaged in monitoring the outcomes of Commonwealth environmental water use

## Your input

The management of Commonwealth environmental water relies on considerable advice and assistance from others. Individuals and groups within the Murray–Darling Basin community are encouraged to submit suggestions for the management of Commonwealth environmental water. Please contact the Commonwealth Environmental Water Office via: ewater@environment.gov.au.

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# 1. Environmental watering in the Victorian Rivers in the Murray-Darling Basin

## 1.1. The Victorian Rivers in the Murray-Darling Basin

The Victorian rivers in the Murray-Darling Basin include the Goulburn-Broken, Campaspe, Loddon, Ovens (Figure 1) and Wimmera catchments. The northern Victorian rivers, particularly the Ovens and Goulburn-Broken, contribute significantly to the water resources of the River Murray, and 11.5 per cent of the Basin's stream flow originates in the Goulburn-Broken. Lake Eildon on the Goulburn River is one of the Basin's major water storages. The Wimmera River in central-west Victoria flows into Lakes Hindmarsh and Albacutya and does not connect to the River Murray. The Victorian rivers region has a highly developed agricultural sector and a population of almost half a million people (DEPI 2015).

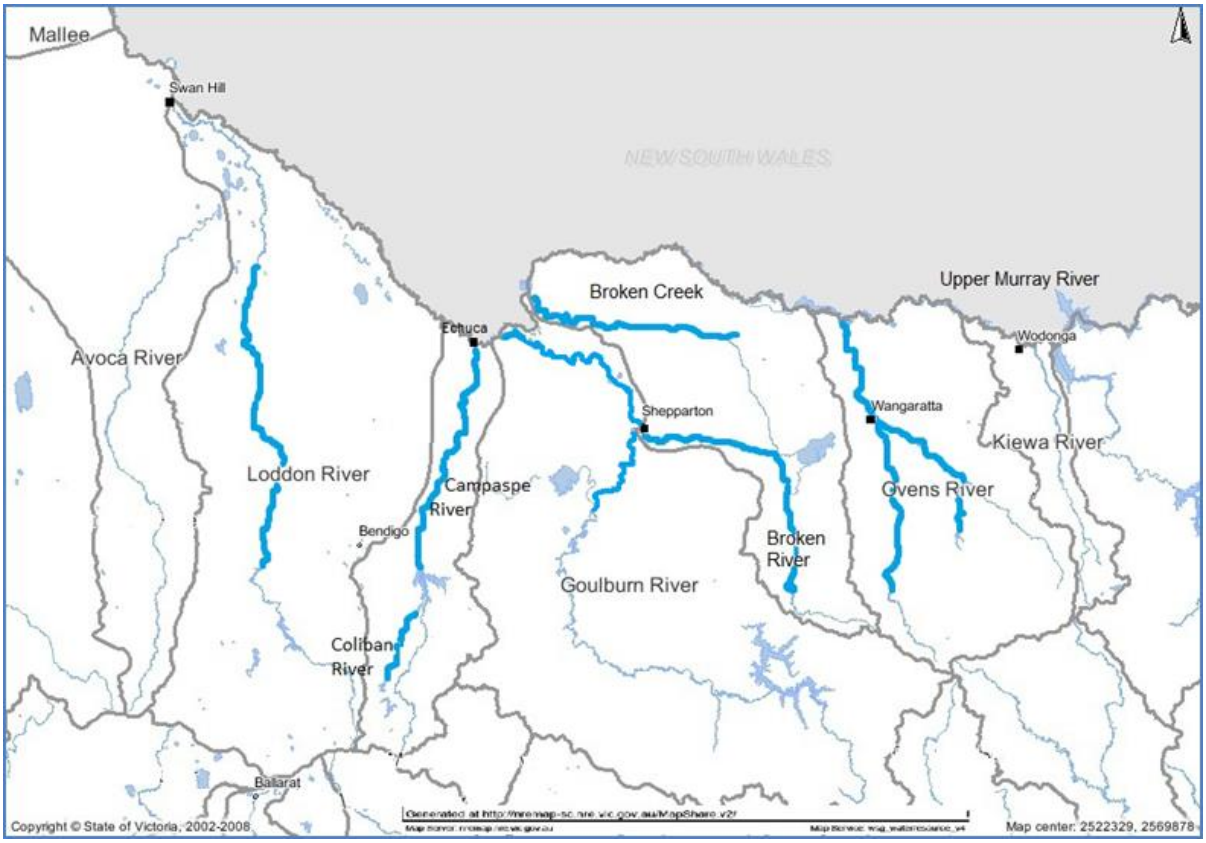


**Figure 1:** Map of the Victorian rivers in the Murray-Darling Basin. The Wimmera catchment is not shown here but is located in central-west Victoria.

Aboriginal people have had a long association with the river valleys of northern and central Victoria:

- The Ovens River catchment falls in the traditional lands of the Bangerang nation and neighbouring Taungurung and Yorta Yorta nations, to the south and west, respectively. The Waywurru nation is also located within the Ovens River valley.
- The Aboriginal people of the northern plains of the Goulburn and Broken catchments are the Yorta Yorta and Bangerang Nations. The Taungurung is the main Nation of people in the Broken River Valley and upper Goulburn Valley.
- West of the Campaspe River was the traditional land of the Dja Dja Wurrung Nation and east was the land of the Taungurong Nation. On the plains north of Rochester, the area is the traditional land of the Yorta Yorta and Bangerang Nations.

- Most of the Loddon catchment and the Avoca catchment is the traditional land of the Dja Dja Wurrung Aboriginal nation. On the floodplains, around Kerang and Kow Swamp, is the traditional land of the Barapa Barapa nation.

- The Wimmera catchment is large and diverse, and covers the traditional country of several Aboriginal Nations, including the Dja Dja Wurrung, Wotjobaluk and Wergaia in the mid and lower catchment. The north of the catchment, towards the River Murray, is the traditional lands of the Latji Latji, Tatti Tatti and Wamba Wamba Nations.

Commonwealth environmental water is delivered to the Victorian rivers primarily as in-stream flows via managed releases from storage. In lower Broken Creek, delivery is via irrigation infrastructure sourced from either the Goulburn system or the River Murray. Commonwealth environmental water use in the Victorian rivers contributes to both enhanced baseflows and freshes. This water can be credited as return flows for further environmental use downstream in the River Murray, with the exception of flows from the Ovens and Wimmera rivers.

Goulburn Murray Water (GMW) is the principal storage and water supply manager in northern Victorian catchments and is responsible for the day to day delivery of water (including environmental water) throughout its river systems and irrigation supply network. Grampians Wimmera Mallee Water (GWMW) is the storage and water supply manager for the Wimmera catchment. The implementation of watering actions within the Victorian rivers is coordinated by the Victorian Environmental Water Holder (VEWH) and managed by regional waterway managers including the Goulburn-Broken Catchment Management Authority (GBCMA), North Central Catchment Management Authority (NCCMA), North East Catchment Management Authority (NECMA) and Wimmera Catchment Management Authority (WCMA).

## 1.2. Environmental objectives in the Victorian Rivers in the Murray-Darling Basin

The long-term environmental objectives for the Murray–Darling Basin are described in the Basin Plan's environmental watering plan and the Basin-wide environmental watering strategy, which includes 'quantified environmental expected outcomes' at both a Basin-scale and for each catchment. The expected outcomes relevant for the Victorian rivers are summarised in Table 1and described in detail in Attachment A.

The Victorian state government has also developed a long-term watering plan for all northern Victorian catchments. The plan identifies the priority environmental assets and ecosystem functions in the catchment, the objectives and targets for these assets and functions, and their watering requirements. The plan is available here: (https://www.water.vic.gov.au/waterways-and-catchments/rivers-estuaries-and-waterways/environmental-water/long-term-watering-plans).

Based on these strategies and plans, and in response to best available knowledge drawing on the results of environmental watering monitoring programs, the objectives for environmental watering in the Victorian rivers are summarised in Table 1 below. The objectives for water-dependent ecosystems will continue to be revised as part of the Commonwealth Environmental Water Office's commitment to adaptive management.

**Table 1:** Summary of objectives being targeted by environmental watering in the Victorian rivers

| **BASIN-WIDE MATTERS** (Matters in red link to the Basin-wide environmental watering strategy) | **OBJECTIVES FOR ENVIRONMENTAL ASSETS IN THE VICTORIAN RIVERS** | |
|---|---|---|
| | **IN-CHANNEL ASSETS** | **OFF-CHANNEL ASSETS** |
| | **Goulburn (lower and middle reaches), Broken, Campaspe, Loddon, Ovens and Wimmera rivers; Upper and lower Broken Creek** | **Goulburn River wetlands; Lower Broken wetlands; Upper Broken Creek wetlands (Moodie Swamp)** |
| **VEGETATION** | Maintain and improve riparian and in-channel vegetation cover, extent, condition and diversity.<br>Increase periods of growth for inundation tolerant vegetation communities that closely fringe or occur within river channels. | Maintain the current extent, condition and diversity of water-dependent vegetation.<br>Improve condition of black box, river red gum and lignum shrublands. Improve recruitment of trees within black box and river red gum communities. |
| **WATERBIRDS** | Provide habitat and food sources to support waterbird breeding, survival and recruitment, and maintain condition and current species diversity. | |
| | | Support waterbird breeding, including brolga in Moodie Swamp |
| **FISH** | Provide flows to support habitat and food sources to promote increased movement, breeding, recruitment and survival of native fish.<br>Improve abundance and maintain species richness.<br>Provide native fish passage through fishways. | Provide flow cues to support habitat and food sources and promote increased movement, recruitment and survival of native fish (particularly for floodplain specialists). |
| **INVERTEBRATES** | Provide habitat to support increased microinvertebrate and macroinvertebrate survival, diversity, abundance and condition. | |
| **OTHER VERTEBRATES** | Provide habitat and food sources to support survival, maintain condition and provide recruitment opportunities for frogs, turtles, platypus and native water rats (Rakali). | |
| **CONNECTIVITY** | Support longitudinal connectivity along Victorian rivers and to the River Murray for environmental functions such as nutrient and sediment transport, organism dispersal and water quality.<br>Support lateral connectivity by increasing the frequency of freshes. | Support lateral connectivity (within constraints) to wetlands and floodplains by contributing to an increase in the frequency of lowland floodplain flows. |
| **PROCESSES** | Support primary productivity, sediment, nutrient and carbon transport and cycling; biotic dispersal/movement; and channel maintenance. | |
| **WATER QUALITY** | Maintain water quality and provide refuge habitat from adverse water quality events (e.g. low dissolved oxygen and hypoxic blackwater), including minimising accumulation of Azolla (aquatic plant) in lower Broken Creek to help maintain DO levels. | Support the transport of nutrients and carbon off the floodplain and into the river channel and downstream. |
| **RESILIENCE** | Provide drought refuge habitat. | |

Information sourced from: Cottingham et al. (2003; 2007; 2010; 2014) GBCMA (2019 a-d), NCCMA (2019 a-b), NECMA 2018) WCMA (2019)

## 1.3. Environmental flow requirements

Not all environmental demands can and will be met through the use of held environmental water. Some demands are met by regulated water deliveries for consumptive purposes and inter-valley transfers, while others are met by large unregulated/natural flows events or are beyond what can be delivered within operational constraints. Figure 2 shows the broad environmental demands that are in scope for Commonwealth environmental water. Importantly, these are broad, indicative demands and individual watering events may contribute to particular opportunities, such as using infrastructure to deliver water to individual wetlands that would otherwise not be possible due to constraints. There may be opportunities for Basin State governments to remove or modify constraints, which will improve the efficiency and/or effectiveness of environmental watering. Further information on operational delivery including constraints is described in Attachment B.

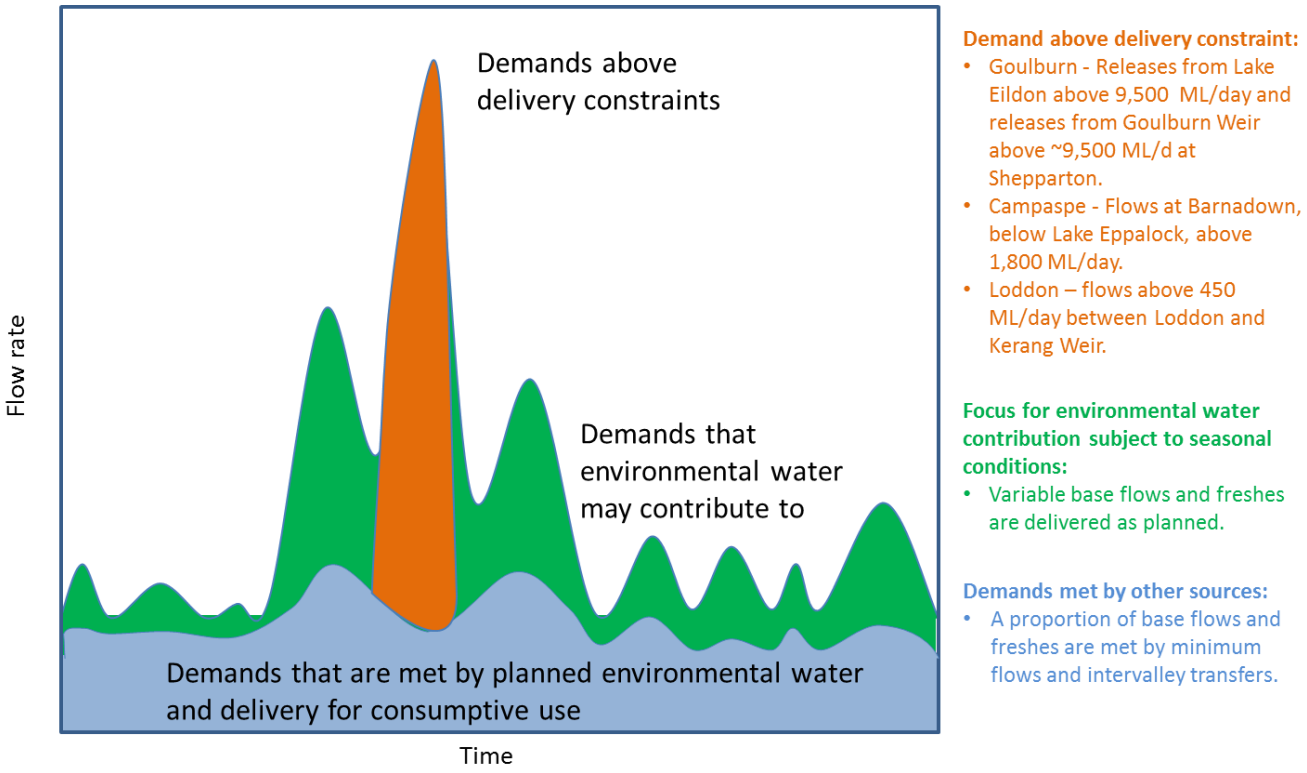


**Figure 2:** Scope of demands that environmental water may contribute to in the Victorian rivers of the Murray-Darling Basin

Based on the above objectives and delivery constraints, specific watering requirements (flow magnitude, duration, timing and frequency) have been identified as being in scope for Commonwealth environmental water. These water requirements are described in Table 3. As with the objectives, the environmental water requirements will continue to be reviewed and revised in response to new knowledge.

# 2. Portfolio management in 2019–20

In planning for the management of Commonwealth environmental water, the Commonwealth Environmental Water Office aims to maximise the outcomes achieved from the available water. This includes consideration of the urgency of demands (based on targeted objectives and watering requirements, watering history and asset condition) and the available supply under different resource scenarios. Plans for water delivery, trade and carryover are then made in a multi-year context, with an assessment also undertaken of need for water in future years.

This planning process is outlined in full in Table 3 and summarised in the sections below.

## 2.1. Outcomes from previous years

Outcomes from monitoring and lessons learned in previous years is a critical component for the effective and efficient use of Commonwealth environmental water. These learnings are incorporated into the way environmental water is managed.

The Commonwealth Environmental Water Office works with the Murray–Darling Basin Authority, state agencies, research organisations, regional organisations, local groups and others, such as landholders to collect and collate relevant monitoring information and evaluation results that facilitates adaptive management and changing our practices where needed. This continual review of information and outcomes is helping to build knowledge about the best way to get positive outcomes on a larger scale, based on what works and what doesn't work.

**Key lessons and findings**

The Commonwealth Environmental Water Office's Long-Term Intervention Monitoring (LTIM) Project has identified a number of key environmental outcomes associated with the use of environmental water in the Goulburn River over the period 2014–15 to 2017–18, including:

- Improved habitat for juvenile and small-bodied fish, and large water bugs (insects, snails, shrimp) by providing flows that increase the areas of still and slow-flowing water that are favourable to their survival.
- Improved habitat for larger native fish by providing flows that increase the depth and area of the larger pools where they live.
- Golden perch spawning as a result of late spring higher flows when water temperature is over 18°C.
- Movement of golden and silver perch from the Murray River into the Goulburn River on higher autumn higher flows.
- The presence of native fish including Murray cod, silver perch, Murray River rainbowfish, Australian smelt and carp gudgeon.
- Spawning by endangered trout cod in the Goulburn River, which had previously not been seen for many years.
- Increased plant cover on the river bank by providing flows that increase soil moisture, reduce erosion, and provide areas of low flow that favour seed and sediment (sand, mud, pebbles) deposition and plant establishment.
- Increased food (organic carbon) availability for fish and large water bugs by providing flows that maintain a healthy balance between the organic carbon that is produced and consumed in the river.
- Increased biomass of large crustaceans (yabbies and shrimps) following high flow events. These animals are an important food source for native fish.

The latest LTIM report for the Goulburn River also notes the environmental impacts of increased deliveries of operational intervalley transfer water across the summer of 2017–18 (Webb et al 2019). These high flows have been associated with bank notching and slumping, and appear to have affected vegetation establishment and survival along the lower bank. Variable flow rates have been implemented where possible to mitigate these risks, however this issue remains a priority for further attention.

The Arthur Rylah Institute for Environmental Research has undertaken native fish and vegetation monitoring in the Campaspe River as part of the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP 2018) and found:

- For the second year in a row the presence of Murray cod larvae
- Australian smelt, flat-headed gudgeon, carp gudgeon, redfin and carp eggs or larvae
- Very low numbers of young-of-year, indicating little recruitment. This may have been due to elevated colder summer flow (intervalley transfers) or cold and rapid river flow changes during spawing season.
- Very high intervalley transfer flows affected the presence of shallow water near the banks, potentially reducing the availability of suitable habitat for juvenile fish; it can also drown lower bank vegetation
- Murray–Darling rainbow fish, previously thought lost to the system, at many sites and in abundance downstream of Elmore in reach 2

These outcomes are being used to inform portfolio management planning and adaptive management decision-making.

## 2.2. Antecedent and current catchment conditions and the demand for environmental water in 2019–20

Asset condition across the Victorian rivers in the Murray-Darling Basin reflect over 15 years of harsh climate conditions. During this period there was prolonged drought conditions between 1997 and 2010, significant flooding in 2010 and 2011, wet conditions in 2012–13 and a subsequent series of three moderate/dry years, until 2016–17. A wet year in 2016-17 was followed by further drying conditions in 2017–18 and generally below average rainfall and above average temperatures during 2018–19. Environmental watering in recent years and the wet conditions experienced during 2016–17 contributed to some improvement in river health and supported ongoing recovery, however, continuing dry conditions over the past two years mean that many of the sites continue to require water for the environment to maintain the ecological health of the waterways and have high demand, as summarised below and outlined in Table 3.

**Goulburn River:** Primarily high demands

There is a high demand, following dry conditions and high intervalley transfer flows, to deliver environmental water to: increase river channel and lower bank vegetation to provide food and habitat for animals and to provide bank stability; protect and increase native fish populations; maintain waterbug populations to support the food web; maintain water quality to minimise the risk of a hypoxic blackwater event; improve stream metabolism by encouraging the production of plankton; flush fine sediment from hard surfaces to encourage new biofilms to grow.

**Lower Broken Creek:** High demand

The presence of numerous small weirs in the system and annual issues with low dissolved oxygen levels and Azolla growth mean the demand for year-round flows is high. Environmental water can be used to: control rapid build-up of Azolla; maintain dissolve oxygen levels suitable to aquatic animals; maintain vegetation; provide cues for fish movement and spawning; and protect populations of native fish, platypus, turtles and water rat (rakali). Return flows from environmental water may also be used to meet high demand requirements in assets downstream in the River Murray.

**Upper Broken Creek:** High demand

As environmental water is used to maintain water quality suitable for native fish populations to survive, the demand is high. Year-round flows also maintain in-stream vegetation and platypus populations as well as supporting the presence of waterbugs to break down organic matter and support the food web.

**Goulburn-Broken catchment wetlands – Moodie Swamp:** Moderate demand

In 2018–19 environmental water was used to partially fill the swamp and if the wetland dries out during 2019–20 there may be demand to provide habitat for waterbirds, maintain rigid and slender water milfoil as well as reduce non-native plant species.

**Broken River:** Moderate demand

If very low flows are experienced, environmental water delivery will be to maintain water quality, in-stream vegetation, waterbugs, native fish and platypus populations.

**Campaspe River** High demand

Key demands following dry conditions and high intervalley transfer flows include: maintaining instream and bank vegetation, particularly mature river red gum trees; providing habitat to protect native fish habitat; maintaining the platypus population; ensuring connectivity the length of the river to the River Murray; increasing waterbug productivity; protecting water quality in deep pools; and flushing leaf litter from banks and low benches to reduce the risk of blackwater events.

**Loddon River** High demand

Following dry conditions in 2018–19 the demand is high including for: supporting populations of small and large bodied native fish; increasing populations of platypus; maintaining floodplain and riparian woody and non-woody vegetation; maintaining benches and deep pools; and engaging flood-runners.

**Ovens River:** Moderate demand

Key demands include maintaining water quality, enabling the movement of native fish and supporting waterbug populations.

**Mullinmur wetland:** High demand

The key demand is to maintain the condition and extent of wetland vegetation and the native fish population.

**Wimmera River:** Critical demand

Assuming dry conditions persist, the focus for 2019–20 will be to prevent loss of high value refuge habitat and mitigating water quality issues (especially salinity) and a key to this will be the effective management of drought refuge pools throughout the system. Should conditions be wetter, then the objective is to continue to pursue vegetation and fish objectives by implementing baseflows and freshes.

**Murray–Darling Basin-wide environmental watering strategy and 2019–20 annual priorities**

The Murray–Darling Basin Authority publish the Basin annual environmental watering priorities each year and have published multi-year priorities since 2017-18. There are no specific 2019–20 Basin annual environmental watering priorities relevant to the Victorian rivers, however the rolling annual priorities are applicable.

**Rolling, multi-year priorities**

- Support lateral and longitudinal connectivity along the river systems
- Maintain the extent, improve the condition and promote recruitment of forests and woodlands
- Improve the abundance and maintain the diversity of the Basin's waterbird population.
- Support Basin-scale population recovery of native fish by reinstating flows that promote key ecological processes across local, regional and system scales in the southern connected Basin.
- Support viable populations of threatened native fish, maximise opportunities for range expansion and establish new populations.

## 2.3. Water availability in 2019–20

**Forecasts of Commonwealth water allocations**

The volume of Commonwealth environmental water likely to be carried-over in the Victorian rivers for use in 2019–20 is estimated to be between 120-130 GL. Total carryover in the southern-connected Basin is estimated to be 410-430 GL.

Allocations against Commonwealth water entitlements in the Victorian rivers are determined by state governments and will vary depending on inflows. The following forecasts in Table 2 are based on the best available information including State forecasts and historical inflow scenarios.

Table 2**: Forecasts of Commonwealth water allocations (including carryover) in 2019–20 in the Victorian rivers as at 31 May 2019.**

| Entitlement type | Forecasts of Commonwealth water allocations (including carryover) in 2019–20 (GL)[1,2] | | | | | |
|---|---|---|---|---|---|---|
| | Very dry ◄ | | | | | ► Very wet |
| | 95 percentile | 90 percentile | 75 percentile | 50 percentile | 25 percentile | 10 percentile |
| Goulburn (High/Low Reliability) | 188 | 289 | 348 | 446 | 450 | 459 |
| Upper Broken Creek and Broken River | 0.2 | 0.3 | 0.5 | 0.5 | 0.5 | 0.5 |
| Campaspe (High/Low Reliability) | 4.1 | 5.2 | 6.8 | 9.6 | 9.6 | 9.6 |
| Loddon (High/Low Reliability) | 0 | 1.3 | 2.1 | 3.4 | 3.4 | 3.5 |
| Ovens (High Reliability) | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Wimmera & Glenelg | 2 | 2 | 2 | 2 | 2 | 2 |
| **Total – Vic Rivers** | **194** | **298** | **359** | **461** | **465** | **474** |
| **Total – Southern-Connected Basin[3]** | **681** | **999** | **1258** | **1630** | **1763** | **2001** |

Notes:

1. The southern-connected Basin includes the Murrumbidgee, Murray, Lower Darling, Goulburn, Campaspe (excluding Coliban) and Loddon entitlements.
2. Forecasts for regulated catchments are given to the nearest whole gigalitre except where the entitlement held by the Commonwealth is below 1 GL.
3. Total forecast water available in the southern-connected Basin assumes that in Victoria 100 per cent of water held in spillable accounts becomes available under a median or dry scenario and 50 per cent or less becomes available under wetter scenarios. These figures do not include supplementary, unregulated or ground water accruals in the southern-connected Basin.

Information on allocations to Commonwealth environmental water holdings can be found at http://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment and is updated monthly.

**Water resource availability scenarios**

Commonwealth environmental water is not managed in isolation. When considering the available resource to meet environmental demands, it is necessary to also factor in the resources managed by other entities and available to contribute to environmental objectives. Relevant resources include held environmental water, planned environmental water, natural and unregulated flows, conveyance water and consumptive water. Further detail on sources of environmental water in the Victorian rivers in the Murray-Darling Basin is provided in Attachment C.

By combining the forecasts of water held by the Commonwealth with streamflow forecasts, as well as taking into account operational considerations, water resource availability scenarios can be developed ranging from very low to very high. Based on available information, low to high resource availability scenarios are in scope for 2019–20. Carryover from 2018–19 precludes a 'very low' resource availability scenario from eventuating, while 'very high' resource availability is not expected to eventuate even in wet conditions, given low water storage levels at the commencement of 2019–20.

## 2.4. Overall purpose of managing environmental water based on supply and demand

Environmental water needs (demand) and water availability (supply) both influence the overall purpose of Commonwealth environmental water management. Under different combinations, the management purpose can range from 'avoiding damage' to the environment to 'improving' ecological health. This in turn informs the mix of portfolio management options that are suitable for maximising outcomes.

Figure 3 shows how current demands and forecasted supply are considered together.

The overall 'purpose' for managing the Commonwealth's water portfolio in the Victorian rivers that are connected to the River Murray for 2019–20 is to protect and improve the aquatic and riparian vegetation and native fish and other biota via habitat provision. If overall resource availability increases, deliveries will seek to re-establish and improve the resilience of native in-channel and bank vegetation through elevated baseflows and freshes. In the disconnected Wimmera River system, it is likely that overall water will be limited and the purpose of managing the Commonwealth's water portfolio is primarily to avoid damage to environmental assets by mitigating water quality issues and managing drought refuge pools throughout the system.

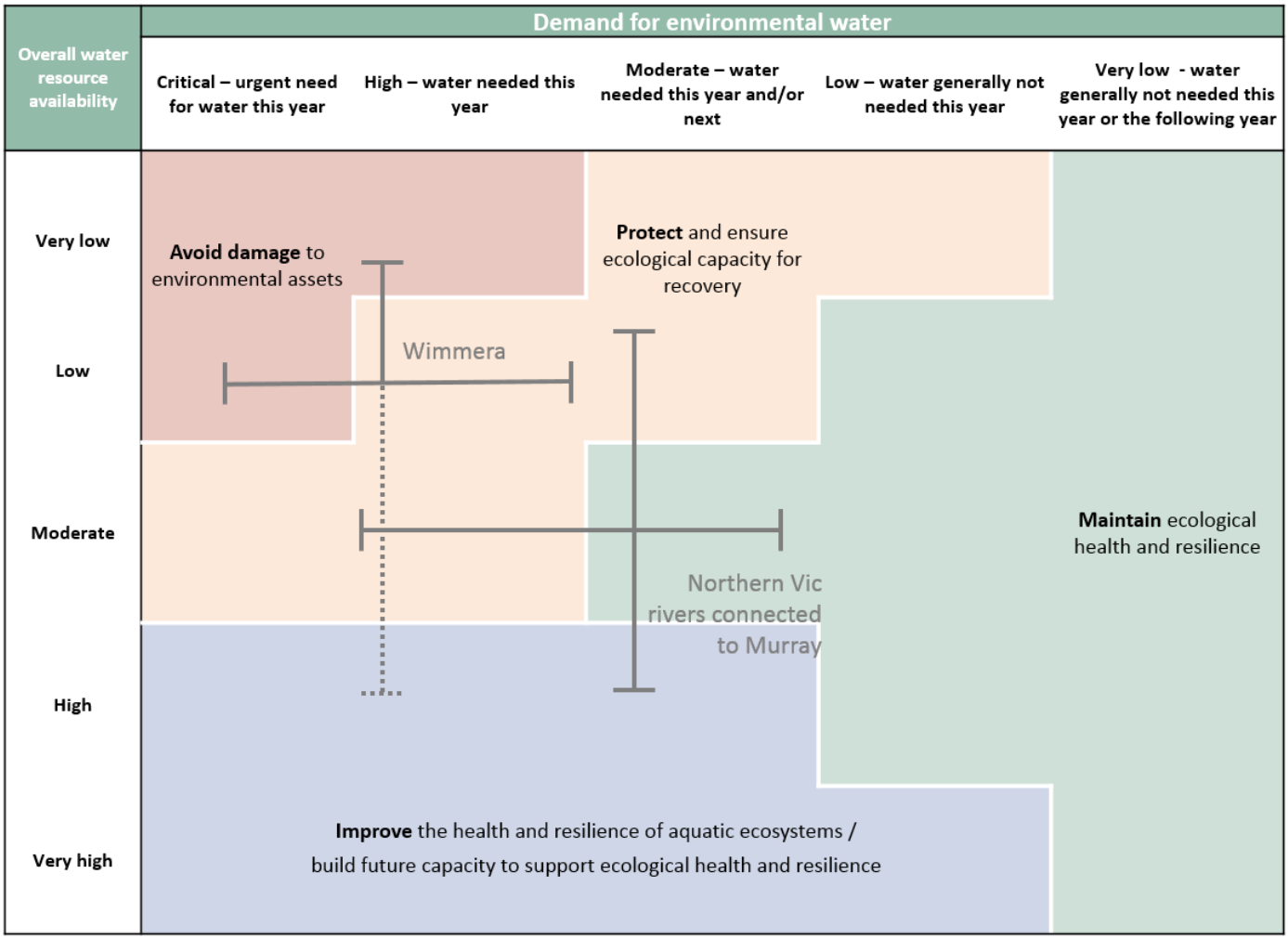


**Figure 3:** Determining a broad purpose for portfolio management in the Victorian rivers for 2019–20. Note: The Wimmera River is depicted separately from other Northern Victorian river as it is disconnected from the Murray and therefore transfer of water allocations into the system to boost resource availability is not possible. Dotted lines represent the unlikely scenario of wetter conditions leading to markedly improved resource availability within the Wimmera system.

Further detail on how the overall purpose for portfolio management changes under different supply and demand scenarios is provided in *Portfolio Management Planning: Approach to planning for the use, carryover and trade of Commonwealth environmental water, 2019–20* (available at: http://www.environment.gov.au/water/cewo/publications).

## 2.5. Water Delivery in 2019–20

Consistent with the demands and purpose described above, the Commonwealth Environmental Water Office is considering supplying environmental water to in-channel watering actions for 2019–20 as described for each catchment below. All watering actions for northern Victorian rivers (except the Ovens) include a range of volumes meaning that flows can be delivered at the higher or lower end of the range depending on water availability and environmental need. Table 3 provides further information about watering actions and ecological objectives, whilst Table 4 describes actions in scope for different resource availability.

**Goulburn River** (See Attachment B, Table 4 options 1a. – 1l)

Commonwealth, Victorian and The Living Murray environmental water will be coordinated with natural flows and intervalley transfers of water to meet environmental demands in the lower Goulburn. Commonwealth environmental water may contribute to low flows and freshes (particularly in winter and spring) as well as to slow the recession of natural flows if required. Flows will look to be coordinated with flows from other southern-connected basin watering actions to meet broader environmental need. Return flows are available for use downstream in the River Murray.

**Lower Broken Creek** (See Attachment B, Table 4 options 2a. – 2c.)

In addition to natural flows and intervalley transfer of water, Commonwealth environmental water may contribute to in-channel low flows, freshes and high flows throughout the year. Return flows are available for use downstream in the River Murray.

**Goulburn-Broken catchment wetlands** (See Attachment B, Table 4 option 3.)

Environmental water for Moodie Swamp will be provided if the maximum drying interval for waterbirds and vegetation is exceeded. These flows also benefit Upper Broken Creek reaches en route.

**Upper Broken Creek** (See Attachment B, Table 4 option 4a and 4c.)

Commonwealth and Victorian environmental water will contribute to low flows and freshes as required.

**Broken River** (See Attachment B, Table 4 options 5a. and 5b.)

Catchment run-off and irrigation releases are generally sufficient to meet environmental flow recommendations, however, when irrigation demand declines and runoff has yet to commence, environmental water may provide a minimum baseflow and a summer/autumn fresh.

**Campaspe River** (See Attachment B, Table 4 options 6a. – 6e.)

Commonwealth, Victorian and The Living Murray environmental water will be coordinated with natural flows and intervalley transfers of water to meet environmental demand. Commonwealth environmental water may contribute to low flows and freshes year-round as required. There is also potential for environmental water to contribute to a combined fish attractant flow. Return flows are available for use downstream in the River Murray.

**Loddon River** (See Attachment B, Table 4 options 7a. – 7i.)

Commonwealth and Victorian environmental water is available to meet environmental demand throughout the year and may include contributions to low flows, high flows and freshes. Environmental water may also be used to deliver low flows and freshed to Serpentine Creek. Return flows are expected to be available for use downstream in the River Murray in 2019–20.

**Ovens River** (See Attachment B, Table 4 options 8a – 8c.)

In average and wet years the in-channel flow recommendations are achieved from natural flows. In a dry to very dry scenario environmental demand is for flows to avoid a cease to flow event. Where possible environmental water delivery is planned to coincide with a bulk release water transfer. In 2019–20 Commonwealth environmental water may be delivered to Mullinmur wetland, which is an off-channel wetland located in the lower Ovens. Delivery arrangements are still to be determined but are likely to require operation of temporary pumps.

**Wimmera River** (See Attachment B, Table 4 option 9.)

Commonwealth and Victorian environmental water will be coordinated with natural flows and operational releases, and may be used to contribute to in-channel baseflows and freshes. If dry conditions persist, the focus for 2019–20 will be to prevent loss of high value refuge habitat and mitigating water quality issues (especially salinity) and a key to this will be the effective management of drought refuge pools throughout the system.

**Stakeholder Feedback**

Early Input to the potential watering actions for 2018–19 was received via the Environmental Watering Advisory Group (EWAG) meetings organised and chaired by the North Central and Goulburn Broken Catchment Management Authorities. Membership includes local land holders, irrigators, community members, the Victorian delivery partners (including the Victorian Environmental Water Holder and Goulburn Murray Water) and the Commonwealth Environmental Water Office. Delivery partners and the Catchment Management Authorities attended workshops to review the 2018–19 watering events, including to identify any risks that arose, and discuss mitigating actions going into 2019–20. Feedback on draft versions of the plan was provided by the Victorian Environmental Water Holder and the Catchment Management Authorities and incorporated into the final version.

## 2.6. Trading water in 2019–20

The Water Act 2007, requires the Commonwealth Environmental Water Holder to trade for the purpose of protecting and restoring the environment. In addition to the obligations of the Water Act 2007, the Commonwealth Environmental Water Holder and Commonwealth Environmental Water Office staff are required to comply with a wide range of existing legislative requirements. This includes: financial management arrangements for Commonwealth agencies; freedom of information; and policies relating to information management, auditing, employee conduct and accountability.

Large parts of the Basin are currently experiencing pressures from water scarcity, with declining storage levels, low allocations and rainfall deficiencies evident in most catchments. It is likely that insufficient water resources will constrain proposed actions. Where the need arises to adjust the availability of allocations in any valley in the southern-connected Basin for environmental use, the transfer of allocations from another southern connected catchment would be explored as the preferred and more efficient option to allocation purchase or sale. The transfer would be undertaken consistent with the rules identified in state water resource plans that apply to all water users. Possible third party impacts from portfolio transfers are considered when trade limits apply.

In 2019-20, administrative transfers may be required between environmental water accounts in trade zones 1A, 1B, 2, 3, 4A, 4B, 4C, 5A, 9A, 9B and 21A to enable environmental water delivery. Based upon water resource availability at the time of the watering event and scale of the event, this may include:

- small (less than 10 GL) within or between Victorian Rivers regions; and
- large (> 100 gigalitres) ***within*** trade zone 1A, due to the large size of environmental watering activities.

No specific commercial trade of water in the Victorian Rivers has been identified for 2019-20. Trade opportunities will be reviewed in the valley throughout the water year and as conditions change. Planning on water trade considers: supply and demand within the catchment and across the Basin. As part of the planning process, the Commonwealth Environmental Water Office undertakes a Basin-wide analysis to identify opportunities to use allocation trade to better match differing demands across catchments. Consideration is given to the water available to meet both current and future environmental needs. Additionally these decisions are influenced by current climatic conditions, as well as implications of trade for commercial outcomes in communities.

Further information will be provided to the market ahead of any trade of Commonwealth environmental water at: http://www.environment.gov.au/water/cewo/trade

For more information on the rules and procedures governing the trade of Commonwealth environmental water, see the Commonwealth environmental water Trading Framework available at: http://www.environment.gov.au/water/cewo/publications/water-trading-framework-nov2016.

## 2.7. Carrying over water for use in 2020–21

The volume of water carried over for use in 2020–21 will depend upon resource availability and demand throughout the year. As the 2019–20 water year progresses, a carryover target will be determined for the Victorian rivers in the Murray Darling Basin sufficient to meet early season requirements.

As documented in Table 3 below, potential demands in the Victorian rivers in 2020–21 include:

- Year-round variable low flows and freshes in the Goulburn and Broken River systems
- Year round variable low flows, high flows and freshes in Lower Broken Creek
- Variable lowflows, high flows and freshes in the Campaspe and Loddon rivers
- Variable low flows in the Wimmera River

Carryover volumes will be adjusted throughout the year as the season unfolds in response to both current and future demands and the water available to meet these demands. These decisions will be based upon best information available at the time.

Given the connected nature of southern Murray–Darling Basin catchments and the varying carryover, account and use limits, carryover is considered at a broader scale than just the Victorian rivers in the Murray-Darling Basin.

More information on how the Commonwealth makes decisions on carryover is here: http://www.environment.gov.au/water/cewo/portfolio-mgt/carryover

## 2.8. Identifying Investment Opportunities

Under the *Water Act 2007*, the Commonwealth Environmental Water Holder has the flexibility to use the proceeds from the sale of water allocations to fund environmental activities in the Basin.

'Environmental activities' must be consistent with the Commonwealth Environmental Water Holder's obligation to exercise their function to protect and restore environmental assets. Environmental activities must also improve the capacity of the Commonwealth Environmental Water Holder to meet the objectives of the Basin Plan environmental watering plan, and be directly linked to current or future delivery of water for the environment.

The option of investing the proceeds in environmental activities will be considered alongside other available water management options, such as purchasing water at another time or place. The Commonwealth Environmental Water Holder is finalising an Investment Framework and an Annual Investment Plan to inform future investment in environmental activities.

**Table 3**: Environmental demands, priority for watering in 2019–20 and outlook for coming years in the northern Victorian rivers in the Murray Darling Basin

Watering actions and objectives outlined in this table are consistent with those planned by the Victorian Environmental Water Holder in its Seasonal Watering Plan (VEWH 2019)

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Goulburn River** *reach 4 Goulburn Weir to Loch Garry; and reach 5 Loch Garry to the River Murray*<br>• Native fish - Murray cod, trout cod, Macquarie perch, golden perch and fresh water catfish<br>• Bank vegetation, especially littoral vegetation and river red gum trees that shade the river and provide: habitat for animals including the squirrel glider; carbon from fallen leaves; habitat for birds such as egrets, herons and cormorants; habitat for biofilms, waterbugs and fish when they die and fall into the river. Frogs also benefit from inundated vegetation at the edge of the river channel.<br>• Waterbugs<br><br>During the past two years very high volumes of intervalley transfer water has impacted on the planned deliver of ewater and this may continue during 2019–20 if dry conditions continue. | Lowflow (all year)<br>500–940 ML/day to: provide slow shallow habitat for small-bodied fish and deep water habitat for large-bodied fish; submerge snags to provide habitat for fish, waterbugs and biofilm growth; maintain aquatic vegetation and water the root zone of vegetation on the lower bank; encourage the production of plankton for food; and disrupt biofilms and maintain water quality. | Annually | Minimum low flows have been delivered every year since the millenium drought. | High | High, however at times this demand will be met by natural or operational deliveries | High |
| | Winter fresh (July)<br>Up to 15 000 ML/day[1] with more than 14 days above 6 600 ML/day to: remove terrestrial vegetation and re-establish flood tolerant native vegetation; inundate benches to encourage plant germination; provide carbon (e.g. leaf litter) to the channel; and improve water quality and waterbug habitat. | Annually | The winter fresh was first delivered in 2014–15, then not delivered in 2015–16 due to low water availability. It was delivered in 2016–17 and 2017–18. | High | High | Moderate |
| | Winter/spring variable low flows (July–Oct between the end of the winter fresh and start of the early spring fresh)<br>Between 800–2000 ML/day to: increase sediment and seed deposition on banks and benches; support dispersal of native vegetation; and support nutrient cycling. | Annually | A variable base flow at this time of year was delivered for the first time in 2018–19. | High | High | High |
| | Spring fresh (Aug–Sept)<br>>6000 ML/day for 14 days to inundate vegetation on benches and the lower banks to facilitate recruitment, sustain growth, and encourage flowering, seed development and distribution. | Annually | An early spring flow was delivered in 2012–13, not delivered in 2013-14 and partially met during 2014–15 and 2015–16. Since then, LTIM has identified the early spring fresh as important to deliver each year. This demand was met in 2016–17, 2017–18 and 2018–19. | High | High | High |
| | Spring/summer fresh (Nov/Dec)<br>When possible, up to 10 000 ML/day for 2 days to stimulate golden perch spawning. | 1 in 2 years | A late spring fresh was delivered from 2012–13 to 2014–15 but with dry conditions in 2015–16 it was not delivered. In 2016–17 fish spawning objectives were met by natural flows so the fresh was not delivered to protect low bank vegetation after prolonged periods of high natural flows. It was delivered in 2017–18 but not in 2018–19 due to the planned prioritisation of vegetation outcomes during this period. | Low | Low – whilst important, this action is unlikely in 2019-20 as the preferred timing clashes with a drying phase for bank vegetation ahead of expected higher summer operational flows. | High |

1. Note the peak flow achievable with environmental water under current operating constraints is approximately 9,500 ML/d in the lower Goulburn. The full target flow of 15,000 ML/d can however be met with unregulated tributary inflows.

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Goulburn River continued** | Spring/summer low flow (after a spring fresh)<br><1000 ML/day for 5–6 weeks to allow newly grown plants to establish, provide bank stability and provide habitat for small-bodied fish and waterbugs. | Annually | This is a new flow requirement. | This is a demand to <u>not</u> provide water above a given flow rate | | Moderate – the need to prioritise a low flow period over sping and summer 2020-21 will be re-assessed alongside the conflicting need to provide a spring/summer fresh |
| | Summer/autumn low flows between pulses (especially relevant when intervalley transfer flows are expected to be high)<br>Flows are not to exceed 1000 ML/day for more than 20 consecutive days, with a minimum of 7 days between pulses. This is to maintain vegetation for more than one season, to provide bank stability and to ensure habitat for small-bodied fish and waterbugs. | When required | This is a new flow requirement. | This is a demand to <u>not</u> provide water above a given flow rate | | High |
| | Summer/autumn fresh (Jan to March)<br>Up to 4 600 ML/day for 10 days to stimulate the migration of juvenile native fish into the Goulburn River from the River Murray. | When conditions are conducive | A fresh specifically to attract fish upstream was first delivered in 2016–17 and again in 2017–18. It relies on suitable flow conditions in the Murray and the presence of juvenile golden/silver perch downstream and was not delivered in 2018–19. | Low | May be met by other means | High - if conditions are conducive |
| | Autumn fresh (March/April)<br>Up to 6000 ML/day for 2 days to: encourage seed germination; reduce turbidity and mix water to improve water quality; flush fine sediment to encourage biofilm growth and improve food and habitat for waterbugs. | Annually | This autumn fresh was delivered from 2012–13 to 2015–16. It was not delivered in 2016–17 or 2017–18 following the earlier fish attractant flow action in those years. This fresh was not delivered in 2018–19 due to the already high volumes delivered as intervalley transfers. | Moderate– if fish attractant flow is not delivered | High if required | High |
| | Winter fresh (June/July 2020)<br>Up to 15 000 ML/day[1] with more than 14 days above 6 600 ML/day to: remove terrestrial vegetation and re-establish flood tolerant native vegetation; inundate benches to encourage plant germination; provide carbon (e.g. leaf litter) to the channel; and improve water quality and waterbug habitat. | Annually | The winter fresh was first delivered in 2014–15, then not delivered in 2015–16 due to low water availability. It was delivered in 2016–17 and 2017–18 and is planned for July 2019. | Moderate | May be met/partially met by other means | High for 2021-22 if not delivered in 2020-21 |
| | Following natural flows (all year)<br>Provide water for a slower recession or add pulses following natural cues/unregulated flows to minimise the risk of bank erosion and hypoxic blackwater. | When required | | High when required | High if required | High when required |
| **Goulburn River**<br>*reach 1 Lake Eildon to Goulburn Weir*<br><br>Native fish - Macquarie perch Only receives water when it is released from Lake Eildon | Spring/autumn/winter low flows (July–Sept and April–June).<br>400 ML/day at Eildon for: wetting riffles to allow scouring of fine sediment and for biofilms and waterbugs habitat; maintaining a wetted channel for vegetation; and ensuring habitat for small-bodied native fish. | Annually | This low flow was delivered during the non-irrigation period in 2017–18 and 2018–19. | High | High | High |

1. Note the peak flow achievable with environmental water under current operating constraints is approximately 9,500 ML/d in the lower Goulburn. The full target flow of 15,000 ML/d can however be met with unregulated tributary inflows.

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History[1] (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Lower Broken Creek** *reach 4 Nathalia Weir to River Murray with en route benefit to reach 1 (Boosey Creek to Nine Mile Creek), reach 2 (Nine Mile Creek) and reach 3 (Broken Creek confluence with Nine Mile Creek to Nathalia Weir).*<br>• Native fish – Murray cod, golden perch, silver perch, unspecked hardyhead and Murray-Darling rainbow fish<br>• Platypus, turtles, water rat (Rakali)<br>• Vegetation – box-dominated grassy woodland communities, river swamp wallaby-grass<br>• Birds – Australian Bittern<br>• Environmental demand requires water in addition to irrigation supply<br>• Source of return flows for use downstream in the River Murray<br><br>During the past two years very high volumes of intervalley transfer water has impacted on the planned deliver of environmental water and this may continue during 2019–20 if dry conditions continue. | Year-round low flow<br>Up to 200 ML/day in reach 3 and 4 and up to 100 ML/day in reaches 1 and 2 to: provide habitat and support movement for platypus and water rat (rakali); provide flowing habitat for fish, vegetation, waterbugs platypus and turtles; maintain dissolved oxygen level and minimise suspended sediment. A minimum of 40 ML/day is required to operate fish ladders and provide native fish passage. | Annually | The year-round flow of 40 ML/day is considered the minimum requirement and has been met during the irrigation season since 2012–13. Water delivery during the non-irrigation commenced in 2016–17 and has continued each year to 2018–19. | High | High during the non-irrigation season.<br>May be partially met by operational deliveries during the irrigation season. | High |
| | Winter/spring/summer/autumn high flow (July to May)<br>Up to 300 ML/day in reach 4 at Rices Weir to flush Azolla, maintain Dissolved Oxygen (DO) levels over summer and to provide habitat and trigger fish spawning and movement. | Annually if required | From 2012–13 to 2015–16 the full delivery of higher base flows and freshes was not achieved due to periods of high irrigation demand and limited channel capacity to carry additional environmental water.<br>Target DO levels have not been achieved in most years, sometimes remaining below the preferred thresholds for extended periods. Since 2015–16, however, the duration and extent of low-DO events has decreased.<br>In 2016–17 to 2018–19 planned flows were achieved. | High | High | High |
| | Winter/spring freshes(July–Oct).<br>Up to 3 actions of 450 ML/day to flush Azolla blooms (if any) and trigger fish migration. | Annually | | High | High | High |
| **Goulburn-Broken catchment wetlands (Moodie Swamp)**<br>*Accessed via a channel from reach 2 – Waggarandall Weir to Reillys Weir*<br>• Birds – Brolga<br>• Native vegetation - cane grass and rigid water milfoil | Autumn – partial fill<br>Delivery to provide habitat for brolga nesting and to promote growth of cane grass and rigid water milfoil. | Moodie Swamp maximum dry interval is 1 year for waterbirds and 3 years for vegetation | Environmental water has been delivered to Moodie Swamp each year between 2013–14 and 2017–18, except for the dry year in 2015–16. No water was required in June 2019. | Moderate | High | High |

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Upper Broken Creek**<br>*reach 1 Casey's Weir to Waggarandall Weir*<br>• Native fish – carp gudgeon, Murray cod, golden perch, Murray-Darling rainbow fish<br>• vegetation – box riparian veg, remnant plains grassy woodland, buloke trees and rigid water milfoil<br>• platypus<br>• common long-necked turtle<br>• Birds – brolga, Australasian bittern | Winter/spring low flows (June–Nov)<br>Up to 15 ML/day for 30–60 days to maintain: pool habitat for native fish and waterbugs; access to food and habitat for platypus; and in-stream vegetation. | Annually | This flow was not met in 2013–14 and has been partially delivered since then, until 2018–19 when it was fully met. | High | High | High |
| | Summer/autumn fresh (Dec–May)<br>Up to 100 ML/day for 10 days to maintain water quality, particularly dissolved oxygen levels in refuge pools. | Annually | No historic information is available. In 2018–19 no water quality issues were identified that required the delivery of this fresh. | High | High if required | High |
| | Summer/autumn low flows (Dec–May)<br>Up to 10 ML/day for 30–60 days to maintain: pool habitat for native fish and waterbug; access to food and habitat for platypus; and in-stream vegetation. | Annually | This flow was delivered during 2018–19. | High | High | High |
| **Broken River**<br>**Reach 1**<br>• Native fish - Murray cod, golden perch, silver perch, Murray-Darling rainbow fish, Macquarie perch, river black fish and mountain galaxias<br>• vegetation – eel grass, common reed and water ribbon | Baseflow (all year)<br>Up to 30 ML/day for 40–100 days to provide diverse habitat (riffles, slackwater, pools) for native fish, aquatic plants, platypus and waterbugs; and support in-stream and fringing aquatic plants and prevent terrestrial plants growing on the river bed. | Annually | Natural flows and consumptive water has been used in the past to meet/partially meet flow targets. Environmental water also benefits reach 1 and 2 (Lake Nillahcootie to Casey's Weir) en route to Moodie Swamp. Commonwealth environmental water is available for use in Broken River, downstream of Casey's Weir for the first time in 2019–20. | Moderate | May be met by other means | Moderate |
| | Summer/autumn fresh (Dec–May).<br>400–500 ML/day for 2 to 5 days to: maintain aquatic vegetation; provide native fish passage; scour sediments from hard surfaces to increase productivity and biofilms; and provide flow cues for native fish breeding and migration. | Annually | This target has not been met until it was partially met in 2017–18 when environmental water was delivered for the first time. Commonwealth environmental water is available for use in Broken River, downstream of Casey's Weir for the first time in 2019–20. | Moderate | May be met by other means | Moderate |

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History[1] (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Ovens River**<br>*reach 1 immediately below Lake Buffalo on the Ovens River; reach 2 immediately below Lake William Hovell on the King River; reach 4 Ovens River from the confluence of the Buffalo River to the confluence of the King River; and reach 5 Ovens River downstream of the confluence of the King River to the Murray River.*<br>• Native fish – Murray cod, trout cod, golden perch and Macquarie perch<br>• Frogs – giant bullfrog and growling grass frog<br>• Waterbirds – egrets, herons, cormorants and bitterns<br>• Vegetation – river red gum forests and woodlands | Up to the total Commonwealth environmental water entitlement of 123 ML per year (50 ML from Lake William Hovell and 73 ML from Lake Buffalo) to contribute to in-stream flows within the Ovens, Kings and Buffalo rivers, for example:<br>• Pulsed autumn fresh in conjunction with a bulk water transfer from Lake Buffalo to scour biofilms and maintain macroinvertebrate assemblage.<br>• Increased summer/autumn baseflows if bulk water transfer is not available to improve flow variability and ensure connectivity between pools and riffles. | Annually | In 2012–13, 2014–15, 2016–17, 2017–18 and 2018–19 Commonwealth environmental water was released to supplement in-stream baseflows in the Buffalo and Ovens River.<br>In 2013–14 and 2015–16 environmental water was delivered as part of a bulk release drawdown provided by Goulburn-Murray Water. | Moderate | High | Moderate |
| | Autumn fresh (March/April)<br>>430 ML/day for 3 days in reaches 1 and 4, and 130–260 ML/day in reach 5 to: achieve connectivity between pools and stimulate native fish movement; improve water quality by mixing pools; provide small variations in river levels and flow to flush sediment from hard surfaces and scour biofilm; and maintain waterbug habitat. | | | | | |
| | Summer/autumn low flow (Dec–May)<br>Provide a small increase in flow variability to support water quality, provide connections between pools and the maintenance of waterbug habitat. | | | | | |
| **Mullinmur wetland**<br>Water delivery trial<br>Fish – native freshwater catfish<br>Vegetation - aquatic plants | Summer top-up flow (Nov–Feb)<br>Delivery to maintain water level, and to support aquatic vegetation and habitat for native cat fish. | | 2019–20 will be the first year that Commonwealth environmental water is able to be delivered to Mullinmur wetland. | High | High | High |

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History[1] (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Campaspe River** *reach 2 Eppalock to Campaspe Weir; reach 3 Campaspe Weir to Campaspe Siphon at Rochester; and reach 4 Campaspe Siphon to River Murray)*<br>• Native fish - Murray cod, silver perch, golden perch, Murray-Darling rainbow fish and flat headed gudgeon<br>• Platypus, native water rats (rakali), turtles and frogs<br>• Bank vegetation, especially mature river red gum trees that support birds including the swift parrot and squirrel glider.<br>• During the past two years very high volumes of intervalley transfer water has impacted on the planned deliver of environmental water and this may continue during 2019–20 if dry conditions continue. | Summer/autumn low flow (Dec-May)<br>10–40 ML/day to: maintain slackwater habitat for zooplankton and native fish; promote the growth of biofilms for water bugs and native fish; maintain water quality in deep pools; allow platypus to move between pools; and maintain in-stream vegetation along the channel edges. | Annually | These flow components have been delivered every year since 2012–13.<br>During dry conditions all flows are delivered at the lower end of the flow ranges.<br>During the 2017–18 and 2018–19 intervalley transfers have exceeded the recommended summer low flows and freshes. | High | May be met by other means | High |
| | Winter/spring low flow (June-Nov)<br>20–70 ML/day to maintain water quality and connectivity between pool refuges to: allow fish movement, facilitate male platypus movement during the breeding season; and provide habitat and food for female platypus prior to breeding. | Annually | | High | May be met by other means | High |
| | Winter/spring increased low flow (June–Nov<br>50–200 ML/day to achieve the same objectives as for winter/spring low flows but with additional vegetation objectives. These include to: prevent terrestrial plants colonising lower sections of the banks; maintain soil water in the banks for river red gum and woody shrubs; and to help establish littoral vegetation. | When additional water is available | | High | High | |
| | Winter/spring fresh (June-Nov)<br>Up to 2 actions of 1,000–1,500 ML/day to maintain connectivity for fish movement and possibly spawning; encourage platypus to select burrows higher on the bank to prevent flooding if it occurs later in the year; flush leaf litter to reduce the risk of blackwater events in summer; and maintain soil moisture for river red gum and woody shrubs | Annually | | High | High | High |
| | Summer/autumn fresh (Dec-May)<br>Up to 3 freshes of 100–200 ML/day to: promote local movement of adult fish to access new habitat; wet submerged wood and flush fine silt and old biofilm to promote new biofilm growth and increase waterbug mass; and encourage movement of juvenile platypus to find other habitat. When conditions are favourable, a fish attraction flow may also be delivered. | Annually | | High | May be met by other means | High |

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History[1] (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| **Loddon River** reach 4 Loddon Weir to Kerang Weir with en route benefit to reaches 1 to 3 storage reservoirs to Loddon Weir and to reach 5 downstream Kerang Weir.<br><br>• Native fish - river blackfish, Murray-Darling rainbow fish and golden perch<br>• vegetation – cane grass, tangled lignum, black box and river red gum<br>• platypus<br>• Water rat (rakali) | Winter/spring low flow (continuous June–Nov)<br>50–100 ML/day to increase water depth for habitat and dispersal of fish, platypus and native water rat; prevent fine sediment settling on hard surfaces; and prevent terrestrial plant growth in the river channel. | Annually | The winter low flow has been delivered in every year since 2012–13 except for 2016–17 when it was partially achieved. | High | High | High |
| | Winter/spring high flow (Aug–Nov)<br>450 ML/day for 6–10 days once a year to: provide flows through flood runners; trigger native fish movement and breeding; flush organic matter from banks and benches to increase productivity and reduce the risk of hypoxic blackwater in summer; scour accumulated sediment in pools; and increase wetted area for growth of bank vegetation. | Annually | The winter fresh was delivered in 2012–13 and between 2016–17 and 2018–19; it was partially delivered in 2013–14 and 2015–16. | High | High | High |
| | Summer/autumn low flows (continuous Dec–May)<br>25–50 ML/day to maintain pool depth for waterbugs, fish, native water rats and aquatic plants; and provide continuous flows for water quality and bank vegetation. | Annually | The summer low flows have been delivered in every year since 2012–13. | High | May be met by other means | High |
| | Summer/autumn freshes (Dec-May)<br>50–100 ML/day for 3–4 days, up to 3 times/year to flush fine sediment from hard surfaces; promote growth of fringing vegetation and enable connectivity for fish and platypus movement. | Annually | The summer freshes have been delivered in every year since 2012–13, except in 2018–19 when it was partially achieved. | High | May be met by other means | High |
| | Autumn high flow (March–May)<br>400 ML/day for 6–10 days, once a year, to trigger and facilitate upstream movement of golden perch, silver perch and Murray cod over one year of age. | Annually in average to wet years | The autumn fresh has been partially achieved since 2013–14 and was fully delivered in 2017–18 and 2018–19. | High | May be met by other means | High |
| **Serpentine Creek** | Winter/spring low flow (June–Nov)<br>20–30 ML/day to: ensure depth to maintain biofilms and flow variability for bank vegetation; inundate exposed debris and vegetation to provide habitat for aquatic animals; maintain water quality by re-oxygenating pools; and maintain spawning habitat for native fish. | Annually | This flow was partially delivered in 2017–18 and not achieved 2018–19. | High | High | High |
| | Winter/spring fresh (Aug–Nov)<br>40–150 ML/day for 2 days once a year to: provide connectivity for fish and waterbug habitat; transport accumulated organic matter; provide cues to platypus to locate burrows above the water level; and scour pools. | | This fresh was delivered in 2017–18 and 2018–19. | High | High | High |
| | Summer/autumn low flows (Dec–May)<br>10–20 ML/day to: provide flow variability and prevent notching; ensure connectivity between pools for fish; re-oxygenate pools to maintain water quality; maintain platypus habitat; and increase wet area to support aquatic plants. | | This flow was not delivered in 2017–18 and 2018–19. | High | High | High |
| | Summer/autumn fresh (Dec–May)<br>30–40 ML/day for 1-3 days up to 3 times a year to: transport accumulated organic matter; maintain fringing vegetation and biofilms; and provide water to inundate benches and flush fine sediment. | | These freshes were delivered in 2017–18 and 2018–19. | High | High | High |

| Environmental assets | Indicative demand (for <u>all sources of water</u> in the system | | Watering History (from all sources of water) | 2019–20 | | Implications for future demands |
|---|---|---|---|---|---|---|
| | Flow/Volume | Required Frequency (maximum dry interval) | | Environmental demand for water | Potential Commonwealth environmental water contribution | Likely environmental demand in 2020–21 if watering occurred as planned in 2019–20 |
| Wimmera System | Up to the total Commonwealth entitlement of 28 000 ML (low reliability water share) per year to contribute toward instream flows within the Wimmera River (baseflow and freshes), to support native riparian vegetation, native fish and waterbugs, and improve connectivity and water quality. | Annual | In 2016–17 the Commonwealth received its first allocation of 14 280 ML against this entitlement. No allocation has been made in 2017-18 and 2018-19 to the entitlement<br>In 2018-19, 7,676 ML of carried-over Commonwealth environmental water was made available for delivery in the Wimmera system. The environmental water has helped supplement and build on the environmental outcomes achieved by the VEWH in the Wimmera system. | Critical | High | Critical<br>If conditions remain dry all remaining Commonwealth allocations are likely to be delivered in 2019–20 |
| | | | | **Carryover potential** | Available allocations expected to be carried into 2019–20, are estimated as 120- 130 GL | Available allocations to be carried into 2020–21 will be identified in Victorian Rivers environmental water holdings at https://www.environment.gov.au/water/cewo/about/water-holdings. |
| | | | | **Trade potential** | It is expected that zero dollar administrative transfers of Commonwealth water allocations will be undertaken between trade zones in the southern connected Basin to support environmental water delivery throughout the 2019-20 water year.<br>No specific commercial trade of water has been identified for 2019-20. Trade opportunities will be reviewed throughout the water year and as conditions change. | Potential to trade will depend on environmental demands, resource availability and market conditions. |

1. History of annual climatic conditions in northern Victorian catchments are summarised as follows: wet in 2012–13, moderate in 2013–14, drying in 2014–15, dry in 2015–16, very wet in 2016–17, drying in 2017–18 and dry to very dry in 2018–19.

**Key - potential watering in 2019–20**

- High priority for Commonwealth environmental watering (likely to receive water even under low water resource availability)
- Secondary priority for Commonwealth environmental watering (watering to occur only if natural trigger is met, or under moderate – high water resource availability); or water demand likely to be met via other means
- Low priority for Commonwealth environmental watering (under high – very high water resource availability)
- Unable to provide Commonwealth water due to constraints

**Key - environmental demands**

- critical demand i.e. urgent need for water in that particular year to manage risk of irretrievable loss or damage
- high demand for water i.e. needed in that particular year
- moderate demand for water i.e. water needed that particular year and/or next
- low demand for water i.e. water generally not needed that particular year
- very low demand for water i.e. water generally not needed that particular year or the following year

Note that demand is considered at a generalised scale; there may be specific requirements that are more or less urgent within the flow regime

# 3. Next steps

## 3.1. From planning to decision making

It is important to distinguish between planning and operational decision making. As shown in Figure 4, planning allows the Commonwealth Environmental Water Office to manage the environmental water portfolio in a holistic manner and is an exercise in developing a broad approach or intention, based on the key drivers (demand and supply).

Decision making throughout each year builds on the intention by considering in more detail the specific prevailing factors and additional factors such as costs, risks, and constraints to water delivery and market conditions.

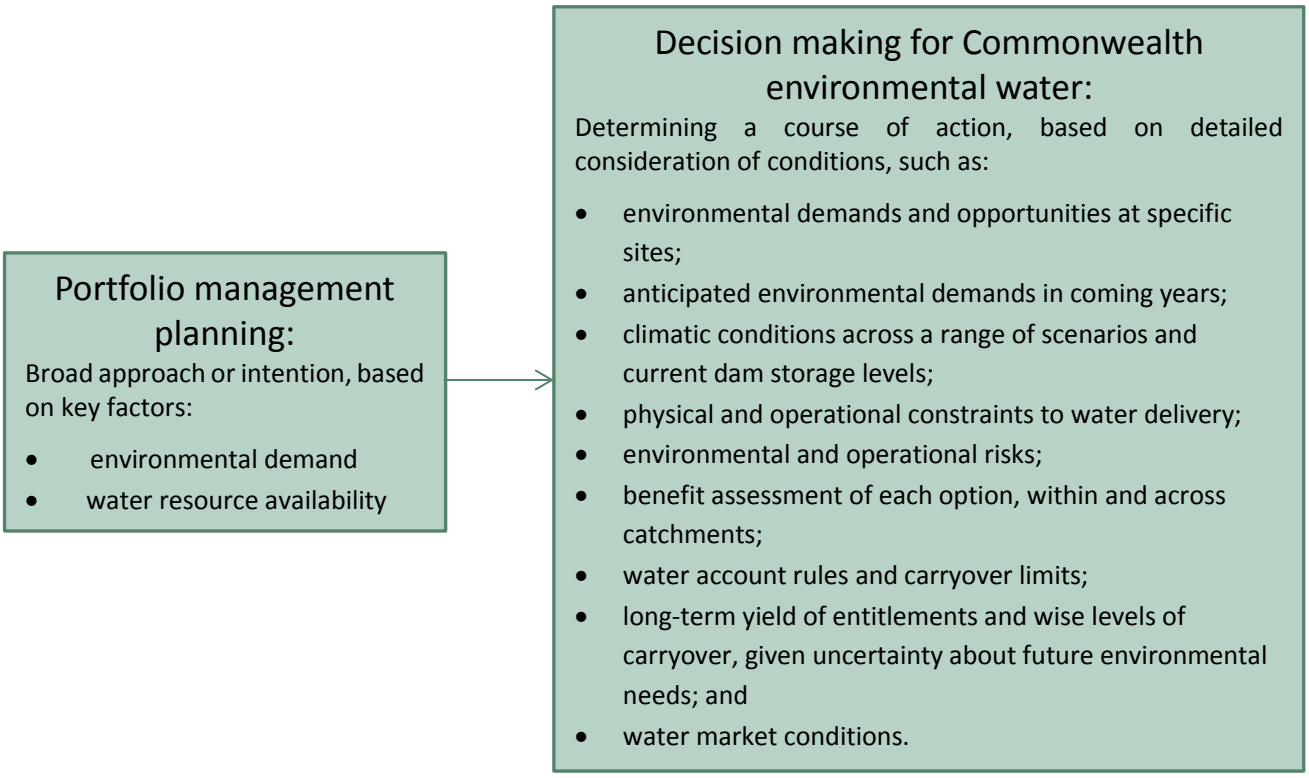


**Figure 4:** Planning and decision making for Commonwealth environmental water use

## 3.2. Monitoring

Operational monitoring is undertaken for all Commonwealth environmental watering actions and involves collecting on-ground data with regard to environmental water delivery such as volumes delivered, impact on the river systems hydrograph, area of inundation and river levels. It can also include observations of environmental outcomes.

The Long Term Intervention Monitoring (LTIM) Project has the lower Goulburn region as a focus area. It aims to understand the environmental response from Commonwealth environmental watering with respect to the targeted objectives by carrying-out monitoring of site condition over many years.

Information on the monitoring activities in the Goulburn is available at http://www.environment.gov.au/water/cewo/catchment/northern-victorian-rivers/monitoring

Monitoring information is also provided by state governments and The Living Murray program.

## 3.3. Further information

For further information on how the Commonwealth Environmental Water Office plans for water use, carryover and trade, please visit our web site: http://www.environment.gov.au/water/cewo

or the sites below:

Water use: www.environment.gov.au/topics/water/commonwealth-environmental-water-office/assessment-framework

Carryover: http://www.environment.gov.au/topics/water/commonwealth-environmental-water-office/portfolio-management/carryover

Trade: http://www.environment.gov.au/water/cewo/trade/trading-framework

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# Attachment A – Expected outcomes from the Basin-wide environmental watering strategy

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the Victorian rivers are described below.

## Goulburn-Broken

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the Goulburn-Broken are described below.

**RIVER FLOWS AND CONNECTIVITY**

Baseflows are at least 60 per cent of the natural level.

Contribute to a 30 per cent overall increase in flows in the River Murray.

A 30–60 per cent increase in the frequency of freshes, bankfull and lowland floodplain flows.

**VEGETATION**

Maintain current extent of forest and woodland vegetation and non woody vegetation and water-dependent vegetation near river channels and on low-lying areas of the floodplain.

Improved condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

**Vegetation extent**

| Area of river red gum (ha) | Area of black box (ha) | Area of coolibah (ha) | Shrublands | Non-woody water dependent vegetation |
|---|---|---|---|---|
| 19 800 | 500 | | | Closely fringing or occurring within the Broken Ck, Broken and Goulburn rivers |

**Black box condition**

| Vegetation condition score | | Percent of vegetation assessed (within the managed floodplain) |
|---|---|---|
| 0 – 6 | >6 – 10 | |
| 28 per cent | 72 per cent | 77 per cent |

**River red gum condition**

| Vegetation condition score | | | | | Percent of vegetation assessed (within the managed floodplain) |
|---|---|---|---|---|---|
| 0 – 2 | >2 – 4 | >4 – 6 | >6 – 8 | >8 – 10 | |
| 1 per cent | 2 per cent | 7 per cent | 34 per cent | 55 per cent | 89 per cent |

**WATERBIRDS**

Current species diversity is maintained.

A 20–25 per cent increase in Basin-wide abundance of waterbirds by 2024.

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds.

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species.

**Important Basin environmental assets for waterbirds in the Goulburn-Broken**

| Environmental asset | Total abundance and diversity | Drought refuge | Colonial waterbird breeding | Shorebird abundance | In scope for C'th watering |
|---|---|---|---|---|---|
| Corop wetlands | * | * | | | No |
| Winton wetlands | | * | | | No |
| Waranga Basin | | * | | | No |

**FISH**

No loss of native species.

Improved population structure of key species through regular recruitment, including:

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years.
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years.

Increased movement of key species.

Expanded distribution of key species and populations.

**Key species for the Goulburn-Broken include:**

| Species | Specific outcomes | In-scope for C'th water in the Goulburn-Broken? |
|---|---|---|
| Flathead galaxias (*Galaxias rostratus*) | Improved core range in additional locations, including the Goulburn. | No |
| Golden perch (*Macquaria ambigua*) | A 10–15 per cent increase of mature fish abundance (of legal take size) in key populations. | Yes |
| Macquarie perch (*Macquaria australasica*) | Establishment of at least four additional riverine populations (candidate sites include mid-Goulburn River). | Yes |
| Murray cod (*Maccullochella peelii peelii*) | A 10–15 per cent increase of mature fish abundance (of legal take size) in key populations. | Yes |
| Silver perch (*Bidyanus bidyanus*) | Expanded population within the Goulburn River.<br>Expanded population upstream of Lake Mulwala and into the Ovens River, and increased range up the lower Goulburn River<br>Improved core range in at least two additional locations (candidate site includes Broken Ck). | Yes – lower Goulburn River.<br>Fish may also migrate into lower Broken Creek. |
| Trout cod (*Maccullochella macquariensis*) | Establishment of at least two additional populations (candidate sites include the mid-Goulburn River).<br>Note: attempts to re-establish mid-Goulburn populations have commenced. | Yes |
| Two-spined blackfish (*Gadopsis bispinosus*) | Expand the range of at least two current populations (candidate sites include the upper Goulburn tributaries). | Yes |

**Important Basin environmental assets for native fish in the Goulburn-Broken**

| Environmental asset | Key movement corridors | High Biodiversity | Site of other Significance | Key site of hydrodynamic diversity | Threatened species | Dry period / drought refuge | In-scope for C'th water |
|---|---|---|---|---|---|---|---|
| Lower Goulburn River | * | * | * | * | * | * | * |
| Broken River | * | * | * | | * | * | * |
| Broken Creek | | | * | | * | * | * |

## Campaspe

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the Campaspe are described below.

**RIVER FLOWS AND CONNECTIVITY**

Baseflows are at least 60 per cent of the natural level.

Contribute to a 30 per cent overall increase in flows in the River Murray.

A 10-20 per cent increase in the frequency of freshes and bankfull.

**VEGETATION**

Maintain the current extent of forest and woodland vegetation and non-woody vegetation.

No decline in the condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

**Vegetation extent**

| Area of river red gum (ha) | Area of black box (ha) | Area of coolibah (ha) | Shrublands | Non–woody water dependent vegetation |
|---|---|---|---|---|
| 1 900 | <100 | | | Closely fringing or occurring within the Campaspe River |

**WATERBIRDS**

Maintain current species diversity.

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024.

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds.

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species.

**FISH**

No loss of native species.

Improved population structure of key species through regular recruitment, including:

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years.
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years.

Increased movements of key species.

Expanded distribution of key species and populations.

**Key species for the Campaspe include:**

| Species | Specific outcomes | In-scope for C'th e-water in the Campaspe? |
|---|---|---|
| Golden perch (*Macquaria ambigua*) | A 10–15 per cent increase of mature fish (of legal take size) in key populations. | Yes |
| Murray cod (*Maccullochella peelii peelii*) | A 10–15 per cent increase of mature fish (of legal take size) in key populations. | Yes |
| River blackfish (*Gadopsis marmoratus*) | Establish 1–3 additional populations (candidate sites include downstream of the Campaspe Rivers). | NoThis species is presumed lost (NCCMA 2019a) |
| Silver perch (*Bidyanus bidyanus*) | Improve core range in at least two additional locations – (candidate sites include Campaspe Rivers). | Yes |

## Loddon River

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the Loddon are described below.

**RIVER FLOWS AND CONNECTIVITY**

Baseflows are at least 60 per cent of the natural level.

Contribute to a 30 per cent overall increase in flows in the River Murray.

A 10–20 per cent increase in the frequency of freshes and bankfull.

**VEGETATION**

Maintain the current extent of forest and woodland vegetation and non-woody vegetation.

No decline in the condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

**Vegetation extent**

| Area of river red gum (ha) | Area of black box (ha) | Area of coolibah (ha)* | Shrublands | Non–woody water dependent vegetation |
|---|---|---|---|---|
| 2 200 | 700 | | | Closely fringing or occurring within the Loddon River. |

**WATERBIRDS**

Maintain current species diversity.

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024.

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds.

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species.

**FISH**

No loss of native species.

Improved population structure of key species through regular recruitment, including:

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years.

Increased movements of key species.

Expanded distribution of key species and populations.

**Key species for the Loddon include:**

| Species | Specific outcomes | In-scope for C'th e-water in the Loddon? |
|---|---|---|
| Freshwater catfish (*Tandanus tandanus*) | Improve core range in at least three additional locations (candidate sites include the Loddon River). | No |
| Golden perch (*Macquaria ambigua*) | A 10–15 per cent increase of mature fish (of legal take size) in key populations. | Yes |
| Murray cod (*Maccullochella peelii peelii*) | A 10–15 per cent increase of mature fish (of legal take size) in key populations. | Yes |
| River blackfish (*Gadopsis marmoratus*) | Establish 1–3 additional populations (candidate sites include downstream of the Loddon). | Yes |
| Silver perch (*Bidyanus bidyanus*) | Improve core range in at least two additional locations – (candidate sites include the lower Loddon). | Yes |

## Wimmera

Expected outcomes from the Basin-wide environmental watering strategy (MDBA 2014) that are relevant to the Wimmera are described below.

**RIVER FLOWS AND CONNECTIVITY**

Baseflows are at least 60 per cent of the natural level.

A 10–20 per cent increase in the frequency of freshes and bankfull.

**VEGETATION**

Maintain the current extent of forest and woodland vegetation and non-woody vegetation.

Improve condition of black box and river red gum.

Improved recruitment of trees within black box and river red gum communities.

**Vegetation extent**

| Area of river red gum (ha) | Area of black box (ha) | Area of coolibah (ha) | Shrublands | Non–woody water dependent vegetation |
|---|---|---|---|---|
| 6 500 | 3 100 | | | Closely fringing or occurring within the Wimmera River. |

**Black box condition**

| Vegetation condition score | | Percent of vegetation assessed (within the managed floodplain) |
|---|---|---|
| 0 –6 | >6 –10 | |
| 42 per cent | 58 per cent | 26 per cent |

**River red gum condition**

| Vegetation condition score | | | | | Percent of vegetation assessed (within the managed floodplain) |
|---|---|---|---|---|---|
| 0 – 2 | >2 – 4 | >4 – 6 | >6 – 8 | >8 – 10 | |
| 3 per cent | 5 per cent | 18 per cent | 60 per cent | 13 per cent | 20 per cent |

**WATERBIRDS**

Maintain current species diversity.

Increase Basin-wide abundance of waterbirds by 20–25 per cent by 2024.

A 30–40 per cent increase in nests and broods (Basin-wide) for other waterbirds.

Up to 50 per cent more breeding events (Basin-wide) for colonial nesting waterbird species.

**FISH**

No loss of native species.

Improved population structure of key species through regular recruitment, including:

- Short-lived species with distribution and abundance at pre-2007 levels and breeding success every 1–2 years.
- Moderate to long-lived with a spread of age classes and annual recruitment in at least 80 per cent of years.

Increased movement of key species.

Expanded distribution of key species and populations.

**Key species for the Wimmera include:**

| Species | Specific outcomes | In-scope for C'th e-water in the Wimmera? |
|---|---|---|
| Freshwater catfish (*Tandanus tandanus*) | Expand the core range of at least two current populations (candidate sites include Wimmera River) | Yes |

# Attachment B – Operational details for watering

## Operational considerations in the Victorian Rivers in the Murray-Darling Basin

The delivery of environmental water in the Victorian rivers in the Murray-Darling Basin is currently constrained by the release capacities from storages, channel capacities and system constraints. The potential risks to third parties are an important consideration for the delivery of environmental water. Floodplain infrastructure works may also constrain maximum flow rates at different times and locations.

Further information about constraints in the Murray-Darling Basin Victorian rivers is provided by the Murray-Darling Basin Authority and can be found in the *Preliminary Overview of Constraints to Environmental Water Delivery in the Murray-Darling Basin* (MDBA 2013a), *Constraints Management Strategy* (MDBA 2013b) and the *Constraints Management Strategy – Goulburn reach report* (MDBA 2015). Specific constraints to be considered are detailed under the potential watering actions – standard operating arrangements section later in this attachment.

Operational considerations such as constraints and risks will differ depending on the inflow scenario. Throughout the year operational and management considerations will be addressed as decisions are taken to make water available for use, and as these decisions are implemented. This will include refining the ecological objectives, assessing operational feasibility and potential risks and the ongoing monitoring of the seasonal outlook and river conditions.

## Potential watering actions under different levels of water resource availability

Under certain levels of water resource availability, watering actions may not be pursued for a variety of reasons, including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the ability to deliver environmental water. Table 4 identifies the range of potential watering actions in the Victorian rivers in the Murray-Darling Basin and the levels of water resource availability that relate to these actions.

**Table 4:** Summary of potential watering actions for the Victorian rivers in the Murray-Darling Basin[1,2]

For all northern Victorian Rivers (except the Ovens) a flow range is provided for each potential watering action. This allows for flexibility of delivery across the year, for example, volumes at the lower end of range and/or shorter duration during dry conditions and an increased magnitude and/or duration and/or additional freshes when possible In all rivers it is aimed to have some flow all year-round, with no cease flow experienced.

| Broad Asset | Indicative demand | Applicable level(s) of resource availability | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| **Goulburn River (Reaches 4 and 5)** | Year-round low flow of 500–940 ML/day. t | 1a. Contribute to year-round low flows to: provide slow shallow habitat for small-bodied fish and deep water habitat for large-bodied fish; submerge snags to provide habitat for fish, waterbugs and biofilm growth; maintain aquatic vegetation and water the root zone of vegetation on the lower bank; encourage the production of plankton for food, disrupt biofilms and maintain water quality. | | | | |
| | Winter fresh (July 2019) of up to 15 000 ML/day with more than 14 days above 6 600 ML/day. | 1b. Contribute to a winter fresh to: remove terrestrial vegetation and re-establish flood tolerant native vegetation; inundate benches to encourage plant germination; provide carbon (e.g. leaf litter) to the channel; and improve water quality and waterbug habitat. | | | | |
| | Winter/spring variable low flows (July–Oct between the end of the winter fresh and start of the early spring fresh) of 800–2000 ML/day. | 1c. Contribute to variable winter/spring low flows to: increase sediment and seed deposition on banks and benches; support dispersal of native vegetation; and support nutrient cycling. | | | | |
| | Spring fresh (Aug–Sept) of >6000 ML/day for 14 days . | 1d. Contribute to a long-duration fresh in early spring to inundate and water vegetation on benches and the lower banks to facilitate recruitment, sustain growth, and encourage flowering and seed development and distribution. | | | | |
| | Spring/summer fresh (Nov/Dec) of up to 10 000 ML/day for 2 days at Murchison/McCoys. | | 1e. When possible contribute to short-duration fresh during November/December to stimulate golden and silver perch spawning. | | | |
| | Spring/summer low flow (after a spring fresh) of <1000 ML/day for 5–6 weeks. | 1f. Contribute to low flows after a spring fresh to allow newly grown plants to establish, provide bank stability, and provide habitat for small-bodied fish and waterbugs. | | | | |
| | Summer/autumn low flows between pulses of <1000 ML/day for more than 20 consecutive days, with a minimum of 7 days between pulses | 1g. This flow is especially relevant when intervalley transfer flows are expected to be high. This is to maintain vegetation for more than one season, to provide bank stability and to ensure habitat for small-bodied fish and waterbugs. | | | | |
| | Summer/autumn fresh (Jan–March) of up to 4600 ML/day for 10 days. | | 1h. Contribute to a fresh to stimulate the migration of juvenile native fish into the Goulburn River from the River Murray | | | |

| Broad Asset | Indicative demand | Applicable level(s) of resource availability | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| | Autumn fresh (Mar/April) of up to 6000 ML/day for 2 days. | 1i. Contribute to a fresh to: encourage seed germination; reduce turbidity and mix water to improve water quality; flush fine sediment to encourage biofilm growth and improve food and habitat for waterbugs. | | | | |
| | Winter fresh (June 2020) of up to 15 000 ML/day with more than 14 days above 6600 ML/day. | | 1j. Up to 15 000 ML/day with more than 14 days above 6 600 ML/day to: remove terrestrial vegetation and re-establish flood tolerant native vegetation; inundate benches to encourage plant germination; provide carbon (e.g. leaf litter) to the channel; and improve water quality and waterbug habitat.<br>Also benefits downstream River Murray ecological targets, including lamprey migration. | | | |
| | Following natural flows (all year) provide water for a slower recession or add pulses. | | 1k. Contribute to actions following natural/unregulated flows to minimise the risk of bank erosion and hypoxic blackwater. | | | |
| **Goulburn River (Reach 1)** | Spring/autumn/winter low flows (July–Sept and April–June) of 400 ML/day. | 1l. Contribute to spring/autumn and winter low flows for: wetting riffles to allow scouring of fine sediment and for biofilms and waterbugs habitat; maintaining a wetted channel for vegetation; and ensuring habitat for small-bodied native fish. | | | | |
| **Lower Broken Creek (Reach 3)** | Year-round low flow of up to 200 ML/day in reach 3 and up to 100 ML/day in reaches 1 and 2. | 2a. Contribute to low flows all year to provide habitat and support movement for platypus and water rat (rakali); provide flowing habitat for fish, vegetation, waterbugs platypus and turtles; maintain dissolved oxygen level and minimise suspended sediment. A minimum of 40 ML/day is required to operate the fish ladder and provide native fish passage. | | | | |
| | Winter/spring/summer/autumn high flow (July to May) of up to 300 ML/day | 2b. Contribute to year-round high flows to flush Azolla, maintain dissolved oxygen levels over summer and provide habitat and trigger fish spawning and movement. | | | | |
| | Winter/spring freshes(July–Oct) of up to 3 actions of 450 ML/day | 2c. Contribute to a winter/spring fresh to flush Azolla blooms (if any) and trigger fish migration. | | | | |
| **Goulburn-Broken catchment wetlands** (Moodie Swamp) | Autumn partial fill | 3a. Contribute to flows in autumn to partially fill Moodie Swamp to provide habitat for brolga nesting and to promote growth of cane grass and rigid water milfoil. | | | | |
| | Winter/spring low flows (June–Nov)) of up to 15 ML/day for 30–60 days | 4a. Contribute to low flows in winter and spring to maintain: pool habitat for native fish and waterbugs; access to food and habitat for platypus; and in-stream vegetation. . | | | | |

| Broad Asset | Indicative demand | Applicable level(s) of resource availability | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| **Upper Broken Creek** | Summer/autumn fresh (Dec–May) of up to 100 ML/day for 10 days. | 4b. Contribute to freshes to maintain water quality and support survival of native fish and waterbugs. | | | | |
| | Summer/autumn low flows (Dec–May) of up to 10 ML/day for 30–60 days | 4c. Contribute to summer/autumn low flows to maintain: pool habitat for native fish and waterbug; access to food and habitat for platypus; and in-stream vegetation. | | | | |
| **Broken River** | Year-round low flow of up to 30 ML/day for 40–100 days | 5a. Contribute to year-round low flows to provide diverse habitat (riffles, slackwater, pools) for native fish, aquatic plants, platypus and waterbugs; and support in-stream and fringing aquatic plants and prevent terrestrial plants growing on the creek bed. | | | | |
| | Summer/autumn fresh (Dec–May) of 400–500 ML/day for 2 to 5 days. | 5b. Contribute to summer or autumn freshes to maintain aquatic vegetation, provide native fish passage; scour sediments from hard surfaces to increase productivity and biofilms; and provide flow cues for native fish breeding and migration. | | | | |
| **Campaspe River** | Summer/autumn low flows (Dec to May) of 10–40 ML/day. | 6a. Contribute to baseflows in summer and autumn to: maintain slackwater habitat for zooplankton and native fish; promote the growth of biofilms for water bugs and native fish; maintain water quality in deep pools; allow platypus to move between pools; and maintain in-stream vegetation along the channel edges. | | | | |
| | Winter/spring low flows (June to Nov) of 20–70 ML/day. | 6b. Contribute to baseflows in winter and spring to maintain water quality and connectivity between pool refuges to: allow fish movement, facilitate male platypus movement during the breeding season; and provide habitat and food for female platypus prior to breeding. | | | | |
| | Winter/spring increased low flow (June to–Nov) of 50–200 ML/day. | | 6c. Contribute to higher baseflows when water is available to achieve the same objectives as for winter/spring low flows but with additional vegetation objectives. These include to: prevent terrestrial plants colonising lower sections of the banks; maintain soil water in the banks for river red gum and woody shrubs; and to help establish littoral vegetation. | | | |
| | Winter/spring fresh (June–Nov) of up to 2 actions of 1,000–1,500 ML/day. | 6d. Contribute to winter high flows to maintain: connectivity for fish movement and possibly spawning; encourage platypus to select burrows higher on the bank to prevent flooding if it occurs later in the year; flush leaf litter to reduce the risk of blackwater events in summer; and . maintain soil moisture for river red gum and woody shrubs. | | | | |
| | Summer/autumn fresh (Dec to May) of up to 3 actions of 100–200 ML/day. | 6e. Contribute to summer/autumn freshes to: promote local movement of adult fish to access new habitat; wet submerged wood and flush fine silt and old biofilm to promote new biofilm growth and increase waterbug mass; and encourage movement of juvenile platypus to find other habitat. When conditions are favourable a fish attraction flow may also be delivered. | | | | |

| Broad Asset | Indicative demand | Applicable level(s) of resource availability | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| **Loddon River** | Summer/autumn freshes (Dec–May) of up to 3 actions of 50–100 ML/day for 3–4 days at peak. | 7a. Contribute to summer freshes to flush fine sediment from hard surfaces; promote and increase fringing vegetation and enable connectivity for fish and platypus movement. | | | | |
| | Winter/spring high flow (Aug–Nov) of 450–750 ML/day with a 6–10 day peak. | 7b. Contribute to the winter/spring high flow to: provide flows through flood runners; trigger native fish movement and breeding; flush organic matter from banks and benches to increase productivity and reduce the risk of hypoxic blackwater in summer; scour accumulated sediments in pools; and increase wetted area for growth of bank vegetation. | | | | |
| | Summer/autumn low flows (continuous during Dec–May) of 25–50 ML/day. | 7c. Contribute to summer/autumn low flows to maintain pool depth for waterbugs, fish, native water rats and aquatic plants; and provide continuous flows for water quality and bank vegetation.to maintain connectivity during dry periods. | | | | |
| | Winter/spring low flow (continuous during June-Nov) of 50–100 ML/day. | 7d. Contribute to winter/spring low flows to increase water depth for habitat and dispersal of fish, platypus and native water rat; prevent fine sediment settling on hard surfaces; and prevent terrestrial plant growth in the river channel. | | | | |
| | Autumn high flow (March–May) of 400 ML/day for 6–10 days. | | | 7e.Contribute to the autumn high flow to trigger and facilitate upstream movement of golden perch, silver perch and Murray cod over one year of age. | | |
| **Serpentine Creek** Reach S1 | Winter/spring low flow (June–Nov) of 20–30 ML/day. | 7f.Contribute to winter/spring low flows to: ensure depth to maintain biofilms and flow variability for bank vegetation; inundate exposed debris and vegetation to provide habitat for aquatic animals; maintain water quality by re-oxygenating pools; and maintain spawning habitat for native fish. | | | | |
| | Winter/spring fresh (Aug–Nov) of 40–150 ML/day for 2 days once per year. | 7g.Contribute to a winter/spring fresh to: provide connectivity for fish and waterbug habitat; transport accumulated organic matter; provide cues to platypus to locate burrows above the water level; and scour pools. | | | | |
| | Summer/autumn low flows (Dec–May) of 10–20 ML/day. | 7h. Contribute to summer/autumn low flows to: provide flow variability and prevent notching; ensure connectivity between pools for fish; re-oxygenate pools to maintain water quality; maintain platypus habitat; and increase wet area to support aquatic plants. | | | | |
| | Summer/autumn fresh (Dec–May) of 30–40 ML/day for 1-3 days up to 3 times a year. | 7i. Contribute to summer/autumn fresh to: transport accumulated organic matter; maintain fringing vegetation and biofilms; and provide water to inundate benches and flush fine sediment. | | | | |

| Broad Asset | Indicative demand | Applicable level(s) of resource availability | | | | |
|---|---|---|---|---|---|---|
| | | Very Low | Low | Moderate | High | Very High |
| **Ovens River** | Autumn fresh (March/April of >430 ML/day for 3 days in reaches 1 and 4, and 130–260 ML/day in reach 5. Possible when ewater is released in conjunction with a bulk water transfer from Lake Buffalo. | 8a. Contribute to a summer/autumn fresh to achieve connectivity between pools and stimulate native fish movement; improve water quality by mixing pools; provide small variations in river levels and flow to flush sediment from hard surfaces and scour biofilm; and maintain waterbug habitat. | | | | |
| | Summer/autumn low flow released over several days (Dec–May) full vol of CEW (123 ML). | 8b. Contribute to summer/autumn low flow to provide a small increase in flow variability to support water quality, provide connections between pools and the maintenance of waterbug habitat.. | | | | |
| **Mullinmur wetland** | Summer top-up flow (Nov–Feb) | 8c. Contribute to a summer top-up flow to maintain water level to support aquatic vegetation and habitat for native cat fish. | | | | |
| **Wimmera System** | Variable baseflows and freshes throughout the year in accordance with priority watering actions designed to meet recommended flow volumes for reaches 2, 3 or 4 of the Wimmera River. | 9a. Contribute to instream baseflows and freshes to support native fish reproduction and condition, riparian vegetation condition, macroinvertebrate habitat and food, hydrological connectivity and biotic dispersal, and maintaining appropriate water quality.<br>If dry conditions persist, the focus for 2019–20 will be to prevent loss of high value refuge habitat and mitigating water quality issues (especially salinity). | | | | |

1. Information sourced from: GBCMA (2019 a-d), NCCMA (2019 a-b), NECMA 2019, WCMA 2019

2. Under certain resource availabilities, options may not be pursued for a variety of reasons including that environmental demand may be met by unregulated flows and that constraints and/or risks may limit the ability to deliver environmental water.

## Potential watering actions – standard operating arrangements

Table 4 identifies the range of potential watering actions in Victorian rivers in the Murray-Darling Basin that give effect to the long-term demands and flow regime identified as being in scope for the contribution of Commonwealth environmental water in any given year. The standard considerations associated with these actions are set out below.

*Approvals:*

*A note on approvals:* watering actions in Victorian rivers are implemented with local delivery partners who play a key role in engaging with the local community and third parties. As some actions may be constrained by other demands in the system, the Commonwealth Environmental Water Office routinely seeks advice from river operators on the timing, magnitude and duration of planned watering.

***Watering action 1:* Goulburn River**

*Standard operational considerations*

- Commonwealth environmental water delivery will not contribute to releases above 9500 ML/day from Lake Eildon to minimise the risk of potential impacts on private property in reach 1, located between Eildon Dam and Yea River.
- Releases from Goulburn Weir are limited to between 8,500 and 9,500ML/day by Goulburn Murray Water due to unknown impact of inundating land.
- Flows greater than 3000 ML/day below Goulburn Weir during irrigation season may impact on some access to pumps and landholders are to be notified at least ten days prior to these events, including for the use of water from intervalley transfers.
- The design of environmental watering actions will take into consideration other river users, including recreational fishers and irrigators, to minimise the risk and inconvenience of inundation of private land and infrastructure and distruption to recreational activities.
- Intervalley transfers undertaken by Goulburn Murray Water may impact on the volume and timing of environmental water actions.
- Drawdowns from Lake Eildon during summer/autumn may attract community concern if the lake-level recedes and affects recreational activity.
- The Bureau of Meteorology minor flood levels at each flow measurement point along the Goulburn River are:
    - 14 500 ML/day at Eildon (reach 1)
    - 21 700 ML/day at Trawool (reach 2)
    - 24 800 ML/day at Seymour (reach 3)
    - 33 100 ML/day at Murchison (reach 4)
    - 28 300 ML/day at McCoys Bridge (reach 5)

*Typical extent:* In-channel flows will be released from Lake Eildon, with en route benefits to reaches 1 to 3 (Eildon to Goulburn Weir). Releases from Goulburn Weir will target reaches 4 and 5 (lower Goulburn River downstream of Goulburn Weir).

***Watering action 2:* Lower Broken Creek**

*Standard operational considerations*

- Environmental water delivery uses infrastructure in the Shepparton and Murray Valley irrigation district. The capacity to deliver environmental water can be limited due to channel constraints when irrigation demand is high. Delivery also takes place during the non- irrigation period to keep the fish ladders open.
- Delivery is not constrained by the risk of flooding private land as the volumes delivered are only a small portion of the creek capacity (2000ML/day). Low lying land in reach 1 means that flows over 120 ML/day are diverted down Nine Mile Creek (reach 2).
- Environmental water will be delivered to complement consumptive water deliveries and intervalley transfers. This approach provides third party benefits to other entitlement holders in the Murray-Darling Basin by allowing intervalley bulk water transfers to be diverted around the Barmah Choke, thereby reducing competition for channel capacity at the Choke.

*Typical extent:* Environmental water is delivered as in-channel flows supplied to lower Broken Creek below Katandra and Nine Mile Creek via Shepparton and Murray Valley irrigation area channel infrastructure.

***Watering action 3:* Goulburn-Broken Catchment Wetlands – Moodie Swamp**

*Standard operational considerations*

- The Upper Broken Creek flow restriction of 10 ML/day flow also applies to environmental water delivery to Moodie Swamp.

*Typical extent:* Wetland inundation via Geary's Channel infrastructure.

***Watering action 4:* Upper Broken Creek**

*Standard operational considerations*

- Unless otherwise agreed, Commonwealth environmental water will only contribute to flows up to 10 ML/day to avoid potential third party flooding impacts in reach 2 below Waggarandall Weir.

*Typical extent:* In-channel flows delivered as managed releases from Lake Nillahcoote and diverted from Broken River to upper Broken Creek at Caseys Weir.

***Watering action 5:* Broken River**

*Standard operational considerations*

- Water volume available is much less that the volume required to delivered the desired flow components. Intervalley water transfers may be used to meet planned actions, paticularly spring and autumn freshes.
- Flows above 400 ML/day in reach 1 may impact on private irrigation infrastucture, limiting delivery to below this volume.

*Typical extent:* In-channel flows delivered as managed releases from Lake Nillahcoote.

***Watering action 6:* Campaspe River**

*Standard operational considerations*

- The maximum regulated release volume from Lake Eppalock, due to the outlet capacity of Lake Eppalock is 1800 ML/day (measured at Barnadown Weir). Planned releases are below this volume.
- Intervalley transfers and operational water delivery (e.g. the Campapse supplement) undertaken by Goulburn Murray Water may impact on the volume and timing of Commonwealth environmental water releases.
- Drawdown from Lake Eppalock during summer/autumn may attract community concern as when the lake-level recedes community perception is that it will adversely affect recreational activity.
- Flows greater than 10,000 ML/day in reach 2 (Eppalock Weir to Campaspe Weir), greater than 8,000 ML/day in reach 3 (Campaspe Weir to Campaspe Siphon) and greater 9,000 ML/day in reach 4 (Campaspe Siphon to River Murray) will cause flooding of low lying floodplain including private property. These flows are not planned and cannot be delivered with current Eppalock outlet capacity.
- Campaspe Weir seepage remains unsolved limiting the delivery of winter high flows.
- Potential inundation of diverter pumps may limit the magnitude of winter high flow.
- Unable to deliver water during annual maintenance of the Lake Eppalock outlet tower.
- The Campapse Siphon, downstream of Rochester (reach 4) is part of the Western Waranga Channel and can be used to release water to reach 4.

*Typical extent:* In-channel flows released from Lake Eppalock targeting reaches 2 (Lake Eppalock to Campaspe Weir) and 4 (Campaspe Siphon to Murray River).

***Watering action 7:* Loddon River**

*Standard operational considerations*

- Due to potential inundation of private land, environmental water will not contribute to flows above 450 ML/day in reach 4 (Loddon Weir to Kerang Weir) without the agreement of potentially affected landholders.
- Flow travel times and attenuation from storages present a challenge for environmental watering as peak flow rates released from storage are required to be much higher than the peak flow rate at the target location.
- Environmental flow regimes are constrained by the limited capacity of the Serpentine, Loddon and Kerang weirs to regulate low flows.
- Regulator damage at Twelve Mile Creek means there is no control over the split of water entering the Loddon River and the creek, particularly during low flows.
- Water available in the Goulburn can be delivered via the Western Waranga Channel to Loddon Weir and reach 4, depending on channel capacity during irrigation season.
- Less water is available for delivery from Cairn Curran if the supplement is not declared, meaning that it is not always possible to deliver flows to reaches 1, 2, 3a and 3b en route to Reach 4.
- Irrigation works year-round throughout the sites may prevent or interupt environmental water deliveries.

*Typical extent:* In-channel flows released from Cairn Curran and Tullaroop Reservoirs, particuarly targeting reach 4 (Loddon Weir to Kerang Weir).

***Watering action 8:* Ovens River**

*Standard operational considerations*

- Water is released each year during periods of regulated flow and prior to the storages reverting to winter storage operating levels.
- The timing for delivery of Commonwealth environmental water is dependent on inflow rates into Lake Buffalo and Lake William Hovell as entitlements can only be released when the storages are not spilling.
- To maximise environmental benefits Commonwealth environmental water release may be timed to occur with the Goulburn Murray Water 'bulk release drawdown'.
- At Lake Buffalo the maximum outflow is 850 ML/day at full supply level in years where bulk water transfer occurs. The minimum outflow of Lake Buffalo is 20 ML/day and this may limit the capacity to deliver the 73 ML over multiple days.
- Similarly in Lake William Hovell, the 50 ML can only be released over a maximum of two days, limiting the ongoing contribution it can provide for critical drought refuges under dry conditions.

*Typical extent:* In-channel flows in the Ovens, King and Buffalo Rivers released from Lake William Hovell and Lake Buffalo. In 2019–20 there is the potentail to deliver regulated flows to Mullinmur Wetland, which is a new site for environmental water in the Ovens River. Mullinmur Wetland is an off-channel wetland that will require pumping to enable water delivery.

***Watering action 9:* Wimmera System**

*Standard operational considerations*

- Commonwealth environmental water is limited to Mt William Creek, reaches 3 and 4 of the Wimmera River and the terminal wetlands (Lakes Albacutya and Hindmarsh). This is due to the entitlement 'point of source' which is limited to Taylors Lake, Rockland Reservoir and Lake Lonsdale.
- The outlet capacity at Lake Lonsdale and Taylors Lake is 600 ML/day and 400 ML/day respectively. Therefore operational constraints limit the regulated delivery of large, bankfull and overbank flows in the Wimmera River.

*Typical extent:* Subject to water availability Commonwealth environmental water will be delivered to the Wimmera River as in-channel flows to be sourced from managed releases from the Wimmera-Glenelg headworks system. As allocations become available the Wimmera Catchment Management Authority will consult with the Commonwealth Environmental Water Office and the Victorian Environmental Water Holder regarding the planned use of this water.

# Attachment C – Long-term water availability

## Commonwealth environmental water holdings

The Commonwealth holds the following entitlements in the Victorian rivers in the Murray-Darling Basin:

- Goulburn (high reliability)
- Goulburn (low reliability)
- Campaspe (high reliability)
- Campaspe (low reliability)
- Loddon (high reliability)
- Loddon (low reliability)
- Broken River (high reliability)
- Broken River (low reliability)
- Ovens (high reliability)
- Wimmera System (low reliability)

The full list of Commonwealth environmental water holdings can be found at www.environment.gov.au/topics/water/commonwealth-environmental-water-office/about-commonwealth-environmental-water/how-much and is updated monthly.

## Other sources of environmental water

Other potential sources of held environmental water that may be used to complement Commonwealth environmental water delivery in the Victorian rivers in the Murray-Darling Basin include:

- Environment Entitlement – The Living Murray Program: Murray-Darling Basin Authority
- Bulk Entitlement (River Murray – Flora and Fauna): Victorian Environmental Water Holder
- Goulburn River Environmental Entitlement: Victorian Environmental Water
- Campaspe River Environmental Entitlement: Victorian Environmental Water
- Bulk Entitlement (Loddon River Environmental Reserve): Victorian Environmental Water
- Wimmera and Glenelg Rivers Environmental Entitlement: Victorian Environmental Water Holder

## Planned environmental water

In addition to water entitlements held by environmental water holders, environmental demands may also be met via natural or unregulated flows and water provided for the environment under the various bulk entitlements which specify minimum passing flows for each of the Victorian river systems (referred to in this document as 'planned environmental water'