Aerial photo of Heart Morass (left) and Dowd Morass (right) after significant inflows in November 2020, by West Gippsland CMA

Section 2

Gippsland region

2.1 Gippsland region overview

In the Gippsland region, *Durt-Yowan* (Latrobe River), lower Latrobe wetlands, *Carran Carran* (Thomson River), Heyfield wetlands and *Wirn wirndook Yeerung* (Macalister River) can receive water from the VEWH's environmental entitlements. The Snowy River also receives environmental flows, but these are managed by the New South Wales Department of Planning, Industry and Environment.

Environmental values, recent conditions, environmental watering objectives and planned actions for each system in the Gippsland region are presented in the system sections that follow.

Traditional Owners in the Gippsland region

Traditional Owners in the Gippsland region continue to have a deep connection to the region's rivers, wetlands and floodplains.

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC), on behalf of the Gunaikurnai people, hold Native Title and is a Registered Aboriginal Party over an area that extends from near Warragul, east to the Snowy River and north to the Great Dividing Range. This area includes *Durt-Yowan* (Latrobe River), *Carran Carran* (Thomson River), *Wirn wirndook Yeerung* (Macalister River), the Snowy River and the lower Latrobe wetlands covered by this section of the seasonal watering plan.

The State of Victoria has entered into a recognition and settlement agreement with the Gunaikurnai people. The recognition and settlement agreement, executed under the *Traditional Owner Settlement Act 2010*, affords Gunaikurnai people rights relating to the use of public land within their agreement area.

Other Registered Aboriginal Parties in this geographic area are the Bunurong Land Council Aboriginal Corporation and Wurundjeri Woi wurrung Cultural Heritage Aboriginal Corporation, but their boundaries do not extend to the waterways managed with water for the environment in the Gippsland region.

Engagement

Seasonal watering proposals are informed by community, stakeholder and program partner engagement, as well as longer-term regional catchment strategies, regional waterway strategies, relevant technical studies (such as environmental flows studies and environmental water management plans). Program partners and other stakeholders help to identify environmental watering priorities and opportunities for the coming year. The strategies and technical reports collectively describe a range of environmental, cultural, economic, social and Traditional Owner perspectives and longer-term integrated catchment and waterway management objectives that influence environmental watering actions and priorities.

The VEWH and its program partners also consider Aboriginal cultural, social and recreational values and uses of waterways when planning for environmental watering activities. Through engagement with community representatives, waterway managers aim to determine how community benefits from environmental flows can be provided while optimising environmental priorities for the year ahead. Aboriginal cultural, social and recreational values and uses are considered for each system in the following system sections.

The International Association for Public Participation's Public Participation Spectrum (IAP2 Spectrum) has been used to categorise the levels of participation of stakeholders involved in the environmental watering planning process. Table 2.1.1 shows the IAP2 Spectrum categories and participation goals.

Table 2.1.1 International Association for Public Participation's Public Participation Spectrum categories and participation goals[1]

IAP2 level	Engagement goal
Inform	Provide balanced and objective information to assist understanding, alternatives, opportunities and/or solutions
Consult	Obtain feedback on analysis, alternatives and/or decisions
Involve	Work directly throughout a process to ensure that concerns and aspirations are consistently understood and considered
Collaborate	Partner in each aspect of the decision including the development of alternatives and the identification of the preferred solution
Empower	Place final decision-making in the hands of the stakeholder

1 The VEWH has the permission of the International Association for Public Participation to reproduce the IAP2 Spectrum.

Table 2.1.2 shows the partners, stakeholder organisations and individuals with which West Gippsland CMA engaged when preparing *Durt-Yowan* (Latrobe River), lower Latrobe wetlands, Thomson (which includes the Heyfield wetlands) and Macalister systems' seasonal watering proposals. This includes engagement conducted as part of developing the seasonal watering proposals as well as engagement during the preparation of key foundational documents that directly informed the proposals. VEWH staff were consulted for operational information as part of the development of all annual seasonal watering proposals by CMAs.

The table also shows the level of engagement between West Gippsland CMA and stakeholders of the environmental watering program in the Gippsland region based on West Gippsland CMA's interpretation of the IAP2 Spectrum.

The level of engagement differs between organisations and between systems, depending on the availability, capacity or interest of stakeholders to participate, roles and responsibilities of organisations in managing a site or system, and the potential interaction of proposed watering with other activities on the waterway. For example, in the Gippsland region, Parks Victoria is more involved in the planning for and management of water for the environment for the lower Latrobe wetlands than for the other Gippsland systems, because it is the land manager for Dowd Morass and Sale Common and it operates the regulators used to release water to these sites.

Table 2.1.2 Partners and stakeholders engaged by West Gippsland Catchment Management Authority in developing seasonal watering proposals for the Latrobe, lower Latrobe wetlands, Thomson and Macalister systems and other key foundation documents that have directly informed the proposals (grouped in alphabetical order)

	Latrobe system	Lower Latrobe wetlands	Thomson system	Macalister system
Community groups and environment groups	**IAP2 level: Inform** • Greening Australia • Latrobe Valley Field Naturalist Club Inc. • Native Fish Australia	**IAP2 level: Inform** • Greening Australia • Latrobe Valley Field Naturalist Club Inc. • Native Fish Australia	**IAP2 level: Involve** • Cowwarr Landcare Group • Heyfield Wetlands Committee of Management • Waterwatch volunteers **IAP2 level: Inform** • Birdlife Australia	**IAP2 level: Involve** • Environment Victoria • Maffra and Districts Landcare Network • Native Fish Australia

Table 2.1.2 Partners and stakeholders engaged by West Gippsland Catchment Management Authority in developing seasonal watering proposals for the Latrobe, lower Latrobe wetlands, Thomson and Macalister systems and other key foundation documents that have directly informed the proposals (grouped in alphabetical order) *(continued)*

	Latrobe system	Lower Latrobe wetlands	Thomson system	Macalister system
Government agencies	**IAP2 level: Collaborate** • Parks Victoria • Southern Rural Water	**IAP2 level: Collaborate** • Parks Victoria	**IAP2 level: Collaborate** • Melbourne Water • Southern Rural Water	**IAP2 level: Collaborate** • Southern Rural Water
	IAP2 level: Consult • Gippsland Water	**IAP2 level: Consult** • Gippsland Water	**IAP2 level: Involve** • Gippsland Water • Department of Environment, Land, Water and Planning	**IAP2 level: Involve** • Gippsland Water
	IAP2 level: Inform • Department of Environment, Land, Water and Planning • East Gippsland CMA	**IAP2 level: Inform** • Department of Environment, Land, Water and Planning • East Gippsland CMA		
Landholders/ farmers	**IAP2 level: Inform** • Individual landholders	**IAP2 level: Collaborate** • Field & Game Australia (Heart Morass)	**IAP2 level: Involve** • Individual landholders	**IAP2 level: Involve** • Macalister Irrigation District irrigators/ diverters • Other landholders
		IAP2 level: Inform • Individual landholders		
Local businesses	**IAP2 level: Inform** • Port of Sale Heritage Cruises	**IAP2 level: Inform** • Port of Sale Heritage Cruises		
Recreational users	**IAP2 level: Inform** • Field & Game Australia • VRFish	**IAP2 level: Collaborate** • Field & Game Australia (Dowd Morass and Sale Common)	**IAP2 level: Involve** • Tourism operators • VRFish	**IAP2 level: Involve** • VRFish
		IAP2 level: Inform • VRFish		
Technical experts	**IAP2 level: Collaborate** • Arthur Rylah Institute (Department of Environment, Land, Water and Planning)		**IAP2 level: Collaborate** • Arthur Rylah Institute (Department of Environment, Land, Water and Planning)	**IAP2 level: Collaborate** • Arthur Rylah Institute (Department of Environment, Land, Water and Planning)
Traditional Owners	**IAP2 level: Collaborate** • Gunaikurnai Land and Waters Aboriginal Corporation	**IAP2 level: Collaborate** • Gunaikurnai Land and Waters Aboriginal Corporation	**IAP2 level: Collaborate** • Gunaikurnai Land and Waters Aboriginal Corporation	**IAP2 level: Involve** • Gunaikurnai Land and Waters Aboriginal Corporation

The New South Wales Government is responsible for planning environmental flows in the Snowy River in consultation with the Victorian Government. The Snowy Advisory Committee was formed in 2018 and provides community and expert advice about the pattern of environmental flows to the Snowy River. The committee's participants represent some Aboriginal, local community and environmental interests, alongside New South Wales and Victorian government agencies. East Gippsland CMA is a member of the Snowy Advisory Committee, and the VEWH is an observer.

Integrated catchment management

Altered water regimes are one of many threats to the health of Victoria's waterways. To be effective, environmental flows need to be part of an integrated approach to catchment management. Many of the environmental objectives from water for the environment in the Gippsland region will not be fully met without simultaneously addressing issues such as barriers to fish movement, high nutrient loads, loss of stream bank vegetation and invasive species.

Victorian and Australian government agencies, Traditional Owner groups, community groups and private landholders collectively implement a wide range of programs that aim to protect and improve the environmental condition and function of land, soils and waterways throughout Victoria's catchments.

Examples of catchment management authority (CMA) on-ground works programs that are likely to support environmental watering outcomes in the Gippsland region include:

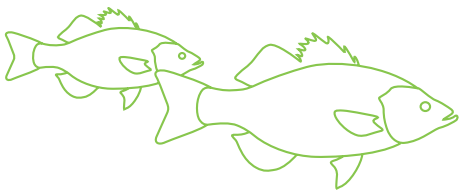
- works to protect and enhance stream banks along priority reaches of rivers and their tributaries including fencing to exclude stock, revegetation of riverbanks, willow removal and erosion control
- work with farmers along *Carran Carran* (Thomson River) and *Wirn wirndook Yeerung* (Macalister River) on grazing and soil management, and on nutrient and water-use-efficiency projects that help to improve water quality and river health
- construction of a fishway on *Carran Carran* (Thomson River) to improve fish passage near the heritage-listed Horseshoe Bend Tunnel, completed in August 2019. The fishway now allows Australian grayling, which are specifically targeted with releases of water for the environment, and other migratory fish, to access over 200 km of river habitat from the upper reaches of the Aberfeldy River down to *Durt-Yowan* (Latrobe River). Tupong have since been found above the Horseshoe Bend Tunnel in surveys conducted by the Arthur Rylah Institute
- a weed and willow control program in remote parts of the Snowy River catchment, which led to 200 km of the river now being willow-free. Surveys and ongoing control of willows in areas that were burnt by the 2019-20 bushfires will be a particular focus over the next five years.

For more information about integrated catchment management programs in the Gippsland region, refer to the West Gippsland and East Gippsland regional catchment strategies and regional waterway strategies.

Risk management

During the development of the seasonal watering proposals for the Latrobe, Thomson and Macalister systems, environmental watering program partners assessed risks associated with potential environmental watering actions for 2021-22 and identified appropriate mitigating strategies. Risks and mitigating actions are continually assessed by program partners throughout the year (see subsection 1.3.6).

In the Snowy system, when weather conditions increase the risk of flooding, the New South Wales Department of Planning, Industry and Environment works with the Bureau of Meteorology, East Gippsland CMA, New South Wales State Emergency Service and the VEWH to inform the community about the management of planned releases. Releases may be cancelled or rescheduled to limit flood impacts on private land.



Seasonal outlook 2021-22

Following relatively dry years in 2018-19 and 2019-20, average rainfall and temperature conditions were observed throughout west Gippsland during most of 2020-21. Below-average rainfall was recorded for the region in July, but a large-scale La Niña event brought average-to-above-average rainfall in the second half of 2020 and January 2021. The *Durt-Yowan* (Latrobe), *Carran Carran* (Thomson) and *Wirn wirndook Yeerung* (Macalister) rivers had relatively high flow throughout winter and spring, and minor flooding occurred in the lower reaches of *Durt-Yowan* (Latrobe River). All of the lower Latrobe wetlands included in the environmental watering program — Sale Common, Dowd Morass and Heart Morass — filled during 2020-21, and Lake Wellington was the freshest it has been — that is, it has the lowest salinity levels — since 2012.

East Gippsland had below-average rainfall in early winter, and much of the catchment was still suffering from dry conditions in 2019-20 and the bushfires that burnt vast areas of the catchment in December 2019 and January 2020. Rainfall increased significantly in July, and the second half of winter 2020 and autumn 2021 were wetter than average. A large rain event across eastern Australia in March 2021 caused minor flooding in some east Gippsland rivers.

The Bureau of Meteorology climate outlook suggests that warmer-than-average temperatures and average to slightly above-average rainfall may occur in the Gippsland region in early 2021-22. Such climatic conditions would likely result in increased inflows to storages in west Gippsland that hold Victorian entitlements to water for the environment, and it may lead to high flow or overbank flows in some systems. The El Niño–Southern Oscillation outlook has been downgraded to inactive, and it is not anticipated to be a significant influencer of the climate in early 2021-22.

Water for the environment for the Latrobe, Thomson and Macalister systems is held in Blue Rock Reservoir, Thomson Reservoir and Lake Glenmaggie respectively. High carryover into 2021-22 is expected in all three west Gippsland river systems because natural events helped meet many of the planned environmental watering actions in 2020-21. The supply of water for the environment going into 2021-22 is likely to be higher than in recent years, which should enable high-priority watering actions to be delivered in winter and spring, without compromising the ability to meet critical demands later in the year.

Allocations across the west Gippsland systems are largely influenced by storage inflows during winter and spring, and so by late spring 2021 waterway managers will be able to determine which potential watering actions they can deliver in summer and autumn. If climatic conditions remain close to the long-term average or become wetter, available water will likely be used to deliver larger-magnitude, longer-duration watering actions to consolidate and build on the environmental outcomes observed in 2020-21. Specific watering actions under these scenarios will aim to have another successful recruitment event for native migratory fish in the Latrobe, Thomson and Macalister systems, enhance recovery of aquatic animal and vegetation communities that were affected by previous dry periods and promote longer-term resilience in the systems. Achieving these flow outcomes may involve timing releases of water for the environment to extend the duration of natural freshes or managed spill releases (where they do not cause impacts to third parties) to optimise outcomes from these events.

If 2021-22 sees a return to drier conditions, the planned flows will likely be delivered at the lower end of their recommended magnitude and duration. There is expected to be sufficient supply to still meet most of the high-priority watering actions planned for dry and drought climate scenarios in 2021-22. Under a drought scenario, environmental watering will focus on protecting high-value assets (such as critical flows for threatened migratory fish, especially species that would normally rely on habitats that were burnt in east Gippsland) and setting aside sufficient reserves to deliver early-season watering priorities in 2022-23.

Environmental watering in the lower Latrobe wetlands in 2021-22 will aim to fill all three wetlands at least partially, given the wetlands experienced several years of dry conditions before 2020-21. It will be preferable to fill the wetlands under average and wet conditions.

The environmental Water Holdings in west Gippsland are not sufficient to meet all the priority flows identified in environmental flow studies, which are ultimately needed to significantly improve the condition of *Durt-Yowan* (Latrobe River), *Carran Carran* (Thomson River) and *Wirn wirndook Yeerung* (Macalister River). Policy actions to increase the supply of water for the environment are being considered through the *Central and Gippsland Region Sustainable Water Strategy* process, which is due to be completed in 2022-23. In the interim, the VEWH and its program partners may consider alternative supply options (such as transfers or trades) to help boost supply for specific watering actions. The VEWH also works with storage managers to identify opportunities to adjust the pattern of consumptive water deliveries to support environmental watering outcomes, while still meeting the needs of consumptive water users.

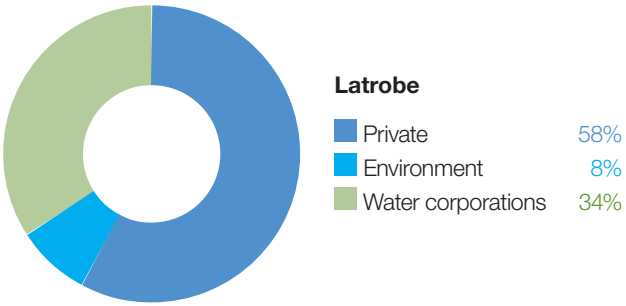
The water year for the Snowy system starts in May and finishes in April the following year, which differs from how water is managed in the other Gippsland systems. The total volume for release and daily release targets for the Snowy River from May 2021 to April 2022 were endorsed by the Snowy Advisory Committee in February 2021, and daily releases will not vary unless flows increase the risk of flooding downstream or operational constraints prevent delivery.

2.2 Latrobe system

Waterway manager – West Gippsland Catchment Management Authority

Storage manager – Southern Rural Water

Environmental water holder – Victorian Environmental Water Holder

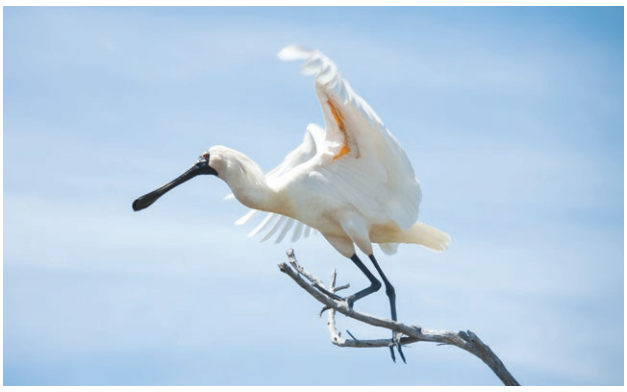


Proportion of water entitlements in the Latrobe basin held by private users, water corporations and holders of water for the environment on 30 June 2020.

The volume attributed to the environment in the Latrobe system does not include water that is available to the lower Latrobe wetlands, because there is no limitation on the volume of water that can be supplied to the wetlands from *Durt-Yowan* (Latrobe River).

Did you know...?

The Latrobe River is known to the Gunaikurnai people as *Durt-Yowan*, which means 'forefinger.'



Top: Durt-Yowan (Latrobe River), by West Gippsland CMA
Above: Spoonbill at Dowd Morass, by David Stork

The Latrobe system includes *Durt-Yowan* (Latrobe River) and lower Latrobe wetlands: Sale Common, Heart Morass and Dowd Morass.

2.2.1 Latrobe River

System overview

Durt-Yowan (Latrobe River) originates on the Baw Baw Plateau and passes through relatively flat to undulating plains, which have been largely cleared for agriculture, before flowing into Lake Wellington (the westernmost point of the Gippsland Lakes) (Figure 2.2.1). Notable tributaries include the Tanjil River, Narracan Creek, Morwell River, Tyers River, Traralgon Creek and *Carran Carran* (Thomson River).

Water for the environment is supplied to *Durt-Yowan* (Latrobe River) from Blue Rock Reservoir on the Tanjil River. Blue Rock Reservoir also supplies water for urban supply and for electricity generators and a paper mill in the Latrobe Valley.

Options to deliver water for the environment to *Durt-Yowan* (Latrobe River) via the Tyers River may be investigated in 2021-22. These options include a physical transfer of water from Blue Rock Reservoir to Moondarra Reservoir via existing infrastructure operated by Gippsland Water or a temporary administrative transfer arrangement. Delivering water via the Tyers River would increase the proportion of the Latrobe catchment that could receive water for the environment without compromising outcomes in the main target reaches of *Durt-Yowan* (Latrobe River). If adopted, these options are expected to benefit native in-stream and streamside vegetation and non-migratory fish within the Tyers River.

Durt-Yowan (Latrobe River) from Rosedale to *Carran Carran* (Thomson River) confluence (reach 5) is the priority reach for environmental watering because it contains endangered plant communities that have good potential for rehabilitation.

Environmental values

The upper reaches of *Durt-Yowan* (Latrobe River) flow through state forest and are relatively intact and ecologically healthy. It contains continuous stands of river red gums and intact streamside vegetation, and it supports native animals including barred galaxias, river blackfish, Gippsland spiny crayfish and nankeen night herons.

Durt-Yowan (Latrobe River) below Lake Narracan is regulated and highly degraded due to historic river management practices. Most large woody habitat has been removed from the river and many sections have been artificially straightened. These practices have caused significant erosion and widened the channel, which has in turn reduced the quality and quantity of habitat for aquatic plants and animals.

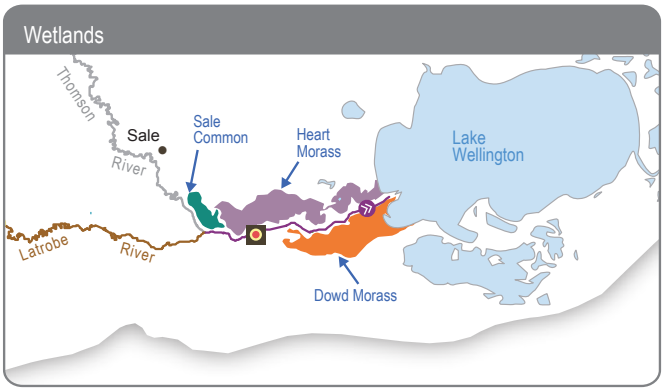
Endangered and vulnerable vegetation is found in all but the most modified sections of *Durt-Yowan* (Latrobe River). The banks along the lower reaches support stands of swamp scrub, characterised by swamp paperbark and tea tree. Mature river red gums grow adjacent to the lower Latrobe wetlands and provide nesting habitat for sea eagles and other birds of prey that hunt in the wetlands. *Durt-Yowan* (Latrobe River) supports several native estuarine and freshwater fish including black bream, Australian bass, Australian grayling and short- and long-finned eel. The river also provides habitat and supports feeding and breeding conditions for platypus, rakali (water rats) and freshwater turtles.

Durt-Yowan (Latrobe River) and its tributaries provide an essential source of freshwater to the Gippsland Lakes system, of which the lower Latrobe wetlands are an important component.

Figure 2.2.1 The Latrobe system

Reach 1 Upstream of Willow Grove
Reach 2 Willow Grove to Lake Narracan
Reach 3 Lake Narracan to Scarnes Bridge
Reach 4 Scarnes Bridge to Kilmany South
Reach 5 Kilmany South to Thomson River confluence
Reach 6 Downstream of Thomson confluence
Reach 7 Lake Wellington
Reach 8 Tanjil River
Water infrastructure
Measurement point
Town
Indicates direction of flow

Grey river reaches have been included for context.
The numbered reaches indicate where relevant environmental flow studies have been undertaken.
Coloured reaches can receive environmental water.



Environmental watering objectives in *Durt-Yowan* (Latrobe River)

	Maintain or increase native fish (migratory, resident and estuary) populations
	Maintain or increase in-stream geomorphic diversity
	Maintain or improve the extent of platypus and rakali (water rats) populations
	Maintain the abundance of freshwater turtle populations
	Improve the condition and increase the extent and diversity of submerged, emergent and streamside native vegetation Reduce the extent and density of invasive plants
	Increase the abundance of all macro- and micro-invertebrates
	Avoid adverse water-quality conditions (such as high salinity) in the lower reaches of *Durt-Yowan* (Latrobe River) and its estuary

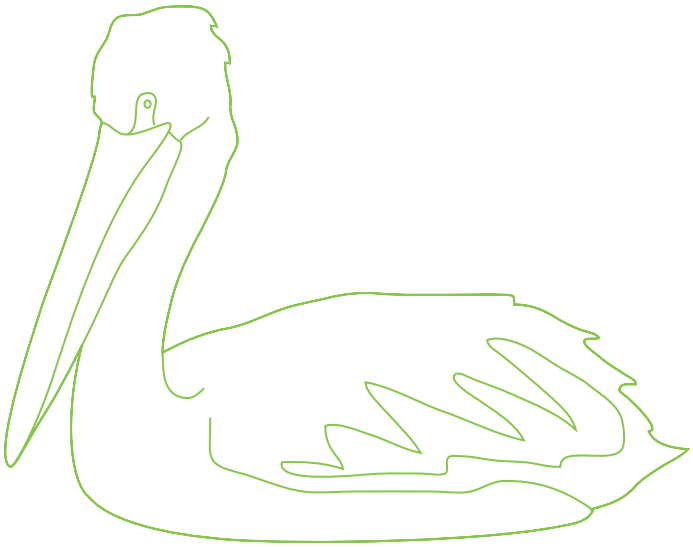
Traditional Owner cultural values and uses

The Gunaikurnai have had a continued connection to Gunaikurnai Country for thousands of years, including with the waterways in the Latrobe system. For the Gunaikurnai as traditional custodians, there are immense challenges to heal, protect and manage Country which has been drastically altered since colonisation. Gunaikurnai see all of Country as connected with no separation between landscapes, waterways, coasts and oceans and natural and cultural resources – the cultural landscape is interdependent.

Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) is working with the West Gippsland CMA to determine how to express Gunaikurnai objectives for water in a way that contributes to seasonal watering proposals from the perspective of traditional custodians, with traditional knowledge.

GLaWAC is working in partnership with West Gippsland CMA to determine how cultural values and uses can be considered in planning for water for the environment. For the Latrobe system, this includes:

- undertaking Aboriginal Waterways Assessments, to examine cultural values and uses, and incorporating the findings of assessments into the *Latrobe Environmental Water Requirements Investigation*
- identifying primary objectives under the modified water regime
- expressing preliminary outcomes: watering actions that recognise and promote:
  - healthy Country
  - the importance of the Latrobe river system to the Gunaikurnai songline of pelican and musk duck and their water quality and habitat requirements
  - waterways as meeting places
  - preliminary accommodation of the water quality and management requirements of species with cultural values and uses.



GLaWAC is sharing with the West Gippsland CMA its knowledge of plant and animal species of cultural significance in and around the waterways of the Latrobe Valley and the importance of specific watering decisions to support them.

Watering requirements to support cultural values and uses include:

- timing environmental watering planned in partnership with GLaWAC to support a seasonal flow regime and wet and dry periods that embody healthy Country
- maintaining freshwater supply to Latrobe estuary, Dowd Morass, Sale Common and Heart Morass and associated freshwater habitats. The lower Latrobe wetlands are an important resource for the Gunaikurnai
- providing connectivity between reaches and onto floodplains to support dependent plants and animals with cultural values and uses of significance to the Gunaikurnai
- maintaining water quality to support the health of native plants and animals with cultural values and uses of significance to the Gunaikurnai.

Social, recreational and economic values and uses

In planning the potential watering actions in Table 2.2.1, West Gippsland CMA considered how environmental flows could support values and uses including:

- water-based recreation (such as fishing and water skiing)
- riverside recreation and amenity (such as hunting)
- socio-economic benefits (such as commercial fishing; diversion for domestic, irrigation and stock use; and power generation).

If the timing or management of planned environmental flows may be modified to align with a community benefit, this is acknowledged in Table 2.2.1 with the following icon.

Recreational benefits from water for the environment in *Durt-Yowan* (Latrobe River)

Watering planned to support water sports activities (e.g. water skiing)

West Gippsland CMA coordinates with the Lake Narracan Ski Club to plan the timing of releases of water for the environment so that they do not affect water levels in the lake during water skiing events held between January and March.

Recent conditions

Climatic conditions in the Latrobe catchment in 2020-21 were close to the long-term average, and some periods of above-average rainfall were observed. High levels of flow were sustained in *Durt-Yowan* (Latrobe River) for most of the year, and several minor floods occurred in winter and spring in the lower reach and estuary. Due to high inflows and little need for environmental flows in 2019-20, the full volume under the environmental entitlement was available at the start of the water year, and it was sustained for the rest of 2020-21 due to low demand.

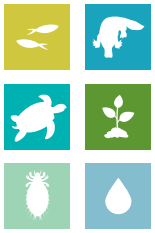
Water for the environment was managed in line with an average climate scenario throughout 2020-21, and all planned watering actions were met or exceeded. Natural inflows provided several large flows that are needed to support key ecological and geomorphological processes and cannot be delivered through managed releases of water for the environment. This is the second year in a row where all deliverable flow components required for *Durt-Yowan* (Latrobe River) have been achieved, which has allowed some recovery in the system following dry years in 2017-18 and 2018-19.

Fish surveys conducted in *Durt-Yowan* (Latrobe River) in March 2021 detected many young-of-year tupong (indicating successful recent recruitment), 12 Australian bass and 25 percent fewer carp compared to 2015 survey results. Fish ecologists from the Arthur Rylah Institute for Environmental Research advised that maintaining minimum low-flow targets throughout 2021-22 will facilitate the upstream dispersal and increase the survival of new tupong recruits.

Scope of environmental watering

Table 2.2.1 describes the potential environmental watering actions in 2021-22, their expected watering effects (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 2.2.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for *Durt-Yowan* (Latrobe River)

Potential environmental watering action	Expected watering effects	Environmental objectives
***Durt-Yowan* (Latrobe River) (targeting reach 5)**		
Winter/spring low flow (620 ML/day during July to November 2021 and June 2022)	• Wet benches to maintain habitat, support the growth of emergent macrophyte vegetation and limit encroachment of terrestrial vegetation • Maintain oxygen levels in pools and maintain sediment (sands and silts) in suspension to prevent pools filling and depositing on substrates, helping to maintain habitat for waterbugs, turtles, aquatic mammals and breeding substrate for river blackfish • Maintain longitudinal connectivity to allow movement/dispersal of native fish, turtles platypus and rakali (water rats)	
Summer/autumn low flow (250-380 ML/day during December to May)	• Maintain an adequate depth in pool habitat to support native fish, turtles, platypus and rakali (water rats) and submerged vegetation • Limit encroachment by terrestrial vegetation and support the growth of emergent macrophyte vegetation • Mix pools to maintain oxygen levels suitable for aquatic animals	
Summer/autumn river freshes (three to six freshes of 920 ML/day for one to five days during December to May) 	Water-quality fresh (one-day duration): • freshen water quality in pools to support fish, waterbug and zooplankton communities • provide sufficient velocity to turn over and flush sediments (sands and silts) from pools and scour algae from hard surfaces Fish and vegetation fresh (three to five days duration) Objectives listed for the one-day fresh and additional objectives: • wet benches to support the growth of emergent macrophyte vegetation • clean fine sediment from stream bed substrates including river blackfish nesting habitats • provide longitudinal connectivity (including over benches for Australian grayling) for native fish, platypus and rakali (water rats)	
Summer/autumn estuary fresh(es) (one to three freshes of 2,200 ML/day at reach 6 for seven to 10 days during December to May) 	Objectives listed for the three-to-five-day river fresh and additional objectives for the Latrobe River estuary: • upper estuary: fully flush with freshwater to support submerged vegetation, provide adequate oxygen levels for aquatic animals, transport silt, wet benches and deliver freshwater to connected wetlands • mid-estuary: partially/fully flush the upper layer of the water column to improve water quality, support emergent macrophytes, provide freshwater habitat and associated food sources for freshwater fish and provide breeding opportunities for estuary fish • lower estuary: partially flush the upper layer of the water column; a flow of this magnitude will also provide opportunities to fill the lower Latrobe wetlands *Note: this event requires a contribution of 1,280 ML/day from Carran Carran (Thomson River) over the equivalent period to meet objectives*	

Scenario planning

Table 2.2.2 outlines the potential environmental watering and expected water use under a range of planning scenarios.

Maintaining target low flows throughout the year to provide habitat and support vegetation growth, and delivering summer/autumn freshes to maintain water quality and provide specific opportunities for fish movement, are high priorities under all climate scenarios. These flows are necessary to consolidate environmental outcomes achieved on the back of wetter conditions in 2019-20 and 2020-21.

Most of the recommended flows are likely to be achieved through a combination of natural events, operational releases, passing flows and environmental deliveries under average and wet climate scenarios. The magnitude and duration of low flows and freshes will likely be lower under drought and dry climate scenarios, where the focus is maintaining current ecological values rather than improving them. However, there will be less natural inflow and lower operational releases under drought and dry climate scenarios, and there will not be enough water for the environment to deliver all of the required watering actions, even at the lower end of their recommended range.

Under drought and dry climate scenarios, the available water for the environment will be used to deliver summer/autumn low flows and a small number of summer/autumn freshes. Summer/autumn flows are prioritised, because critically low flow at this time of year can lead to poor water quality and reduce available habitat, which in turn will threaten populations of native fish, platypus and turtles.

It is unlikely that target summer/autumn low flows will be able to be maintained continuously from December to May under a drought scenario, and up to four freshes will likely be needed to prevent adverse water-quality events in reach 5, although it is likely there will only be sufficient supply to deliver three of these under a drought scenario. At least one of these freshes should have a longer duration — between three to five days — to provide an opportunity for fish movement and to water native vegetation on low channel benches. More freshes with larger magnitudes and longer durations will be delivered under dry, average and wet climate scenarios, which will extend benefits downstream of reach 5. Where inflow from the Thomson River estuary is of sufficient magnitude, some freshes will instead be delivered for up to 10 days, to achieve additional environmental objectives in the Latrobe River estuary.

There are no true carryover provisions in the Latrobe system; rather, the VEWH maintains an ongoing share of storage capacity in Blue Rock Reservoir. Under a drought scenario, it will be important to ensure a minimum of 2,500 ML is maintained in storage at the end of 2021-22 to help deliver critical watering actions in 2022-23. Under dry, average and wet scenarios in 2021-22, several of the demands are expected to be met with natural flows, and so it is expected that medium to large volumes will remain available in storage at the end of the water year. Therefore, there is no additional priority carryover requirement.

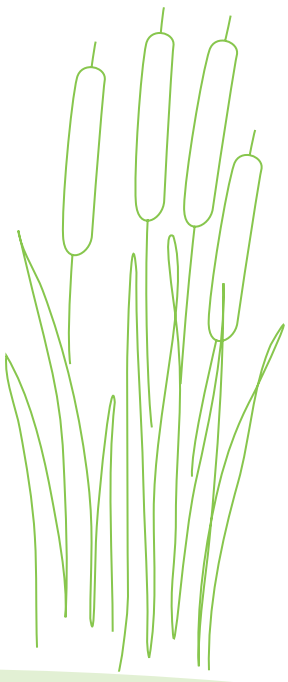


Table 2.2.2 Potential environmental watering for *Durt-Yowan* (Latrobe River) under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	• No unregulated flows • Passing flows reduced	• Possible spills from storages in spring, minor flood levels may occur • Passing flows may be reduced	• Regular spills from storages in spring, minor to moderate flood levels may occur	• Large and frequent spills from storages, moderate to major flood levels may occur
Predicted supply of water for the environment	• 18,700 ML	• 20,700 ML	• 25,700 ML	• 33,700 ML
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Summer/autumn low flow (partial) • Summer/autumn river fresh (two at lower duration, one at mid-duration [four days])	• Summer/autumn low flow • Summer/autumn river fresh (four at lower duration and two at mid-duration [three days]) • Replace one mid-duration summer/autumn river fresh with an estuary fresh, if conditions allow	• Winter/spring low flow (partial) • Summer/autumn low flow • Summer/autumn river fresh (one at lower duration and three at mid-duration [four days]) • Replace all mid-duration summer/autumn river freshes with estuary freshes, if conditions allow	• Winter/spring low flow • Summer/autumn low flow • Summer/autumn river fresh (one at lower duration and three at upper-duration [five days]) • Replace all mid-duration summer/autumn river freshes with estuary freshes, if conditions allow
	Tier 1b (supply deficit)			
	• Winter/spring low flow (partial) • Summer/autumn low flow (continuous) • Tier 1a mid-duration summer/autumn river fresh replaced with a summer/autumn estuary fresh (delivered for seven days) • One additional summer/autumn river fresh (at lower duration)	• Winter/spring low flow (partial) • One additional summer/autumn estuary fresh	• Winter/spring low flow (continuous)	• N/A
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 16,200 ML (tier 1a) • 28,300 ML (tier 1b) • 0 ML (tier 2)	• 14,400-20,400 ML (tier 1a) • 13,400 ML (tier 1b) • 0 ML (tier 2)	• 7,400-15,200 ML (tier 1a) • 12,000 ML (tier 1b) • 0 ML (tier 2)	• 8,600-15,200 ML (tier 1a) • 0 ML (tier 1b) • 0 ML (tier 2)
Priority carryover requirements	• 2,500 ML	• 0 ML		

2.2.2 Lower Latrobe wetlands

System overview

The lower Latrobe wetlands (Dowd Morass, Heart Morass and Sale Common) are an important component of the internationally recognised Gippsland Lakes Ramsar site and provide habitat for a variety of waterbirds of state, national and international conservation significance. The wetlands are located on the floodplain of *Durt-Yowan* (Latrobe River) between its confluence with *Carran Carran* (Thomson River), and they form part of the Gippsland Lakes system.

River regulation and water extraction from *Durt-Yowan* (Latrobe River), *Carran Carran* (Thomson River) and *Wirn wirndook Yeerung* (Macalister River) have reduced the frequency of small- and medium-sized floods that naturally wet the lower Latrobe wetlands. Construction of levees and drains and filling of natural depressions have also altered water movement into and through the wetlands. The drainage and flooding regime in all three wetlands is now managed to some extent with regulators connected to *Durt-Yowan* (Latrobe River).

Environmental values

Sale Common is one of only two remaining freshwater wetlands in the Gippsland Lakes system. It provides sheltered feeding, breeding and resting habitat for a large range of waterbirds, including the Australasian bittern.

Dowd Morass is a large, brackish wetland that regularly supports rookeries of colonial nesting waterbirds including Australian white ibis, straw-necked ibis, little black and little pied cormorants, royal spoonbills and great egrets.

Heart Morass is also a large brackish wetland, with open expanses providing shallow feeding habitat for waterbirds including black swans, Eurasian coots and a variety of ducks.

Together, the lower Latrobe wetlands function as a diverse and complementary ecological system. Colonial nesting waterbirds breed among swamp paperbark trees at Dowd Morass in spring. Migratory shorebirds feed on the mudflats that are exposed as the wetlands draw down and dry over summer. Waterfowl and fish-eating birds use open-water habitat at the wetlands year-round. The wetlands also support threatened vegetation communities including swamp scrub, brackish herbland and aquatic herbland.

Environmental watering objectives in the lower Latrobe wetlands

- Maintain the abundance of frog populations
- Maintain the abundance of freshwater turtle populations
- Maintain or restore a variety of self-sustaining submerged and emergent aquatic vegetation types
- Maintain or restore the diversity, condition and/or extent of native streamside vegetation fringing wetlands
- Discourage the introduction and spread, or reduce the extent and density of undesirable/invasive plants (Sale Common)
- Maintain or enhance waterbird breeding, recruitment, foraging and sheltering opportunities
- Provide suitable physio-chemical conditions to support aquatic life
- Avoid catastrophic water-quality conditions (such as acid sulfate soil exposure) (Heart Morass)

Traditional Owner cultural values and uses

The Gunaikurnai have had a continued connection to Gunaikurnai Country for thousands of years, including with the waterways that feed into the lower Latrobe wetlands. For the Gunaikurnai as traditional custodians, there are immense challenges to heal, protect and manage Country which has been drastically altered since colonisation. Gunaikurnai see all of Country as connected with no separation between landscapes, waterways, coasts and oceans and natural and cultural resources – the cultural landscape is interdependent.

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) is working with the West Gippsland CMA to determine how to express Gunaikurnai objectives for water in a way that contributes to seasonal watering proposals from the perspective of traditional custodians, with traditional knowledge.

Leading up to the *Seasonal Watering Plan 2021-22*, the focus on the lower Latrobe wetlands has included:

- incorporating the findings of the *Durt-Yowan* (Latrobe River) Aboriginal Waterways Assessment into the *Latrobe Environmental Water Requirements Investigation*, which will assist the CMA to consider cultural benefits in water for the environment planning and decision-making for the lower Latrobe wetlands
- on-Country discussions with GLaWAC and Gunaikurnai Elders and Community to examine cultural values and uses
- discussions about the importance of maintaining the wetlands as a freshwater system to support culturally significant species including totem species
- the importance of the lower Latrobe wetlands to the Gunaikurnai, traditionally and today
- concerns about water quality and increasing salinity
- concerns about pest species including carp.

GLaWAC is sharing with the West Gippsland CMA its knowledge of plant and animal species of cultural significance in and around the waterways of the Latrobe Valley, and the importance of specific watering decisions to support them.

Watering requirements to support cultural values and uses include:

- timing of environmental watering planned in partnership with GLaWAC to support a seasonal flow regime and wet and dry periods that embody healthy Country
- maintaining freshwater supply to the Latrobe River estuary, Dowd Morass, Sale Common and Heart Morass and associated freshwater habitats; the lower Latrobe wetlands are an important resource for the Gunaikurnai
- providing connectivity between reaches and onto floodplains to support dependent flora and fauna with cultural values and uses of significance to the Gunaikurnai
- maintaining water quality to support the health of native flora and fauna with cultural values and uses of significance to the Gunaikurnai.

Increasing the involvement of Traditional Owners in environmental water planning and management, and ultimately providing opportunities to progress towards self-determination within and beyond the environmental watering program, is a core commitment of the VEWH and its agency partners. This is reinforced by a range of legislation and policy commitments (for example the *Water Act 1989*, the Victorian Aboriginal Affairs Framework, *Water for Victoria* (2016)) and, in some cases, agreements under the *Traditional Owner Settlement Act 2010*. Where Traditional Owners are more deeply involved in the planning and/or delivery of environmental flows for a particular site, their contribution is acknowledged in Table 2.2.3 with an icon. The use of this icon is not intended to indicate that these activities are meeting all the needs of Traditional Owners but is incorporated in the spirit of valuing that contribution, and indicating progress towards this objective.

Watering planned and/or delivered in partnership with Traditional Owners to support cultural values and uses

GLaWAC and West Gippsland CMA are exploring opportunities to enhance environmental watering with Traditional Owner outcomes in the lower Latrobe wetlands. In 2021-22, this is planned to include a jointly managed Gunaikurnai environmental watering event in Dowd Morass. The overarching objective is to deliver water for the environment to the western end of the morass in a way that better aligns with the natural flow paths of *Durt-Yowan* (Latrobe River) and wetland, supporting enhanced environmental and cultural outcomes. The flow will be delivered at a time of cultural significance to Gunaikurnai people and be aligned with appropriate seasonal conditions (water quality and weather) to support healthy Country.

Social, recreational and economic values and uses

In planning the potential watering actions in Table 2.2.3, West Gippsland CMA considered how environmental flows could support values and uses including:

- water-based recreation (such as canoeing and fishing)
- riverside recreation and amenity (such as birdwatching, camping and duck hunting)
- socio-economic benefits (such as commercial eel and carp fishing).

Recent conditions

Climatic conditions in the Latrobe catchment in 2020-21 were close to the long-term average, with some periods of above-average rainfall observed. Several minor floods in the lower reaches of *Durt-Yowan* (Latrobe River) in winter and spring spilled into Dowd Morass. The VEWH's entitlement for the lower Latrobe wetlands is not limited in volume, and regulator gates may be opened opportunistically based on the water height in *Durt-Yowan* (Latrobe River) at Swing Bridge.

Environmental watering at the lower Latrobe wetlands was managed in line with an average climate scenario in 2020-21, and all planned watering actions were achieved. A combination of natural floods in winter and spring and managed inflows of water for the environment fully or partly filled Sale Common, Dowd Morass and Heart Morass in 2020-21. This watering followed two years of relatively dry conditions at all three wetlands, and it helped improve the condition of fringing wetland vegetation communities and provided feeding and breeding habitat for aquatic animals and waterbirds. Water for the environment was used to partly flush Heart Morass from October to January, to export accumulated salts and sulfates and transfer nutrients between the river and the wetland. Heart Morass and Dowd Morass began to draw down over the warmer months, and the regulator gates were opened as needed (and where water quality allowed) to prevent complete drying. Sale Common was actively managed to maintain water levels between a partial fill and full supply levels year-round. No trigger-based fills were required to prevent or respond to declines in water quality at any of the lower Latrobe wetlands in 2020-21.

Environmental watering in 2021-22 aims to build on the achievements of 2020-21, protecting high-priority environmental values, supporting key ecohydrological functions and providing refuge habitat in the event of drought. Fill events will be targeted at all wetlands to achieve these outcomes, where flow conditions and water quality in *Durt-Yowan* (Latrobe River) allow.

Scope of environmental watering

Table 2.2.3 describes the potential environmental watering actions in 2021-22, their expected watering effects (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objective(s) they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

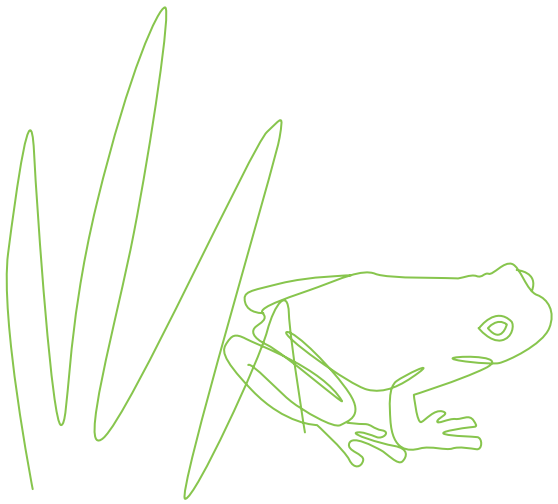


Table 2.2.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the lower Latrobe wetlands

Potential environmental watering action	Expected watering effects	Environmental objectives
Sale Common		
Top-up (anytime, following bird breeding event if required)	• Prolong wetting of reed beds to maintain habitat and food resources for nesting waterbirds and protect chicks from predators	
Partial fill (in July to August1 with top-ups as required to maintain water depth of at least 0.3 m Australian Height Datum [AHD] and surface coverage year-round)	• Encourage the growth and flowering of semi-aquatic plants • Provide appropriate wetland habitat for frogs and turtles • Provide conditions that support waterbug communities and food resources for waterbirds • Discourage invasive plants, particularly the excessive spread of giant rush	
Fill (with top-ups as required during August to November, to maintain water depth of 0.4 to 0.5 m AHD for two months)	• Wet the outer boundaries of the wetland to support the growth and flowering of streamside and fringing wetland plants, increasing foraging opportunities for waterbirds • Encourage bird and turtle breeding by providing nesting habitat • Provide connectivity between the river and wetlands and increase habitat and feeding opportunities for frogs and turtles	
Trigger-based fill or top-up to 0.5m AHD (during December to January, if required to drown out invasive vegetation)	• Wet key habitats within the wetland for a sufficient duration to discourage invasive plants, particularly the excessive spread of giant rush	
Partial drawdown (during December to March)	• Oxygenate sediments to enable aquatic vegetation germination and recruitment • Provide water level fluctuations for emergent vegetation reproduction and expansion (particularly swamp scrub and tall marsh) • Break down organic matter and promote nutrient cycling • Expose mudflats and create shallows to facilitate waterbird foraging	
Dowd Morass		
Top-up (any time, following bird breeding event if required)	• Prolong wetting of reed beds to maintain habitat and food resources for waterbirds and protect chicks from predators, following an observed breeding event	
Fill to control salinity (anytime)	• Dilute salt concentrations within the wetland that may be caused by king tides from Lake Wellington (likely occurring between March to May) or other sources • This watering action is likely to be triggered[1] if electrical conductivity is rising and reaches 7,000 µS/cm	
Partial fill (with top-ups as required to maintain surface coverage during July to December and April to June[2])	• Provide seasonal variation in water depth throughout the wetland to support the growth and flowering of semi-aquatic plants • Wet vegetation and soils at middle elevations within the wetland to increase the abundance of waterbugs and other food resources for frogs, turtles and waterbirds • Provide connectivity between the river and wetlands and between wetlands, increasing available habitat for frogs and turtles • Support bird breeding (when delivered in spring/early summer following earlier fill) by maintaining wetted habitat around reed beds	

Table 2.2.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the lower Latrobe wetlands *(continued)*

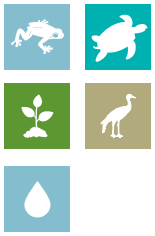
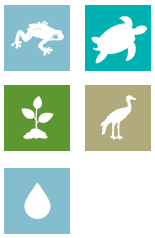
Potential environmental watering action	Expected watering effects	Environmental objectives
Fill (with top-ups as required to maintain water depth of 0.6m AHD during August to November)	• Wet reed beds and deep water next to reedbeds to provide waterbird nesting habitat and to stimulate bird breeding • Wet high-elevation banks and the streamside zone to support vegetation growth, creating nesting habitat for waterbirds • Wet vegetation and soils at higher elevations to stimulate ecosystem productivity and increase the abundance of waterbugs and other food resources for frogs, turtles and waterbirds • Provide connectivity between the river and wetlands and between wetlands, increasing available habitat and food resources for frogs and turtles • Reduce the impact of saltwater incursion from Lake Wellington	
Partial drawdown (during January to March)	• Oxygenate sediments to enable aquatic vegetation germination and recruitment • Provide water level fluctuations for emergent vegetation reproduction and expansion (particularly swamp scrub and tall marsh) • Break down organic matter and promote nutrient cycling • Expose mudflats and create shallows to facilitate waterbird foraging	
Heart Morass		
Top-up to permanently maintain water level above -0.3 m AHD (anytime)	• Minimise the risk of acid sulfate soils developing by keeping known high-risk areas wet • Respond to decreasing pH from the rewetting of exposed acid sulfate soils (most likely during high-wind events) • Dilute salt concentrations within the wetland that may be caused by king tides from Lake Wellington or other sources. This watering action is likely to be triggered[3] if wetland overtopping appears likely; based on rising water levels at Lake Wellington (reaching or exceeding +0.5m AHD)	
Top-up (anytime, following bird breeding event if required)	• Prolong wetting of reed beds to maintain habitat and food resources for waterbirds and protect chicks from predators, following an observed breeding event	
Fill and partial flushing flow (during July to November[4])	• Wet high-elevation banks and streamside zone to support vegetation growth, creating nesting and foraging habitat for waterbirds, and provide food resources for terrestrial birds • Provide connectivity between the river and wetlands and between wetlands, increasing available habitat and providing food resources for frogs and turtles • Export accumulated salts and sulfates and allow the import and export of nutrients, dissolved organic carbon and seed dispersal between *Durt-Yowan* (Latrobe River) and Heart Morass	

Table 2.2.3 Potential environmental watering actions, expected watering effects and associated environmental objectives for the lower Latrobe wetlands *(continued)*

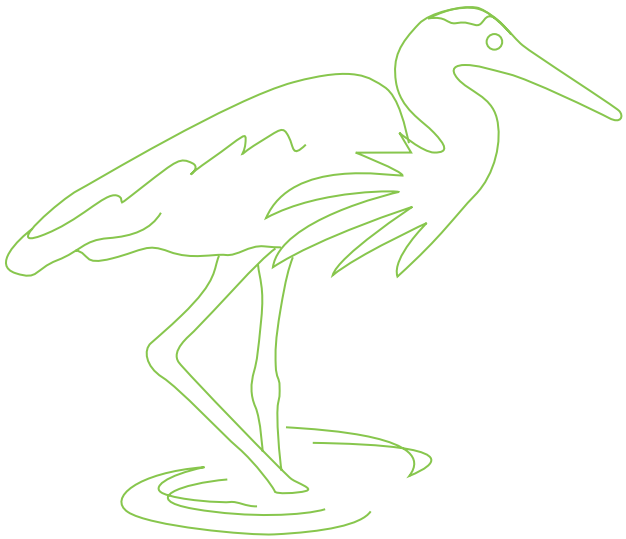
Potential environmental watering action	Expected watering effects	Environmental objectives
Partial fill (with top-ups as required to maintain a minimum water depth 0.3 m AHD during August to December[1] and April to June)	• Support the growth and flowering of semi-aquatic plants • Provide appropriate wetland fringing habitat for frogs and turtles • Provide conditions that support waterbug communities and food resources for frogs, turtles and waterbirds	
Partial drawdown (during January to March)	• Oxygenate sediments to enable aquatic vegetation germination and recruitment • Provide water level fluctuations for emergent vegetation reproduction and expansion (particularly swamp scrub and tall marsh) • Break down organic matter and promote nutrient cycling • Expose mudflats and create shallows to facilitate waterbird foraging	

1 If salinity level in the Latrobe River exceeds 15,000 µS/cm, a fill will not be provided.

2 This is the likely timing under a drought scenario. Note, under a dry, average or wet scenario a fill event may occur during this period, as detailed in Table 2.2.4.

3 If the salinity level in the Latrobe River exceeds 10,000 µS/cm, a top-up will not be provided.

4 If a partial flushing flow is not possible until the end of November, top-ups will be provided to maintain a fill with a minimum water depth of 0.5m AHD.



Scenario planning

Table 2.2.4 outlines the potential environmental watering and expected water use under a range of planning scenarios.

The main priority for environmental watering at the lower Latrobe wetlands in 2021-22 is to fill each wetland as much as possible in winter/spring and prevent complete drying over summer and autumn. The proposed watering actions aim to consolidate environmental outcomes from 2020-21, further enhance recovery from extended drying in 2018-19 and 2019-20 and build ecosystem resilience ahead of future dry periods. The wetlands can only be filled when water levels and water quality in lower reaches of *Durt-Yowan* (Latrobe River) are suitable, and therefore the timing and extent of filling events will be heavily influenced by natural climatic conditions and flow in *Durt-Yowan* (Latrobe River). It is likely that only partial fills will be possible under a drought scenario, and natural overbank floods are likely at any time of year under a wet scenario. Trigger-based inflows to address a potential acid sulfate soil risk, support a natural waterbird breeding event or control invasive vegetation will be delivered when needed and possible, even if the timing of these actions compromise other planned filling or partial drawdown events. Specific watering plans for each wetland under different climate scenarios are described below.

Sale Common

The minimum aim for Sale Common is to partially fill the wetland in winter and provide top-ups as needed to maintain water levels above 0.3 m AHD throughout the year, which will wet about half of Sale Common. Maintaining at least a partial fill is considered ecologically important to support wetland plant communities (which experienced near-complete drying in 2018-19 and 2019-20) and provide habitat for frogs, turtles and waterbirds. This is likely to be the maximum water level achieved under a drought scenario.

Filling the wetland for at least two months from late winter or early spring is a high priority where possible to connect the wetland to *Durt-Yowan* (Latrobe River), stimulate recruitment of plant communities at the outer margins of the wetland and provide nesting habitat for breeding waterbirds. This is likely to be achieved under average and wet scenarios, and it may be achieved under a dry scenario if there is sufficient flow and water quality in *Durt-Yowan* (Latrobe River) at the required time.

Dowd Morass

The plan at Dowd Morass is to fill or partly fill the wetland in winter and spring, then allow a controlled partial drawdown in summer, with top-ups as needed during the drawdown phase and from April to June 2022 to prevent water levels from dropping too much. A partial fill will support some vegetation outcomes and help maintain habitat and food for waterbirds, frogs and turtles, but a complete fill will likely be needed to trigger waterbird breeding and improve vegetation communities at higher elevations. River conditions under a drought scenario will likely prevent a complete fill in winter and spring, and the planned partial drawdown in summer may not be achievable under a wet climate scenario due to local runoff and unregulated inflows from *Durt-Yowan* (Latrobe River).

Heart Morass

Acidity and salinisation represent a high risk to environmental values at Heart Morass, and maintaining water levels above -0.3 m AHD at all times is a high priority to avoid exposing potential acid sulfate soils. Flushing flows, whereby water for the environment is delivered at the upstream end of the wetland and released through a downstream regulator, are also a high priority to deliver where possible, to remove accumulated salt and sulphides. Maintaining water levels above -0.3 m AHD should be possible under all climate scenarios. Flushing flows will probably be provided naturally under a wet scenario and will be provided partially with water for the environment where possible under dry and average climate scenarios.

Water levels in *Durt-Yowan* (Latrobe River) under a drought scenario are not likely to be high enough to support a partial flushing event at Heart Morass. The preferred water regime under a drought scenario will be to partially fill the wetland from winter to early summer to support wetland plant communities and maintain habitat and food resources for frogs, turtles and waterbirds.

A partial draw down is recommended at Heart Morass over summer and autumn under drought to average climate scenarios, to expose shoreline habitat to increase the diversity of vegetation communities, allow nutrient cycling and provide foraging habitat for shorebirds. Significant drawdown is unlikely under a wet climate scenario.

Table 2.2.4 Potential environmental watering for the lower Latrobe wetlands under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river and wetland conditions	• No natural inflow from *Durt-Yowan* (Latrobe River), and wetlands are likely to dry completely	• Minor natural inflow from *Durt-Yowan* (Latrobe River) in winter/spring; expect moderate to substantial drying in summer	• Moderate winter/ spring flow in *Durt-Yowan* (Latrobe River) likely to fill or partially fill the wetlands; expect minor drying in summer	• Major flow in *Durt-Yowan* (Latrobe River) in winter/ spring and possibly autumn/ winter likely to fill all wetlands with very little drying in summer
Sale Common				
Potential environmental watering – tier 1 (high priorities)[1]	• Top-up (any time, following bird breeding) • Partial fill (with top-ups as required) • Partial drawdown (during December to March)	• Top-up (any time, following bird breeding) • Fill (with top-ups as required during August to November) • Trigger-based fill or top-up to 0.5m AHD (during December to January, if required) • Partial fill (with top-ups as required during December to June)		
Dowd Morass				
Potential environmental watering – tier 1 (high priorities)[1]	• Top-up (any time, following bird breeding) • Fill (any time, to control salinity) • Partial fill (with top-ups as required in August to December and April to June) • Partial drawdown (during January to March)	• Top-up (any time, following bird breeding) • Fill (any time, to control salinity) • Partial fill (with top-ups as required in July, December and April-June) • Fill (with top-ups as required during August to November) • Partial drawdown (during January to March)		• Top-up (any time, following bird breeding) • Fill (any time, to control salinity) • Partial fill (with top-ups as required in July and April to June) • Fill (with top-ups as required during August to November)
Heart Morass				
Potential environmental watering – tier 1 (high priorities)[1]	• Top-up (any time, to permanently maintain water level above -0.3m AHD) • Top-up (any time, following bird breeding) • Partial fill (with top-ups as required during August to December) • Partial drawdown (during December to March)	• Top-up (any time, to permanently maintain water level above -0.3m AHD) • Top-up (any time, following bird breeding) • Fill and partial flushing flow (during July to November) • Partial fill (with top-ups as required during April to June) • Partial drawdown (during December to March)		• Top-up (any time, to permanently maintain water level above -0.3m AHD) • Top-up (any time, following bird breeding) • Fill and partial flushing flow (during July to November) • Partial fill (with top-ups as required during April to June)

1 Potential environmental watering at the lower Latrobe wetlands is not classified as tier 1a, tier 1b or tier 2, because there is no limitation on the volume of water that can be supplied to the site from *Durt-Yowan* (Latrobe River). Water can be diverted to the lower Latrobe wetlands at any time of the year when flows are above -0.7m AHD at *Durt-Yowan* (Latrobe River) at the Swing Bridge gauging station.

2.3 Thomson system

Waterway manager – West Gippsland Catchment Management Authority

Storage managers – Melbourne Water (Thomson Reservoir), Southern Rural Water (Cowwarr Weir)

Environmental water holder – Victorian Environmental Water Holder

Did you know...?

The Thomson River is known to the Gunaikurnai people as *Carran Carran*, which means 'brackish water'.

Top: Carran Carran (Thomson River) at Coopers Creek, by West Gippsland CMA
Above: Heyfield wetlands vegetation, by West Gippsland CMA

System overview

Carran Carran (Thomson River) flows from the slopes of the Baw Baw Plateau to join *Durt-Yowan* (Latrobe River) south of Sale (Figure 2.3.1). The major tributaries of *Carran Carran* (Thomson River) are the Aberfeldy and Jordan rivers in the upper reaches and *Wirn wirndook Yeerung* (Macalister River) in the lowest reach. Most natural flow originates from the Aberfeldy River. Two major structures regulate flow on *Carran Carran* (Thomson River): Thomson Reservoir — the largest water supply storage for metropolitan Melbourne — and Cowwarr Weir — a regulating structure that supplies irrigation water to parts of the Macalister Irrigation District.

Thomson Reservoir harvests most of the flow from the upper catchment of *Carran Carran* (Thomson River) and has a significant effect on the flow in all downstream reaches. The natural flow from the Aberfeldy River, which meets *Carran Carran* (Thomson River) below Thomson Reservoir, is essential for providing natural freshes and high flows in *Carran Carran* (Thomson River).

Water for the environment is held in the Thomson Reservoir and released into the river as required. Reach 3 of *Carran Carran* (Thomson River) (from the Aberfeldy River confluence to Cowwarr Weir) is the highest priority for environmental watering due to its heritage river status, high-value native streamside vegetation, high-quality in-stream habitat and low abundance of exotic fish species.

At Cowwarr Weir, *Carran Carran* (Thomson River) splits into the old *Carran Carran* (Thomson River) course (reach 4a) and Rainbow Creek (reach 4b) (see Figure 2.3.1). Passing flows throughout the year are split two-thirds down reach 4a and one-third down 4b to avoid impacts to irrigators located on Rainbow Creek. Water for the environment is primarily delivered to the old *Carran Carran* (Thomson River) course (reach 4a) to support fish migration because Cowwarr Weir impedes fish movement through Rainbow Creek.

The Heyfield wetlands is a cluster of several pools located between *Carran Carran* (Thomson River) and the township of Heyfield. Due to the construction of levees and weirs along *Carran Carran* (Thomson River), river water rarely enters the wetlands; and while the largest pool receives stormwater from the Heyfield township, smaller ponds rely on rainfall or pumped water for the environment to maintain environmental values. These values include wetland plant communities that have been planted as part of a comprehensive revegetation program in recent years.

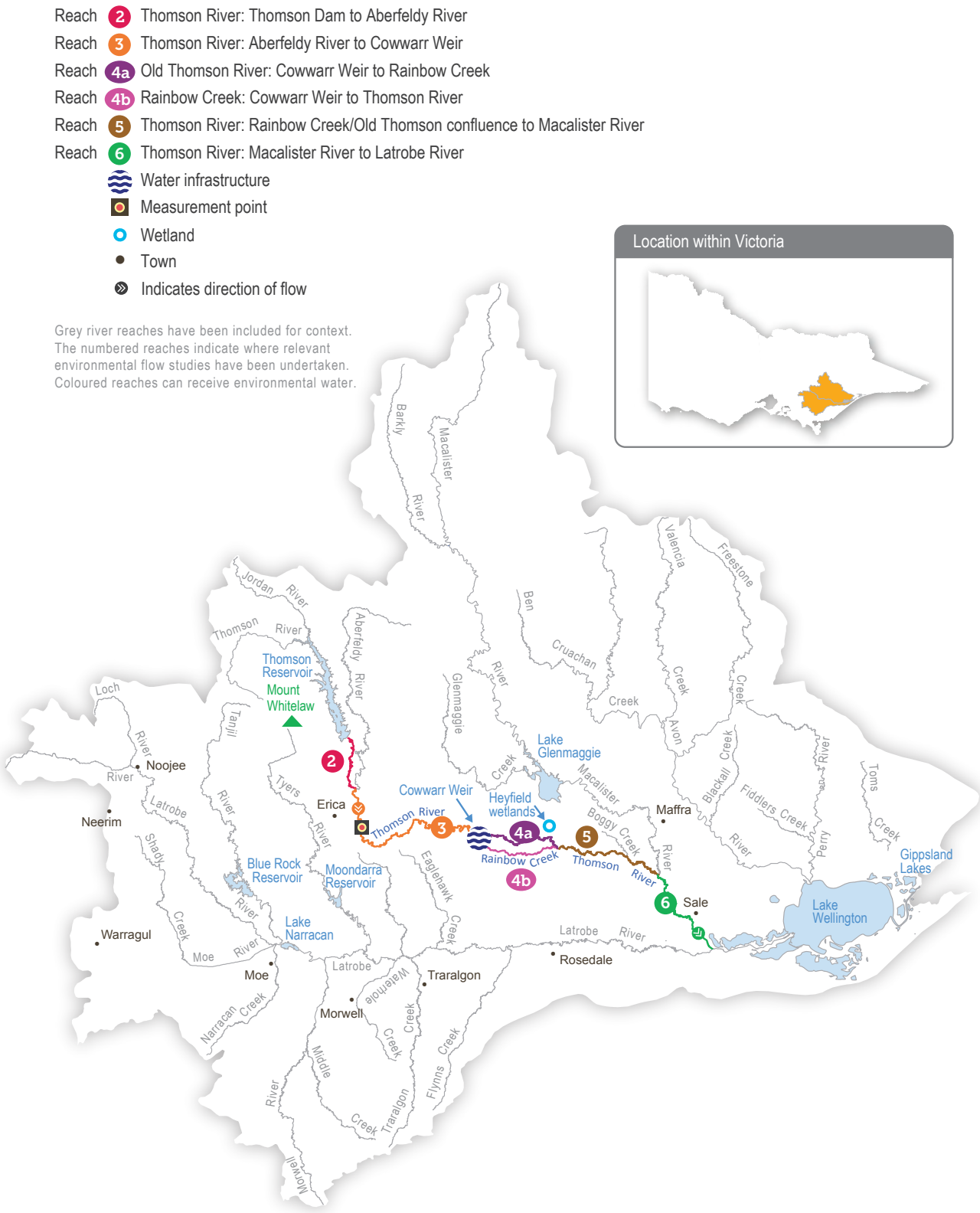
Environmental values

Carran Carran (Thomson River) supports native species of migratory fish that need to move between the sea and freshwater environments to complete their life cycles, including Australian grayling, tupong, short- and long-finned eel, Australian bass, and pouched and short-headed lamprey. A focus for environmental flows management is the Australian grayling, which is listed as a threatened species in Victoria. Australian grayling spawn in response to autumn freshes, and the larvae and juveniles spend time at sea before returning to the freshwater sections of coastal rivers.

The composition and condition of streamside vegetation vary throughout Thomson River catchment. The vegetation is intact and near-natural condition above Thomson Reservoir in the Baw Baw National Park. Streamside vegetation between Thomson Reservoir and Cowwarr Weir is mostly in good condition but is affected by exotic weeds including blackberry and gorse. Below the Cowwarr Weir, the vegetation is degraded due to stock access and widespread weed invasion.

The Heyfield wetlands are one of the few remaining freshwater wetland sites in the Gippsland Plains landscape area. They provide habitat for aquatic and terrestrial animals including threatened migratory birds that prefer shallow, slow-moving waterbodies.

Figure 2.3.1 The Thomson system



Environmental watering objectives in the Thomson system

	Restore populations of native fish, specifically Australian grayling Maintain/enhance the structure of native fish communities
	Maintain the existing frog population and provide suitable habitat
	Maintain or enhance the physical form of the channel to provide a variety of channel features and habitats for aquatic animals Maintain or enhance river function by maintaining substrate condition and enabling carbon cycling
	Increase the abundance of platypus
	Maintain and restore the structural diversity and appropriate distribution (zonation) of streamside vegetation along the riverbank and reduce terrestrial encroachment/invasion (*Carran Carran* [Thomson River]) Increase the recruitment and growth of native in-stream, fringing and streamside vegetation (*Carran Carran* [Thomson River]) Maintain the existing vegetation, promote the growth and establishment of semi-aquatic species (Heyfield wetlands) Enhance the resilience of semi-aquatic species (Heyfield wetlands)
	Restore and maintain the natural invertebrate community
	Provide freshwater habitat for migratory and non-migratory wetland birds within the Gippsland Plains landscape
	Maintain and improve water quality in the Thomson River estuary

Traditional Owner cultural values and uses

The Gunaikurnai have had a continued connection to Gunaikurnai Country for thousands of years, including with the waterways in the Latrobe system, into which *Carran Carran* (Thomson River) feeds. For the Gunaikurnai as traditional custodians, there are immense challenges to heal, protect and manage Country which has been drastically altered since colonisation. Gunaikurnai see all of Country as connected with no separation between landscapes, waterways, coasts and oceans and natural and cultural resources – the cultural landscape is interdependent.

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) are working with the West Gippsland CMA to determine how to express Gunaikurnai objectives for water in a way that contributes to seasonal watering proposals from the perspective of traditional custodians, with traditional knowledge.

This has included GLaWAC membership on the Steering Committee and Project Advisory Group for the 2020 review of the *Carran Carran* (Thomson River) FLOWS study. FLOWS studies provide guidance about the timing, watering duration and amount of water needed by native plants and animals and are therefore a critical input to the annual water for the environment planning process.

GLaWAC cultural water officers have also recently completed an Aboriginal Waterways Assessment on *Carran Carran*, and they are assessing how to document, protect and further the river's cultural values and uses. Traditionally, *Carran Carran* was an important meeting place and a place to camp. Today, the majority of *Carran Carran* is inaccessible to the Gunaikurnai, making it difficult to meet and yarn along the river.

Assessments for watering requirements of *Carran Carran* for the Gunaikurnai have been based on cultural indicators, including:

- the condition of the lower Latrobe wetlands (which *Carran Carran* helps supply)
- the condition and prevalence of plants and animals with cultural values and uses
- species known to be indicators of water quality, water regimes and healthy Country.

GLaWAC is sharing with the West Gippsland CMA its knowledge of plant and animal species of cultural significance in and around the waterways of the Latrobe Valley, and the importance of specific watering decisions to support them.

Watering requirements to support cultural values and uses include:

- timing of environmental watering planned in partnership with GLaWAC to support a seasonal flow regime and wet and dry periods that embody healthy Country
- maintaining freshwater supply to the Latrobe River estuary, Dowd Morass, Sale Common and Heart Morass, and associated freshwater habitats. The lower Latrobe wetlands are an important resource for the Gunaikurnai
- providing connectivity between reaches and onto floodplains to support dependent plants and animals with cultural values and uses of significance to the Gunaikurnai
- maintaining water quality to support the health of native plants and animals with cultural values and uses of significance to the Gunaikurnai.

Social, recreational and economic values and uses

In planning the potential watering actions in Table 2.3.1, West Gippsland CMA considered how environmental flows could support values and uses including:

- water-based recreation (such as kayaking, canoeing, fishing and swimming)
- riverside recreation and amenity (such as birdwatching, camping, hiking and duck hunting)
- community events and tourism (such as community education and events at the Heyfield wetlands, and visitation by locals and non-locals)
- socio-economic benefits (such as outdoor education businesses and helping to maintain bankside vegetation, preventing erosion and potential land loss.).

If the timing or management of planned environmental flows may be modified to align with a community benefit, this is acknowledged in Table 2.3.1 with the following icons.

Recreational benefits from water for the environment in *Carran Carran* (Thomson River)

	Watering planned to support water sports activities (canoeing and kayaking)
	Watering planned to support peaks in visitation (e.g. camping or other public activities on long weekends or school holidays)

Autumn, winter and spring freshes in *Carran Carran* (Thomson River) create ideal whitewater rafting conditions for kayakers and canoers. The timing of environmental flows may be adjusted to optimise opportunities to support these recreation activities, where it does not compromise environmental outcomes. For example, the spring fresh, which aims to cue the migration of Australian grayling and other native fish, may be delivered over the Melbourne Cup racing carnival weekend in November when many people take advantage of the Tuesday public holiday to spend a long weekend kayaking on the *Carran Carran* (Thomson River). Kayaking and rafting activities have inherent risks, and large environmental flows are ramped up and down over several days to avoid sudden changes in water levels that may affect river users. The West Gippsland CMA also provides notification of planned large releases of water for the environment to alert river users about potential increases in the water level and velocity.

Interested community members can register on the West Gippsland CMA website to receive notification of upcoming watering events.

Recent conditions

The *Carran Carran* (Thomson River) catchment had average to above-average rainfall throughout much of 2020-21. The majority of water for the environment for the Thomson system is allocated up-front at the start of the water year, with additional allocation throughout the year based on inflows to Thomson Reservoir. Consistent inflows occurred throughout winter and spring, boosting water availability and resulting in further allocations, which by the end of spring were 17 percent greater than at the same time in 2019-20. Water was released from Thomson Reservoir throughout the year to meet minimum passing flow requirements, irrigation demand and some environmental flow demands. Environmental flows in *Carran Carran* (Thomson River) were managed in line with average and wet climate scenarios — note that the potential watering actions for 2020-21 were the same under both scenarios — and most planned environmental flows in winter and early spring 2020 were met by natural flows.

Carran Carran (Thomson River) had several natural freshes in July and August including one event that peaked above 6,000 ML per day at Coopers Creek gauge. Water for the environment was used to deliver a spring fresh of 800 ML per day at Coopers Creek in late September/early October 2020 to support vegetation outcomes.
A natural fresh that peaked at about 3,000 ML per day in late October/early November provided a natural trigger for fish to migrate upstream from marine/estuarine habitats. Over summer, operational and natural flows met low-flow requirements and partially met one summer/autumn fresh. Water for the environment was used to deliver a fresh in March 2021 to support vegetation growth and flush sediments, and to deliver two autumn freshes of 800 ML per day to trigger downstream fish migration. It was also used to maintain low flows through autumn 2021. No water for the environment was delivered to the Heyfield wetlands in 2020-21: significant rainfall across the catchment filled the wetlands in winter and water levels were maintained throughout spring, providing habitat for waterbirds, frogs and turtles.

All of the high priority (tier 1) planned environmental watering actions for *Carran Carran* (Thomson River) were met in 2020-21. Some tier 2 watering actions were also partially met, which contributed to environmental outcomes in the Thomson River estuary.

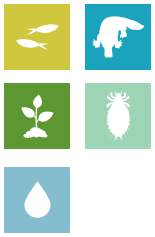
Environmental monitoring indicates improved environmental outcomes in the Thomson system and some recovery from drier conditions between 2017 and 2019. Fish surveys in February 2021 detected successful recruitment following spring freshes in 2020. Specific findings included the catch of 19 Australian grayling in the middle to lower reaches and the highest catch rate of tupong in the 17 years of surveying. Some tupong were also caught upstream of Horseshoe Bend, which indicates fish are using the recently constructed fishway to access habitat in the upper reaches of *Carran Carran* (Thomson River) and the Aberfeldy River. On a landscape scale, west Gippsland catchments may play an important role in providing habitat for coastal migratory fish populations, given many catchments in east Gippsland were affected by the 2019-20 bushfires. Environmental watering in 2021-22 will aim to maintain and where possible build on the environmental outcomes achieved in 2020-21. Scientists at the Arthur Rylah Institute have recommended maintaining low flows in 2021-22 to promote the upstream dispersal and survival of new tupong recruits.

Scope of environmental watering

Table 2.3.1 describes the potential environmental watering actions in 2021-22, their expected watering effects (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objectives they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 2.3.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Thomson system

Potential environmental watering action	Expected watering effects	Environmental objectives
***Carran Carran* (Thomson River) (targeting reach 3)**		

Winter/spring/autumn low flow (125-350 ML/day during July to November 2021 and May to June 2022)	• Maintain a minimum level of habitat and maintain water quality in pools and riffles for waterbugs and fish (when delivered at 125 ML/day). Habitat availability and condition is increased when delivered at higher magnitudes
	• Regulate the water temperature and wet large woody debris to provide food and shelter for waterbugs and fish
	• Maintain sufficient water depth to facilitate platypus and fish movement between localised habitats and increase foraging opportunities (further enhanced when delivered at higher magnitudes)
	• Wet low-lying benches (when delivered at higher magnitudes) to prevent encroachment by invasive plants and permit seed dispersal
	• Additional benefits to the Thomson River estuary (reach 6) are expected when provided at 350 ML/day magnitude:
	  • partially flush the upper water column, helping to sustain waterbug communities and fish by maintaining oxygen levels
	  • prevent high salinity levels, helping to maintain emergent macrophyte vegetation
	  • provide freshwater to the Latrobe system
		

Spring fresh(es) (one to two freshes of 800-900 ML/day for five to seven days during September to November)
• Watering planned to support water sports activities
• Watering planned to support peaks in visitation
	• Trigger the migration of adult and juvenile native fish (in particular the upstream migration of juvenile Australian grayling and Australian bass from marine/estuarine habitats)
	• Improve and maintain streamside vegetation by inundating the benches and providing variable water levels for plant zonation
	• Carry plant seeds from the upper catchment for deposition downstream
	• Deposit fine particulate sediments on the benches and prevent pools from infilling
	• Scour substrates to remove accumulated fine sediment and biofilms to improve habitat and food for waterbugs
	• Additional benefits to Thomson River and its estuary (reach 6) are expected when provided at 900 ML/day magnitude:
	  • wet vegetation on higher benches
	  • partially flush the upper water column in the Thomson River estuary, helping to sustain waterbug communities and fish by maintaining oxygen levels
	  • prevent high salinity levels, helping to maintain emergent macrophyte vegetation
	  • provide freshwater to the Latrobe system
		

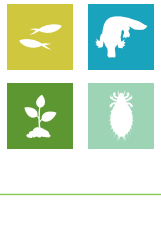
Summer/autumn low flow (125 ML/day during December to April)	• Maintain habitat and water quality in pools and riffles for waterbugs and fish • Facilitate localised movement between habitat types for small-bodied native fish and platypus • Wet low-lying benches to prevent encroachment by invasive plants and enable vegetation zonation	

Table 2.3.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for the Thomson system *(continued)*

Potential environmental watering action	Expected watering effects	Environmental objectives

Summer/autumn fresh(es) (one to two freshes of 230-350 ML/day for seven days during December to March)	• Wet aquatic and fringing vegetation to maintain its condition and support its growth
	• Provide velocity and depth diversity and prevent sediment smothering by fine sediments
	• When delivered in February-March (at 230 ML/day) the fresh also aligns with and supports native fish movement:
	  • trigger downstream migration of adult short- and long-finned eel and upstream movement of juvenile Australian bass
	  • increase the water depth over riffles to facilitate local movement between habitats for large-bodied native fish
		

Autumn freshes (two freshes of 800 ML/day for five to seven days during April to May)	• Trigger the migration of adult and juvenile native fish, in particular:
	  • the downstream migration and spawning of adult Australian grayling (April)
	  • the downstream migration of adult tupong and upstream migration of adult and juvenile Australian bass (May)
	• Carry plant seeds and propagules from the upper catchment for deposition downstream and help maintain zonation of vegetation
	• Prevent infilling of pools by mobilising fine sediments and depositing them on existing bars and benches, to provide substrate for vegetation
	• Scour substrates to remove accumulated fine sediment
		

Heyfield wetlands		
Fill (in August)	• Wet ponds to capacity, to stabilise the banks and support the spring growth of semi-aquatic vegetation • Provide freshwater habitat for waterbirds and frogs (such as growling grass frogs and golden bell frogs)	
Top-ups as required to maintain water level (during September to December)	• Top up ponds before summer to maintain vegetation and enhance recruitment by triggering seed release • Maintain habitat for waterbirds and frogs (such as growling grass frogs and golden bell frogs)	
Partial drawdown (during December to February)	• Oxygenate surface soils, break down accumulated organic matter and cycle nutrients • Enhance waterbird food availability by exposing the mudflats and provide access to burrowing invertebrates	

Scenario planning

Table 2.3.2 outlines the potential environmental watering and expected water use under a range of planning scenarios.

It is important to deliver a mix of low flows and freshes throughout the year in *Carran Carran* (Thomson River), but the magnitude, duration and frequency of these events will generally be lower under drought and dry climate scenarios compared to average and wet scenarios. The reason for this is two-fold. First, there is unlikely to be enough water for the environment to deliver flows at the upper end of their recommended magnitude and duration under drier climate scenarios. Second, under drier climate scenarios the main environmental focus is maintaining key habitats and resources for existing plants and animals, whereas under wetter climate scenarios it will be important to deliver larger-magnitude events, to increase the recruitment of native plants and animals.

Under all climate scenarios, the highest-priority watering actions to be met with environmental flows in *Carran Carran* (Thomson River) are 800 ML per day autumn and spring (in October/November) freshes, which target migratory fish movement into or out of the system. These events are essential to cue the spawning and recruitment of the threatened Australian grayling population and other native migratory fish species. Where possible, the spring and autumn freshes may be timed to coincide with events or long weekends to provide additional recreational benefits for river users. Two autumn freshes will likely be delivered under all climate scenarios, but under a dry scenario, the duration may be reduced from seven to five days to conserve water. Freshes that last for five days are expected to trigger some fish migration, although total fish movement is likely to be less than for a seven-day fresh. Providing an additional 800-900 ML per day spring fresh in September is important under all scenarios to support vegetation outcomes, but there is unlikely to be enough water for the environment to actively deliver these events in drought to average climate scenarios. It will be important to deliver two summer/autumn freshes under all climate scenarios to clear fine silt and biofilms from in-stream habitat and facilitate the movement of native fish and platypus.

Delivery of low flows throughout the year is expected to change, depending on the climate scenario. A flow of 125 ML per day in reach 3 is the target magnitude in summer/autumn and is the minimum recommended flow during winter/spring, which is expected to be met under all climate scenarios by operational passing flows. Under drought and dry scenarios, the target flow rate may be increased up to 230 ML per day for brief periods in May and June, to provide greater fish and platypus passage throughout the reach. Under wetter climate scenarios, increasing the flow magnitude between 230 and 350 ML per day in July 2021 and again between May and June 2022 is preferred, as it results in additional benefits for fringing and streamside vegetation.

Under all climate scenarios, a minimum of 2,600 ML is prioritised for carryover into 2022-23, to meet critical early-season, low-flow requirements in *Carran Carran* (Thomson River).

The recommended water regime for Heyfield wetlands is the same under all climate scenarios because extensive revegetation at the site has occurred in recent years and wetlands filling is required to support the semi-aquatic and terrestrial fringing plants to establish and promote natural recruitment. Water for the environment will likely be needed to fill and top up the wetlands under drought and dry climate scenarios. Natural runoff is likely to meet some or all of the recommended watering actions at Heyfield wetlands under average and wet climate scenarios.

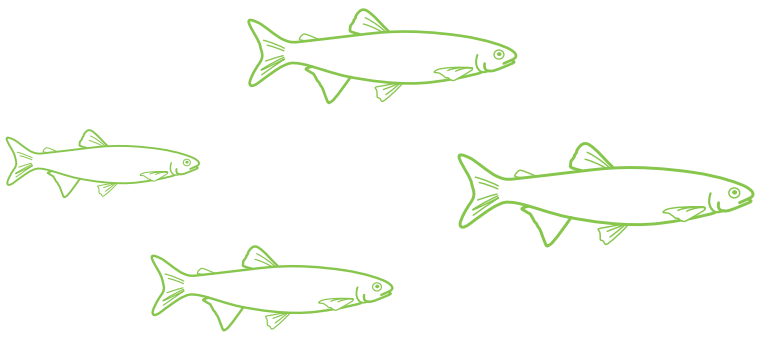


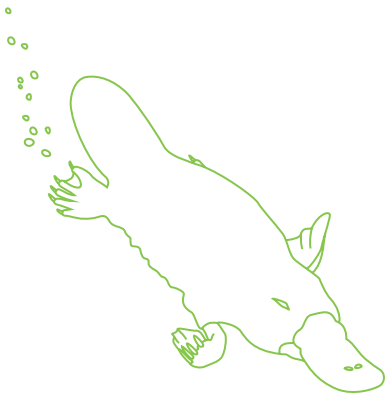
Table 2.3.2 Potential environmental watering for *Carran Carran* (Thomson River) under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	• Limited natural flow • Large volume of consumptive water released from storage	• Natural flow from Aberfeldy River and other tributaries contributes to low flow and freshes • Moderate volume of consumptive water released from storage	• Natural flow from Aberfeldy River and other tributaries contributes to low flow, freshes and high flow • Small volume of consumptive water released from storage	• Natural flow from Aberfeldy River and other tributaries contributes to low flow, freshes and sustained high flow • Minimal volume of consumptive water released from storage
Predicted supply of water for the environment	• 25,700-28,700 ML	• 28,700-31,700 ML	• 31,700-34,700 ML	• 33,700-37,700 ML
***Carran Carran* (Thomson River) (targeting reach 3)**				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Winter/spring low flow (125-230 ML/day between May and June 2022, and 125 ML/day at other times) • Spring fresh (one fresh, at lower duration and magnitude) • Summer/autumn low flow • Summer/autumn freshes (two freshes, one at upper, one at lower duration) • Autumn freshes (two freshes, one at lower duration [in May])	• Winter/spring/autumn low flow (at 230 ML/day in July 2021 and May to June 2022, and 125 ML/day at other times) • Spring fresh (one fresh, at longer duration but lower magnitude) • Summer/autumn low flow • Summer/autumn freshes (two freshes, one at upper, one at lower duration) • Autumn freshes (two freshes)	• Winter/spring/autumn low flow (at 350 ML/day in July 2021 and May to June 2022, and 125 ML/day at other times) • Spring fresh (one fresh, at longer duration but lower magnitude) • Summer/autumn low flow • Summer/autumn freshes (two freshes, one at upper, one at lower duration) • Autumn freshes (two freshes)	• Winter/spring low flow (at 350 ML/day in July 2021 and May to June 2022, and 125 ML/day at other times) • Spring freshes (two freshes, both at longer duration but one at lower magnitude) • Summer/autumn low flow • Summer/autumn freshes (two freshes, one at upper, one at lower duration) • Autumn freshes (two freshes)
	Tier 1b (supply deficit)			
	• Autumn/winter/spring low flow (in addition to tier 1a, increase magnitude to 350 ML/day during July to November) • Tier 1a spring fresh delivered at longer duration and one additional spring fresh at longer duration and upper magnitude	• Autumn/winter/spring low flow (at upper magnitude continuously) • One additional spring fresh, at longer duration and upper magnitude	• Autumn/winter/spring low flow, at upper magnitude continuously • One additional spring fresh, at longer duration and upper magnitude	• Autumn/winter/spring low flow, at upper magnitude continuously
Potential environmental watering – tier 2 (additional priorities)	• N/A			

Table 2.3.2 Potential environmental watering for *Carran Carran* (Thomson River) under a range of planning scenarios *(continued)*

Planning scenario	Drought	Dry	Average	Wet
Heyfield wetlands				
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Fill (in August) • Top-ups (two, in September-December) • Partial drawdown (in December to February)			
	Tier 1b (supply deficit)			
	• N/A			
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 22,000 ML (tier 1a) • 30,400 (tier 1b) • 0 ML (tier 2)	• 25,000 ML (tier 1a) • 30,400 ML (tier 1b) • 0 ML (tier 2)	• 34,500 ML (tier 1a) • 18,200 ML (tier 1b) • 0 ML (tier 2)	• 39,500 ML[1] (tier 1a) • 13,200 ML (tier 1b) • 0 ML (tier 2)
Priority carryover requirements	• 2,600 ML			

1 While the demand is in excess of available supply, it is expected that some of the events will be at least partially met with natural inflows under a wet scenario.



2.4 Macalister system

Waterway manager – West Gippsland Catchment Management Authority

Storage manager – Southern Rural Water

Environmental water holder – Victorian Environmental Water Holder

Did you know...?

Wirn wirndook Yeerung (Macalister River) has been prioritised as a key fishery for the Native Fish Report Card Program, where monitoring will focus on Australian bass and Australian grayling. This four-year monitoring program is collecting long-term information about the condition of native recreational fisheries across the state. The program is a partnership between the Department of Environment, Land, Water and Planning, the Victorian Fisheries Authority and recreational fishing licence holders. The program started in 2017, collecting information on various indicators of fish population health including abundance, year-class distribution for specific fisheries and target recreational species and priority threatened species.

Top: Wirn wirndook Yeerung (Macalister River) at Lanigans Bridge, by West Gippsland CMA
Above: Short-finned eel, by Trevor Prescott

System overview

Wirn wirndook Yeerung (Macalister River) flows from Mt Howitt in the Alpine National Park and joins *Carran Carran* (Thomson River) south of Maffra (Figure 2.4.1). The river winds its way in a south-easterly direction through mostly forested, confined valleys and narrow floodplains above Lake Glenmaggie. The downstream reaches flow through wide alluvial floodplains that have been cleared for agriculture. The Wellington River and Glenmaggie Creek are the main tributaries of *Wirn wirndook Yeerung* (Macalister River).

Lake Glenmaggie is the major water-harvesting storage regulating *Wirn wirndook Yeerung* (Macalister River). Maffra Weir is a small diversion weir located further downstream in Maffra.

Before the construction of Lake Glenmaggie, *Wirn wirndook Yeerung* (Macalister River) would regularly receive high and medium flows in winter and spring. Although Lake Glenmaggie regularly spills, high flows are less frequent than natural because much of the water is captured by the storage. A notable impact of irrigation and water-harvesting is reversed seasonality of flows between Lake Glenmaggie and Maffra Weir. Summer flows through this reach are much higher than natural due to the delivery of irrigation water. Winter flows in this reach are lower than natural because a high proportion of the inflows are captured and there are no irrigation demands over winter. Below Maffra Weir, most flows are diverted for irrigation in summer/autumn. The changed hydrology restricts fish migration, limits the growth and recruitment of in-stream and streamside plants and reduces the quality of in-stream habitat.

Water for the environment is stored in Lake Glenmaggie and released to *Wirn wirndook Yeerung* (Macalister River). The river is divided into two reaches for the purposes of managing environmental flows: Lake Glenmaggie to Maffra Weir (reach 1) and Maffra Weir to *Carran Carran* (Thomson River) (reach 2).

Maffra Weir is a major barrier to fish movement along the river, so environmental watering for migratory fish objectives mainly focus on reach 2. All other objectives apply to both reaches 1 and 2.

Environmental values

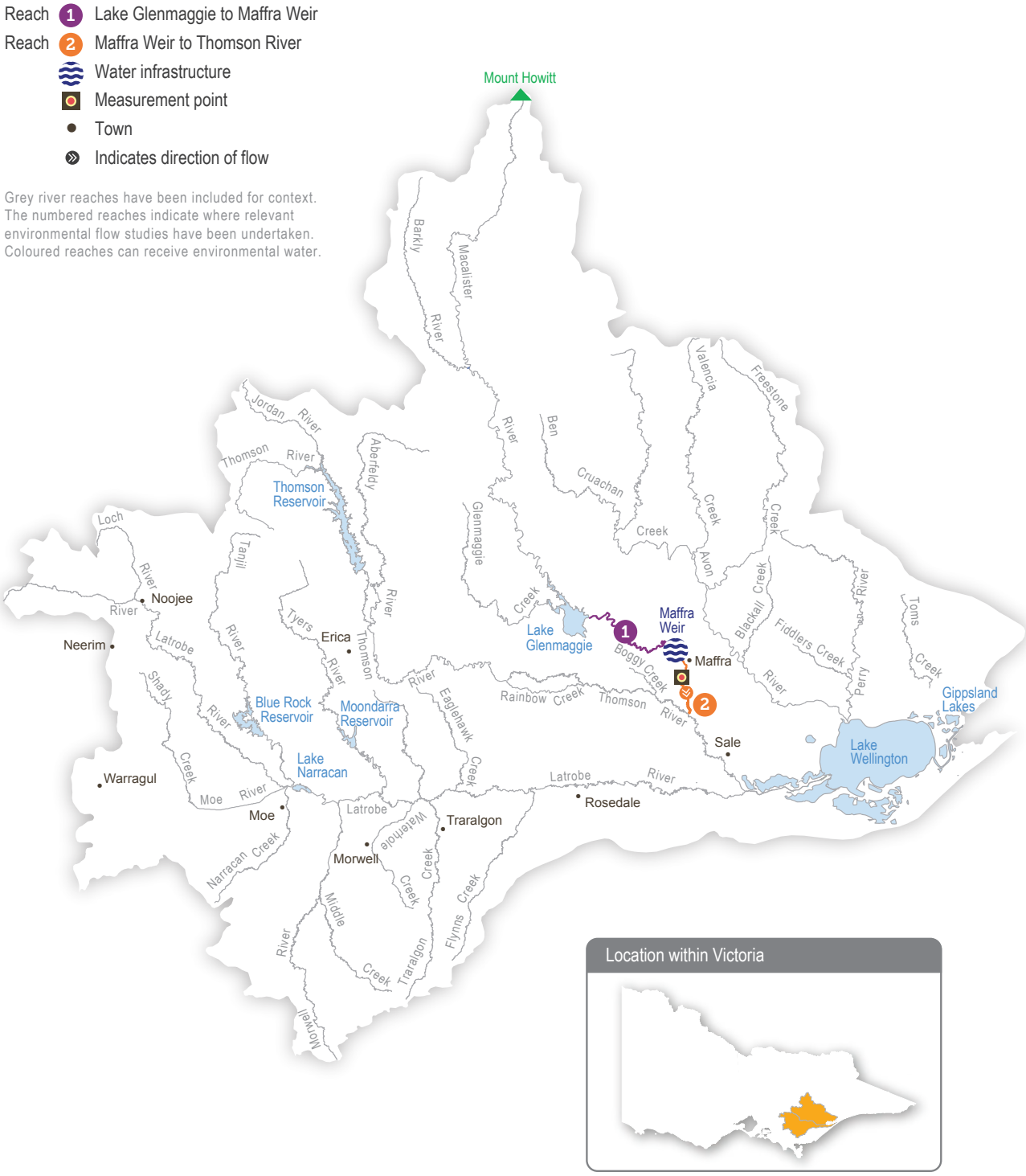
Seven migratory native fish species move between *Wirn wirndook Yeerung* (Macalister River), the estuary and the sea to complete their life cycle. These species include the Australian grayling, short-finned eel, long-finned eel, tupong, Australian bass, short-headed lamprey and common galaxias. Yellow-eye mullet, which is an estuarine species, has been recorded in the river. Platypus and rakali (water rats) are widely distributed through *Wirn wirndook Yeerung* (Macalister River) and its tributaries.

The streamside vegetation corridor along the regulated reaches of *Wirn wirndook Yeerung* (Macalister River) is fragmented. Immediately below Lake Glenmaggie, the vegetation is in good condition and includes remnant river red gums and good-quality stands of shrubs, particularly in areas where revegetation has occurred in combination with stock exclusion. Further downstream, the vegetation is degraded. In recent years, the cover of in-stream vegetation has declined, which may be due to a combination of increased water turbidity, erosion and a lack of an appropriate water regime to encourage plant growth. The cover of non-woody plants (such as reeds, sedges and rushes) along the fringes of the river is patchy.

Environmental watering objectives in *Wirn wirndook Yeerung* (Macalister River)

	Increase the distribution, recruitment and abundance of all native fish, and increase opportunities for the spawning and recruitment of native migratory fish (such as the Australian grayling)
	Improve and maintain the form of the riverbank and bed to provide physical habitat for aquatic animals and plants
	Increase the abundance of platypus and rakali (water rats)
	Improve native emergent (non-woody) and fringing (woody) vegetation in the streamside zone Reinstate submerged aquatic vegetation
	Increase the abundance and number of functional groups of waterbugs

Figure 2.4.1 The Macalister system



Traditional Owner cultural values and uses

The Gunaikurnai have had a continued connection to Gunaikurnai Country for thousands of years, including with the waterways in the Latrobe system (into which *Wirn wirndook Yeerung* [Macalister River] feeds). For the Gunaikurnai as traditional custodians, there are immense challenges to heal, protect and manage Country, which has been drastically altered since colonisation. Gunaikurnai see all of Country as connected with no separation between landscapes, waterways, coasts and oceans and natural and cultural resources – the cultural landscape is interdependent.

The Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC) are working with the West Gippsland CMA to determine how to express Gunaikurnai objectives for water in a way that contributes to seasonal watering proposals from the perspective of traditional custodians, with traditional knowledge.

GLaWAC expressed that more water needs to go down *Wirn wirndook Yeerung* (Macalister River) between Lake Glenmaggie and Lake Wellington, to improve water quality including the threat of salinity, and support plants and animals with cultural values and uses.

The timing of watering events has also been raised by GLaWAC. This includes providing increased water depth to promote downstream fish migration and spawning, deeper water pools to prevent water-quality degradation, and more variation to water levels to better mimic natural conditions.

Traditionally the landscape – which includes *Wirn wirndook Yeerung* (Macalister River), anabranches and associated floodplains – has been a rich source of food, medicine and resources for the Gunaikurnai people. In the area, there are many sites of cultural significance near the river and around Lake Glenmaggie. The Gunaikurnai people have moved through the landscape along the waterways for thousands of years, sourcing food and plants along the way.

From the perspective of the Gunaikurnai people, the land and waterways flowing to the Gippsland Lakes are interconnected and cannot be considered separately where decisions made can impact downstream. The lower Latrobe wetlands and the rivers that feed them, including *Wirn wirndook Yeerung* (Macalister River), have important cultural significance to the Gunaikurnai people.

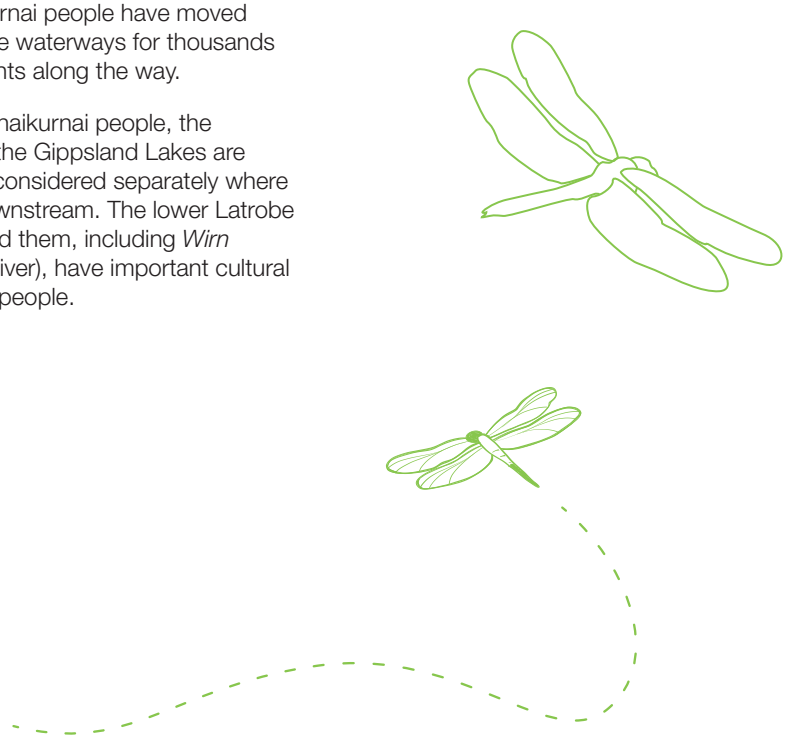
Watering requirements to support cultural values and uses include:

- timing of environmental watering planned in partnership with GLaWAC to support a seasonal flow regime and wet and dry periods that embody healthy Country
- maintaining freshwater supply to the Latrobe River estuary, Dowd Morass, Sale Common and Heart Morass, and associated freshwater habitats. The lower Latrobe wetlands are an important resource for the Gunaikurnai
- providing connectivity between reaches and onto floodplains to support dependent plants and animals with cultural values and uses of significance to the Gunaikurnai
- maintaining water quality to support the health of native plants and animals with cultural values and uses of significance to the Gunaikurnai.

Social, recreational and economic values and uses

In planning the potential watering actions in Table 2.4.1, West Gippsland CMA considered how environmental flows could support values and uses including:

- water-based recreation (such as canoeing, kayaking and swimming)
- riverside recreation and amenity (such as fishing and hunting)
- socio-economic benefits (such as preventing erosion and potential loss of private land).



Recent conditions

Rainfall in the Macalister system in 2020-21 was slightly higher than the long-term average. High inflows in autumn 2020 filled Lake Glenmaggie, and additional rain events caused it to spill multiple times through winter and spring. Opening allocations of high-reliability water shares were 100 percent, and low-reliability water share allocations reached 100 percent in April 2021.

Releases of water for the environment in the Macalister system were made in line with the average and wet climate scenarios throughout 2020-21. All of the planned watering actions for 2020-21 were met through a combination of natural flows, operational and consumptive releases and environmental flows. Flows at Riverslea gauge (located in reach 2) exceeded 4,000 ML per day several times between July and October 2020. Water for the environment was used to maintain connectivity in the river as needed during the storage filling season and to deliver freshes in autumn and early winter to support fish migration.

Fish surveys conducted in *Wirn wirndook Yeerung* (Macalister River) in March 2021 caught many young-of-year tupong, which suggests high flows in spring 2020 supported successful recruitment for that species. On a landscape scale, west Gippsland catchments may provide refuge habitat for coastal migratory fish populations that moved out of east Gippsland catchments following the extensive bushfires in 2019-20. Environmental watering in 2021-22 aims to maintain or where able build on the environmental outcomes from 2020-21. Fish ecologists from the Arthur Rylah Institute for Environmental Research recommend maintaining target low flows throughout 2021-22 to promote the upstream dispersal and survival of new tupong recruits.

Scope of environmental watering

Table 2.4.1 describes the potential environmental watering actions in 2021-22, their expected watering effects (that is, the intended physical or biological effects of the watering action) and the longer-term environmental objective(s) they support. Each environmental objective relies on one or more potential environmental watering actions and their associated physical or biological effects.

Table 2.4.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for *Wirn wirndook Yeerung* (Macalister River)

Potential environmental watering action	Expected watering effects	Environmental objectives
***Wirn wirndook Yeerung* (Macalister River) (targeting reach 2)[1]**		
Winter/spring low flow (300 ML/day for at least 120 days during July to November 2021 and June 2022)	• Provide permanent wetted habitat for waterbugs and maintain water depth over riffles to enable fish passage between local habitats • Increase water depth to provide sustained wetting of low-level benches, limiting the encroachment of terrestrial vegetation	
Spring/summer fresh(es) (one to two freshes of 700-1,500 ML/day for three to 10 days during September to December)	• Cue the upstream migration of adult fish (e.g. short-headed lamprey) and the recruitment of juveniles (e.g. Australian grayling, tupong, common galaxias, Australian bass, short- and long-finned eels) from marine/estuarine environments • Wet mid- and higher-level benches to water woody vegetation and move organic matter into the channel to transport food resources downstream (when delivered at upper magnitude) • Provide flow with sufficient shear stress to scour biofilms and flush fine sediment from pools and small gaps to improve geomorphic habitat and food resources for waterbugs (when delivered at upper magnitude)	
Spring/summer low flow (60-90 ML/day during September to February)	• Maintain the water depth in pools and hydraulic habitat for native fish[2] • Maintain permanent wetted habitat in pools and riffles for waterbugs[2] • Provide longitudinal connectivity for local movement of platypus and rakali, as well as protection from predation, access to food sources and maintenance of refuge habitats[2]	
Trigger-based summer/autumn low flow (40-60 ML/day for five to 13 days when triggered, during December to May)	• Maintain permanent wetted habitat in pools and riffles for fish and waterbugs to survive • Provide shallow, slow-flowing habitat to maintain in-stream vegetation • Maintain a minimum depth in pools to allow for turnover of water and to slow degradation of water quality to support aquatic life	

Table 2.4.1 Potential environmental watering actions, expected watering effects and associated environmental objectives for *Wirn wirndook Yeerung* (Macalister River) *(continued)*

Potential environmental watering action	Expected watering effects	Environmental objectives
Summer/autumn fresh(es) (one to three freshes of 140 ML/day for three to five days during December to March)	• Increase water depth to allow fish to move throughout the reach • Flush pools to maintain water quality for aquatic animals • Flush substrates and improve the quality of existing waterbug habitat and food supply • Wet low benches to facilitate the dispersal of seeds and propagules from emergent vegetation throughout the reach • Provide flow with sufficient shear stress to flush fine sediment from small gaps to improve geomorphic habitat	
Autumn fresh (one fresh of 350 ML/day for five days during April to May)	• Cue the downstream migration of Australian grayling towards the estuary for spawning • Additional benefits for *Carran Carran* (Thomson River) and the Latrobe system are expected when delivered for greater than three days: • fully flush the upper Thomson River estuary (when delivered for greater than three days and combined with freshes in *Carran Carran* (Thomson River) and contribute freshwater to the lower reaches of *Durt-Yowan* (Latrobe River) and wetlands	
Autumn/winter low flow (60-90 ML/day during March to August)	• Maintain pool and riffle habitat for waterbugs and a minimum depth over riffles to allow fish (e.g. Australian grayling, tupong and Australian bass) to migrate downstream towards the estuary habitat to spawn or breed[2] • Provide connectivity throughout the river for the local movement of platypus and rakali (water rats), as well as protection from predation and access to food • Provide low-velocity flow and clear water to enable the establishment of submerged vegetation[2]	
Autumn/winter fresh (one fresh of 700 ML/day for five days during July to August 2021 or May to June 2022)	• Cue the downstream migration towards the estuary of Australian bass for spawning and of tupong for breeding • Increase the wetted area and improve water quality by flushing pools, providing habitat and conditions for waterbugs • Wet low and mid-level benches to facilitate the dispersal of emergent and fringing vegetation seeds and propagules throughout the reach	

1 All freshes target reach 2 specifically. Low flows target both reach 1 and 2, but the magnitudes targeted apply to both reaches.

2 At 90 ML per day, expected watering effects are met in reach 1 and 2. At 60 ML per day, expected watering effects are met in reach 2 only.

Scenario planning

Table 2.4.2 outlines the potential environmental watering and expected water use under a range of planning scenarios.

Under all climate scenarios, providing year-round low flows to *Wirn wirndook Yeerung* (Macalister River) is the highest-priory watering action, to maintain habitat connectivity for aquatic animals. Year-round operational passing flows of 60 ML per day meet flow objectives for reach 2, providing the minimum connectivity requirement. Increasing flows to 90 ML per day where water availability allows is preferred, as it has additional benefits for reach 1. Where possible, low flows will be delivered at the upper end of the recommended range and for longer durations under average and wet climate scenarios, to provide more habitat and food to help grow waterbug, fish and platypus populations and to exclude terrestrial vegetation from the main channel. Low-flow requirements are expected to be met by passing flows and consumptive water orders during the irrigation season, but water for the environment will likely be needed to meet minimum low-flow targets to support fish movement between mid-April and mid-August, when water from the upper catchment is harvested to fill Lake Glenmaggie.

Under drought and dry climate scenarios, low inflows to Lake Glenmaggie may trigger reduced operational passing flows any time over summer and autumn. While maintaining low flows of at least 60 ML per day is the target under all scenarios, under this circumstance potentially large volumes of water for the environment would be required to meet this target continuously, which is unlikely to be possible with available supply. As a result, the low-flow target may be allowed to drop to 40 ML per day for five to 13 days at a time. Water quality would be regularly monitored in this situation, and where necessary water for the environment may also be used to deliver summer/autumn freshes to avoid a serious water quality outcome and loss of environmental values.

Delivering at least one fresh of 350 ML per day in autumn and 700 ML per day in spring (both for five days) is a high priority under all climate scenarios, to provide a migration trigger for native fish to move into or out of the system to complete their life cycles. An additional 700 ML per day fresh may also be delivered in late autumn or winter to further trigger fish migration, where water availability allows: most likely under dry and average climate scenarios. Over summer and autumn, at least one smaller-magnitude fresh will likely be delivered under drought and dry climate scenarios, to maintain water quality over the warmer months, with additional events possible under average and wet climate scenarios. Several other large freshes are recommended to slow the recession following a spill from Lake Glenmaggie or to cue additional fish movement in autumn/winter, but they are a lower priority and will need to be at least partly met via operational releases under most scenarios.

Under all climate scenarios, a minimum of 1,900 ML is prioritised for carryover into 2022-23, to meet critical early-season low-flow requirements in *Wirn wirndook Yeerung* (Macalister River).

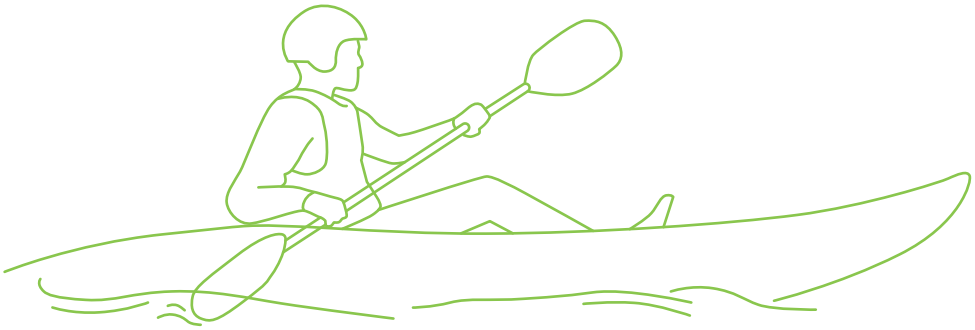


Table 2.4.2 Potential environmental watering for *Wirn wirndook Yeerung* (Macalister River) under a range of planning scenarios

Planning scenario	Drought	Dry	Average	Wet
Expected river conditions	• No natural flow • Passing flows at Maffra Weir reduced	• Possible spills from Lake Glenmaggie in spring, minor flood levels may occur • Passing flows at Maffra Weir may be reduced	• Regular spills from Lake Glenmaggie in spring, minor to moderate flood levels may occur	• Large and frequent spills from Lake Glenmaggie, moderate to major flood levels may occur
Predicted supply of water for the environment	• 13,400 ML	• 16,700 ML	• 18,700 ML	• 23,200 ML
Potential environmental watering – tier 1 (high priorities)	**Tier 1a (can be achieved with predicted supply)**			
	• Spring/summer fresh (one fresh, between September to November at mid-duration [five days] but lower magnitude) • Spring/summer low flow (delivered at upper magnitude in November only, following fresh) • Trigger-based summer/autumn low flow • Summer/autumn fresh (one fresh, at lower duration) • Autumn fresh (one fresh) • Autumn/winter low flow (delivered at upper magnitude in April to August[1]) • One autumn/winter fresh	• Spring/summer fresh (one fresh, between September to November at mid-duration [five days] but lower magnitude) • Spring/summer low flow (delivered at upper magnitude in November only, following fresh) • Trigger-based summer/autumn low flow • Summer/autumn fresh (one fresh, at lower duration) • Autumn fresh (one fresh) • Autumn/winter low flow (delivered at upper magnitude in April to August[1]) • One autumn/winter fresh	• Spring/summer fresh (one fresh, between September to November at mid-duration [five days] but lower magnitude) • Spring/summer low flow (delivered at upper magnitude in November only, following fresh) • Summer/autumn freshes (three freshes) • Autumn fresh (one fresh) • Autumn/winter low flow (delivered at upper magnitude in April to August[1]) • Autumn/winter fresh (one fresh)	• Spring/summer fresh (one fresh, between September to November at mid-duration [five days] but lower magnitude) • Spring/summer low flow (delivered at upper magnitude in November only, following fresh) • Summer/autumn freshes (three freshes) • Autumn fresh (one fresh) • Autumn/winter low flow (delivered at upper magnitude in April to August[1]) • Autumn fresh (one fresh)

Table 2.4.2 Potential environmental watering for *Wirn wirndook Yeerung* (Macalister River) under a range of planning scenarios *(continued)*

Planning scenario	Drought	Dry	Average	Wet
	Tier 1b (supply deficit)			
	• Spring/summer low flow (upper magnitude continuous) • Autumn/winter fresh (one fresh) • Autumn/winter low flow (upper magnitude continuous)	• Spring/summer low flow (upper magnitude continuous) • Autumn/winter low flow (upper magnitude continuous)	• One additional spring/summer fresh (at upper magnitude) • Spring/summer low flow (upper magnitude continuous) • Autumn/winter low flow (upper magnitude continuous)	• Winter/spring low flow (upper magnitude) • One additional spring/summer fresh (at upper magnitude) • Spring/summer low flow (upper magnitude continuous) • Autumn/winter low flow (upper magnitude continuous)
Potential environmental watering – tier 2 (additional priorities)	• N/A			
Possible volume of water for the environment required to achieve objectives	• 11,100 ML (tier 1a) • 10,000 ML (tier 1b) • 0 ML (tier 2)	• 16,300 ML (tier 1a) • 5,300 ML (tier 1b) • 0 ML (tier 2)	• 18,800 ML (tier 1a) • 8,500 ML (tier 1b) • 0 ML (tier 2)	• 21,400 ML (tier 1a) • 38,200 ML (tier 1b) • 0 ML (tier 2)
Priority carryover requirements	• 1,900 ML			

1 Otherwise deliver at 60 ML per day (passing flow rate).

2.5 Snowy system

Waterway managers – East Gippsland Catchment Management Authority and New South Wales Department of Planning, Industry and Environment

Storage manager – Snowy Hydro Limited

Environmental water holders – Victorian Environmental Water Holder, New South Wales Department of Planning, Industry and Environment

Did you know...?

The Snowy River is a popular spot for whitewater rafting, canoeing and kayaking. Most flows from the upper Snowy River catchment are captured in lakes Eucumbene and Jindabyne. Environmental flows released from Lake Jindabyne provide important paddling opportunities that are no longer available from natural flows.

Top: Snowy River, by East Gippsland CMA
Above: Great egret, by Keith Ward

System overview

The Snowy River originates on the slopes of Mount Kosciuszko. It drains the eastern slopes of the Snowy Mountains in New South Wales before flowing through the Snowy River National Park in Victoria and into Bass Strait (Figure 2.5.1).

There are four major dams and multiple diversion weirs in the upper Snowy River catchment that capture and divert water to the Murrumbidgee and Murray River valleys. The hydrological effects of the Snowy Mountains Scheme are substantial, but they are partly alleviated by the contribution of flows from tributaries (such as the Delegate River in NSW and the Buchan and Brodribb rivers in Victoria).

The construction and operation of the Snowy Mountains Hydro-electric Scheme previously diverted 99 percent of the Snowy River's mean annual natural flow at Jindabyne. The loss of flow changed the structure and function of the river, reduced the opening of the Snowy River entrance to Bass Strait and resulted in a decline in environmental values.

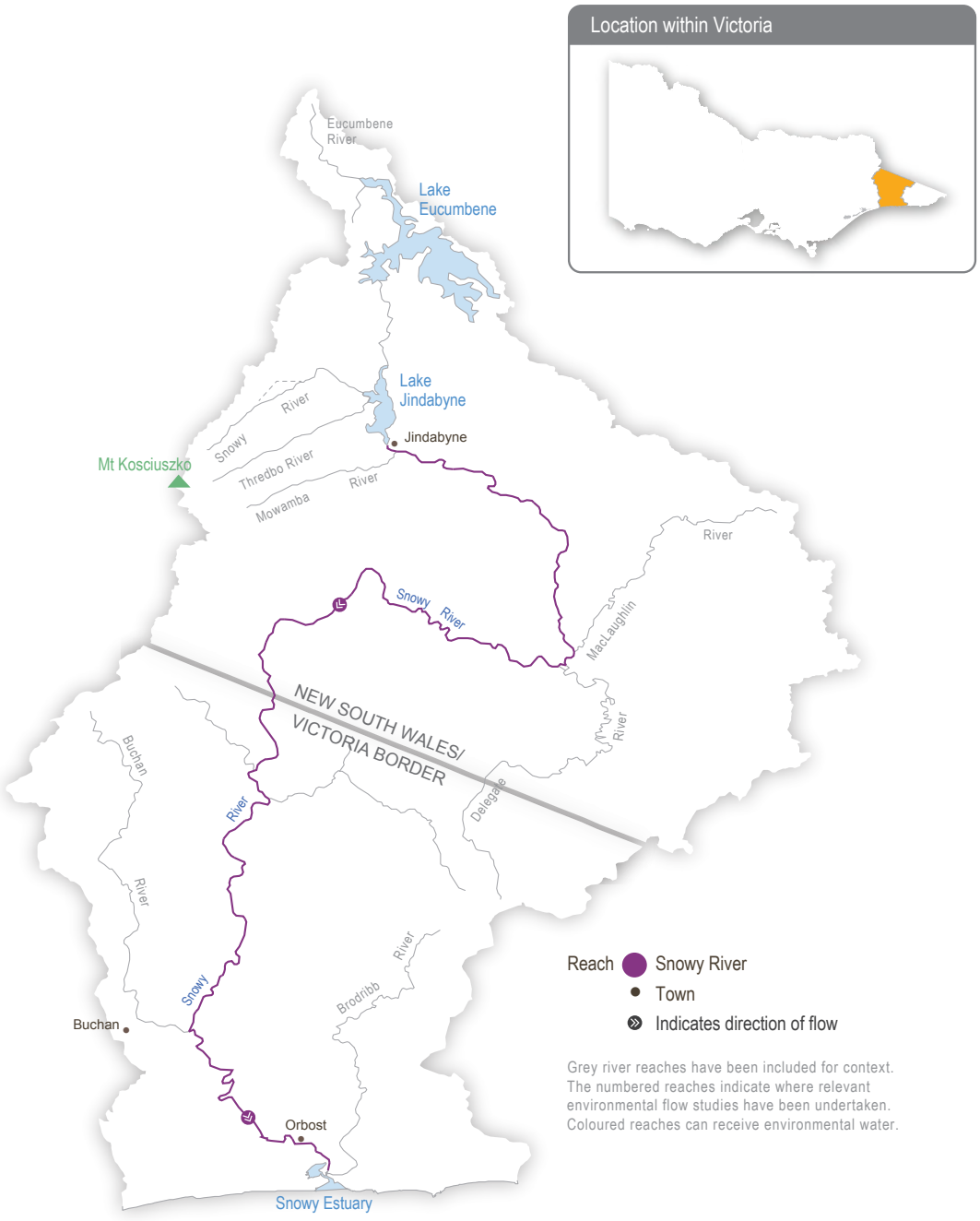
The Victorian, NSW and Commonwealth governments agreed to recover some of the water and in 2002 delivered this first environmental flow to the Snowy River below Jindabyne Dam to help restore the damage done by decades of limited flow. The Victorian share of water for the environment available for use in the Snowy system is held in the Victorian Murray, Goulburn and Loddon systems. The NSW share of water for the environment available for use in the Snowy system is held in the NSW Murray and Murrumbidgee systems. Collectively, the water is made available for environmental flows in the Snowy River via a substitution method, whereby water for the environment allocated in Victoria and NSW replaces water that was earmarked for transfer from the Snowy to Victoria and NSW to support irrigation demands. The NSW Department of Planning, Industry and Environment plans environmental flow releases in the Snowy River in consultation with the Snowy Advisory Committee. The committee includes representatives of the Aboriginal community, local community, the Victorian Government, NSW Government, and environmental experts. The committee brings together local knowledge and expert advice to help inform the management and delivery of water for environmental outcomes.

Water for the environment is delivered daily to the Snowy River below Jindabyne Dam. The annual allocation of water for the environment varies based on water availability, rainfall and inflows. At most, it is equivalent to 21 percent of what the average annual natural flows were before the construction of the Jindabyne Dam.

Environmental values

Environmental values in the upper reaches and tributaries of the Snowy River include freshwater fish (such as river blackfish and Australian grayling). The lower reaches support estuary perch and Australian bass that move between saltwater and freshwater systems. The estuary contains estuarine and saltwater species such as flathead and black bream. The floodplain wetlands of the Snowy River near Marlo provide feeding and breeding areas for wetland and migratory birds.

Figure 2.5.1 The Snowy system



Recent conditions

While dry conditions were observed in late autumn and early winter 2020, above-average rainfall was recorded in the Snowy River catchment over late winter, shifting to average conditions over spring. Summer storms brought about by La Niña conditions resulted in very much above-average rainfall across the catchment, and a minor flood occurred in March 2021. Water availability for environmental flows in the Snowy River is determined by allocations in the Murray, Goulburn, Loddon and Murrumbidgee rivers. In 2020-21, water availability for the Snowy River was relatively low, due to dry conditions in 2019-20. Total water allocated for environmental releases was 91,476 ML[1], which was among the lowest allocations received since 2011. For comparison, 117,871 ML was released in 2019-20.

The water year in the Snowy system runs from 1 May to 30 April, and the daily flow regime is planned in advance by the Snowy Advisory Committee. Relatively small peak magnitudes for high flows and shorter durations for freshening flows were delivered from Lake Jindabyne in 2020-21 because of reduced water availability. Four winter/spring high-flow events were released (one less than in 2019-20), and a flushing flow occurred in September 2020, although it had a limited effect on the flow in Victoria. In the lower Snowy River within Victoria, several peaks over winter and again in October were observed, which was likely from a combination of the upstream environmental flow releases and contributions from major tributaries within Victoria (such as the Buchan River). Wetter conditions and consistent inflows into storages throughout the Murray-Darling Basin in 2020-21 will significantly boost allocation for Snowy River environmental releases in 2021-22.

East Gippsland CMA has monitored the lower reaches of the Snowy River and its estuary for the past nine years. Their results indicate that the managed environmental flows help improve physical and ecological processes, increase ecosystem productivity and improve aquatic habitat. Extensive bushfires in December 2019 and January 2020 affected most of the Snowy catchment. Although rivers and streams had poor water quality, particularly after heavy rain events, the prevailing conditions have provided good growing conditions for natural vegetation to regenerate. It will take years for the catchment to recover from impacts of this scale.

Scope of environmental watering

The total volume available for release to the Snowy River in 2021-22 is 209,577 ML. This is one of the highest allocations of water for the environment made available for the Snowy River.

Due to operating rules in the system, the daily flow regime that will be delivered in 2021-22 is pre-planned: the storage manager will make daily releases of varying magnitude from Lake Jindabyne between May 2021 and April 2022 to mimic the typical flow pattern of a mixed snowmelt/rainfall river system characteristic of the Snowy Mountains. A 'natural flow scaling' approach is applied and the continuous daily releases aim to support ecological processes in the Snowy River below Jindabyne Dam and maintain a healthy river that is much smaller than the natural channel that existed before the river was regulated.

Following several years of dry conditions, the increased water availability for the environment allows for a larger number of high-flow releases in 2021-22, with greater peak magnitudes. The flow pattern is similar to previous years and mimics a snowmelt river with higher flows during winter and spring. Nine high-flow releases are scheduled between June and November 2021. These include a large flushing flow in October 2021 that has a target peak flow rate equivalent to 10,362 ML per day, which will be held for about eight hours to flush sediment and wet high benches and backwaters. Other peak flows will mimic winter rainfall and spring snowmelt events. Collectively, the multiple high-peak flows of the planned regime aim to improve the physical attributes of the river by scouring and depositing sediment and improving in-stream habitat for native fish, platypus, frogs and waterbugs. Moderate to high flow rates will be sustained from July to December, helping to mix water in the estuary to benefit plants and fish (such as Australian bass). Lower flow rates will be maintained from December or January until the end of the water year in April 2022.

For further information, visit the NSW Department of Planning, Industry and Environment's Water for the environment website: https://www.environment.nsw.gov.au/topics/water/water-for-the-environment/snowy-and-montane

1 The actual release volume that was delivered in 2020-21 may alter slightly due to accounting adjustments and will be verified in Snowy Hydro Limited's Annual Water Operating Plan.