West Gippsland
Catchment Management Authority

West Gippsland Seasonal Watering Proposal 2021-22

Acknowledgement of Country

The West Gippsland Catchment Management Authority (WGCMA) would like to acknowledge and pay our respects to the Traditional Landowners and other indigenous people within the catchment area: the Gunaikurnai people. We also recognise the contribution of Aboriginal and Torres Strait Islander people and organisations in land and natural resource management.

Cover photo:

Sale Common looking south (Nov 2020)

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Management

Organisation: West Gippsland Catchment Management Authority
Author(s): Stephanie Suter & Adrian Clements

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West Gippsland Seasonal Watering Proposal 2021-22

List of Acronyms and terms

AHD	Australian Height Datum
BoM	Bureau of Meteorology
DELWP	Department of Environment, Land, Water and Planning
EE	Environmental Entitlement
ENSO	El Niño/La Niña Southern Oscillation
EWAG	Environmental Water Advisory Group
GL	Gigalitre
LEWRI	Latrobe Environmental Water Requirements Investigation
ML	Megalitre
MW	Melbourne Water
PAG	Project Advisory Group
SRW	Southern Rural Water
VEWH	Victorian Environmental Water Holder
Water year	Year starting on the 1st of July
WGCMA	West Gippsland Catchment Management Authority

Executive Summary

The purpose of the document is to present the proposed watering actions and priorities for the four environmental water entitlements in West Gippsland for the 2021-2022 water year. Namely, the Latrobe River environmental water entitlement held in Bluerock Reservoir, the Thomson River environmental water entitlement held in the Thomson Reservoir, the Macalister River environmental water entitlement held in Lake Glenmaggie, and the Lower Latrobe Wetland environmental water entitlement (covering Dowd Morass, Heart Morass and Sale Common).

The objectives, scenarios and associated potential watering actions in this proposal were written taking into consideration the best available ecological and natural resource management science and the long-term environmental objectives for the rivers and wetlands. Also considered are the past and forecast seasonal conditions, and ongoing environmental monitoring which inform adaptive management in each of the systems. Various stakeholders including landholder and community group representatives, Traditional Owners, Southern Rural Water, Melbourne Water, Parks Victoria, Field and Game Australia, and the Victorian Environmental Water Holder have been engaged during the preparation of these proposals. The risks associated with implementing the proposal have been identified through consultation with various stakeholders and appropriate mitigation strategies have been identified.

The seasonal watering proposals for each system have been combined into this single document to demonstrate the landscape scale adaptive management used when managing water for the environment in West Gippsland.

The expected water availability for each system and the associated storage operator and land managers are shown in Table 1.

Table 1-1 Summary of the expected water availability at the beginning of 2021-22 water year and the waterway, storage and land managers for each environmental water entitlement

System Name	**Latrobe River**	**Thomson River**	**Macalister River**	**Lower Latrobe Wetlands**
Expected water availability. (July 1st, 2021)	18 GL*	26 GL*	22 GL*	N/A
Waterway Manager	West Gippsland Catchment Management Authority			
Storage Operator(s)	Southern Rural Water & Melbourne Water			N/A
Land Manager(s)	N/A			Parks Victoria & Field and Game Australia

*these values are estimates based on April 2021 assessment.

Environmental Objectives

The broad, system scale objectives identified for the Latrobe River, Thomson River, Macalister River and lower Latrobe Wetlands are summarised in Table 10-2:

Table 11-2 Summary of the system scale environmental objectives for each environmental water entitlement

Value	Latrobe River	Thomson River	Macalister River	Lower Latrobe Wetlands
Fish 	Maintain or improve fish (migratory, resident and estuary) and eel populations	Maintain/enhance native fish community structure	Increase the distribution and abundance of all native fish species and improve spawning and recruitment opportunities for migratory species	
Macroinvertebrates 	Improve abundance of all macro- and micro-invertebrates	Restore or maintain the natural macroinvertebrate and microinvertebrate community	Increase the abundance and number of functional groups of macroinvertebrates	
Birds, turtles, frogs and reptiles 	Improve extent of frog populations and maintain refuge habitat Maintain abundance of freshwater turtle populations	Maintain populations of birds, turtles, frogs and reptiles	Maintain the abundance of frog, turtle, and waterbird communities	Maintain/ enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities Maintain abundance of freshwater turtle and frog populations

Value	Latrobe River	Thomson River	Macalister River	Lower Latrobe Wetlands
Platypus and rakali 	Maintain or improve extent of platypus and rakali populations	Increase the abundance of platypus	Increase the abundance of platypus and rakali	
Vegetation 	Improve condition, extent and diversity of submerged, emergent and riparian vegetation or control invasive species	Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity	Improve native emergent and fringing vegetation Re-instate submerged aquatic vegetation.	Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species
Geomorphology 	Maintain or improve instream geomorphic diversity	Maintain or enhance physical form and functioning of the stream bed	Improve physical habitat	
Connectivity 	Provide freshwater to the Latrobe estuary and lower Latrobe wetlands (requires contribution from Thomson catchment)	Maintain and improve in-stream habitat diversity and connectivity		
Water quality 	Avoid adverse water quality conditions			Provide suitable physio-chemical conditions to support aquatic biota including Acid Sulfate Soil inundation
Critical Watering 				Provide critical watering or drawdown to avoid catastrophic conditions

Potential Watering Actions

Table 10-3 summarises the highest priority watering actions for each of the river and wetland systems for 2021-22.

Table 11-3 Summary of the highest priority watering actions for each environmental water entitlement

River/Wetland	Flow Component	Primary Ecological Objectives
Latrobe River	Summer-Autumn low flow	Providing longer durations of freshwater to the upper part of the water column in the estuary
	Summer-Autumn fresh (fish and vegetation)	Reduce terrestrial vegetation encroachment and flush sediments from pools Coinciding with flows in the Thomson and Macalister to maximise benefits for fish migration, provide environmental benefit in the Latrobe Estuary, and provide freshwater for the lower Latrobe Wetlands
Thomson River	Autumn fresh	Provides a trigger for downstream migration and spawning of Australian grayling
	Spring fresh	Encourages recruitment of juvenile migratory native fish species from estuarine/marine habitats, particularly Australian grayling.
	Autumn-Winter fresh	Provides a trigger for fish migration, specifically for species such as tupong and Australian bass
	Summer-Autumn fresh	Provide fish passage during the dry season to enable movement of fish and other fauna into available habitats.
	Winter-Spring low flow	Winter-Spring low flows provide important longitudinal connectivity and enable fish and other fauna to move freely between habitats. This is particularly important during this time as it is considered the juvenile recruitment period for native diadromous species, such as Australian grayling and tupong
	Autumn-Spring deliveries to Heyfield Wetlands	Provides growth and establishment opportunities for aquatic vegetation, and habitat for wetland bird and frog species.
Macalister River	Autumn fresh	Provides a trigger for downstream migration and spawning of Australian grayling.
	Autumn-Winter low flow	Provides fish passage for migratory species completing (i.e. Australian grayling) or about to complete (i.e. Tupong, Australian bass) migration
	Spring-Summer low flow	Provides complete longitudinal connectivity, allowing for aquatic biota to move between different habitats
	Winter fresh	Provides a flow trigger for the downstream migration of fish species, such as Tupong and Australian bass
	Spring fresh	Provides a flow trigger for the upstream migration of adult and juvenile migratory fish species.
Lower Latrobe Wetlands	Partial fill (**Sale Common**)	Provides conditions suitable for vegetation growth and flowering, bird breeding, foraging and nesting
	Urgent fill and urgent drawdown (anytime) (**All**)	To manage unexpected or out of season events which may lead to catastrophic conditions
	Partial fill (**Dowd Morass**)	Minimises saltwater inflow from Lake Wellington and provides conditions suitable for vegetation growth and flowering, bird breeding, foraging and nesting
	Partial fill (**Heart Morass**)	Provides conditions suitable for vegetation growth and flowering, bird breeding, foraging and nesting

River/Wetland	Flow Component	Primary Ecological Objectives
	Fill (**Sale Common**)	Provides conditions suitable for vegetation growth and flowering, bird breeding, foraging and nesting

East Gippsland Fires

Given the population dynamics of migratory fish species, such as Australian grayling who migrate out to the ocean, the larger fish population will have been greatly impacted by the 2019 East Gippsland fires and related water quality issues. This raises the importance of flow deliveries targeted at migratory fish migration, spawning and recruitment with the Thomson, Macalister and Latrobe rivers. At a landscape scale, this region is highly likely to become an important refuge for fish species and a potential source for population recovery.

Fish surveys in March 2021 recorded a large-scale recruitment event of tupong in the Thomson, Macalister and Latrobe rivers. This recruitment event has seen large numbers of young-of-year tupong enter our river systems. This makes all flows related to fish migration, spawning, recruitment and refuge protection high priority watering actions for delivery under all climate scenarios.

Risk Assessment and Management

Potential risks arising from the implementation of the 2021- 22 seasonal watering priorities were assessed and risk tables developed during the Gippsland Risk Planning Workshop in February 2021. Risks and mitigation strategies for each system are provided in section 6.

Engagement

Table 11-4 summarises the engagement that has occurred in the development of the West Gippsland Seasonal Watering Proposal for 2021-22.

Table 11-4 Partners and stakeholders engaged by West Gippsland CMA in developing seasonal watering proposals for the Latrobe River, lower Latrobe wetlands, Thomson River and Macalister River systems and other key foundation documents that have directly informed the proposals

Who	Latrobe River	Lower Latrobe wetlands	Thomson River	Macalister River
Community groups and environment groups	**IAP2 level: Inform** • Greening Australia • Latrobe Valley Field Naturalists • Native Fish Australia	**IAP2 level: Inform** • Greening Australia • Latrobe Valley Field Naturalists • Native Fish Australia	**IAP2 level: Involve** • Heyfield Wetlands Committee • Cowwarr Landcare Group • Waterwatch volunteers **IAP2 level: Inform** • Landcare groups • Birdlife Australia	**IAP2 level: Involve** • Environment Victoria • Maffra and districts Landcare network • Native Fish Australia

Who	Latrobe River	Lower Latrobe wetlands	Thomson River	Macalister River
Government agencies	**IAP2 level: Collaborate** • VEWH • Parks Victoria • Southern Rural Water	**IAP2 level: Collaborate** • VEWH • Parks Victoria	**IAP2 level: Collaborate** • VEWH • Melbourne Water • Southern Rural Water	**IAP2 level: Collaborate** • VEWH • 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 - Water and Catchments	**IAP2 level: Involve** • Gippsland Water
	IAP2 level: Inform • Department of Land, Environment, Water and Planning (Latrobe Valley Regional Water Study) • Department of Land, Environment, Water and Planning (Waterways and Catchments) • East Gippsland CMA	**IAP2 level: Inform** • Department of Land, Environment, Water and Planning (Latrobe Valley Regional Water Study) • Department of Land, Environment, Water and Planning (Waterways and Catchments) • East Gippsland CMA		
Landholders/ farmers	**IAP2 level: Inform** • Individual landholders	**IAP2 level: Collaborate** • Field and 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 River Cruises	**IAP2 level: Inform** Port of Sale Heritage River Cruises		
Recreational users	**IAP2 level: Inform** • VRFish • Field and Game Australia	**IAP2 level: Collaborate** Field and Game Australia (Dowd Morass and Sale Common)	**IAP2 level: Involve** • Tourism operators • VRFish	**IAP2 level: Involve** VRFish
		IAP2 level: Inform VRFish		

Who	Latrobe River	Lower Latrobe wetlands	Thomson River	Macalister River
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: Collaborate** Gunaikurnai Land and Waters Aboriginal Corporation

Table of Contents

1. Introduction

This seasonal watering proposal outlines the West Gippsland Catchment Management Authority's (WGCMA) proposed priorities for use of environmental water within the Lake Wellington catchment. This is as per the requirements under section 192A of the *Water Act 1989* and is a priority of the West Gippsland Waterway Strategy (WGCMA, 2014). This proposal covers the four environmental entitlements managed on behalf of the Victorian Environmental Water Holder (VEWH), by the WGCMA. These entitlements are for the Latrobe River, Thomson River, Macalister River, and the Lower Latrobe wetlands.

Potential watering actions and environmental objectives for the Latrobe, Macalister and Thomson rivers are informed by flow recommendations and objectives, derived from the Latrobe Environmental Water Requirements Investigation (LEWRI)(Alluvium, 2019), the Macalister River Environmental Flows Review (Alluvium, 2015) and the Thomson River Environmental Flows and Management Review (Streamology, 2020). Where meaningful, this proposal also includes watering requirements specific to the Latrobe Estuary. Although the estuary does not have a specific entitlement, it benefits from all river flows of the Thomson, Macalister, and Latrobe.

This proposal will be used by the VEWH to inform the development of the Seasonal Watering Plan 2021-22. The plan will outline the full scope of state-wide priorities for use of environmental water, including the West Gippsland catchment environmental entitlements. Environmental water in the Latrobe, Thomson and Macalister rivers will be used to protect and enhance the ecological health of their respective waterways. Where applicable, coordinated management of the three river entitlements will also be used to protect and enhance the Lower Latrobe Wetlands and the Latrobe Estuary. The extent to which this is achieved will be governed by the amount of water available and the relevant climatic scenario.

Climatic conditions and system regulation strongly influence river flows, and thereby the opportunities and need to actively manage environmental water. Flexibility is built into this proposal to enable adaptive management.

1.1 Proposal Outline

This document outlines the proposed annual watering priorities, actions and objectives for the Latrobe, Thomson, and Macalister rivers for 2021-22. It also outlines the proposed watering priorities, actions and objectives of the Lower Latrobe Wetlands, Heyfield wetlands and the Latrobe estuary.

Overview, catchment and climate observation information are combined in the introductory chapter, Section 1. Details specific to each system will be outlined in subsequent sections, to reflect the individual systems and their entitlements.

Risk management, engagement details, shared benefit details and knowledge gap details are documented at a catchment scale and presented in Sections 6 and 7.

WGCMA and storage operator approval and endorsement sections for each system are presented in Section 8.

References and appendices are presented in the final sections 9-10.

1.2 Landscape overview – Lake Wellington catchment

The Lake Wellington catchment extends from Lake Wellington to the slopes of the Great Dividing and Strzelecki Ranges. It includes almost 1.2 million hectares of land in the catchments of Latrobe, Thomson, Macalister and Avon Rivers and runs from Noojee and Warragul in the west to Stratford in the east. Lake Wellington is the most westerly of the Gippsland Lakes and forms part of the Gippsland Lakes Ramsar site, a wetland complex of international conservation significance. Three of the four major rivers in the catchment are regulated (Latrobe Thomson and Macalister rivers) and each have an environmental water entitlement. A fourth environmental water entitlement is held to divert water to the lower Latrobe wetlands (Dowd Morass, Heart Morass and Sale Common) (Figure 1-1).

Figure 1-1 Map of the Lake Wellington Catchment, with environmental water receiving rivers and wetlands highlighted (dark blue)

1.2.1 Latrobe River

The Latrobe River catchment drains the Baw Baw Plateau (1,500 m elevation) and flows into Lake Wellington. The Latrobe River itself extends 242 km from just east of Powell Town in west Gippsland to just east of Sale in central Gippsland. Notable tributaries include the Tanjil River and Narracan Creek, Morwell River, Tyers River, Traralgon Creek and the Thomson River (Figure 1-2).

The Latrobe River system is one of the most significantly modified river systems in Victoria outside of major urban areas (EarthTech, 2005). It is viewed as a working river, reflecting the significant past, present and future pressures and expectations placed upon it along its

length (Alluvium, 2009). Large areas of the catchment have been cleared for agriculture, and major industrial, mining and power generation activities heavily impact the Latrobe River and some of its tributaries. The Latrobe River channel has undergone significant de-snagging and straightening, resulting in a loss of about 25% of its length in the mid and lower reaches (Reinfelds & Rutherfurd, 1995), consequential accelerated bank erosion, deepening and widening of the river channel and associated loss of ecological function (Sinclair Knight Merz, 2009). Other major changes include: floodplain drainage, channelisation of the lower reaches of the Moe and Morwell Rivers, incision of some tributaries, regulation of major tributaries (EarthTech, 2005), and ongoing stock grazing and water extraction (33% of average annual flows, including the Thomson River) (Tilleard, 2009; Tilleard & Ladson, 2010). The estimated environmental flow shortfall in the Latrobe River prior to the establishment of an environmental entitlement in Blue Rock Reservoir was 37 GL/yr on average (Alluvium, 2009). This figure was reviewed in line with the updated flow recommendations to range between 7.5 GL/yr in reach 5 to 88.9 GL/yr in reach 3 (annual average under full uptake and baseline climate conditions (Alluvium, 2020a)

The Latrobe River system does however retain many significant environmental values: the upper Latrobe River is ecologically healthy and endangered and vulnerable riparian vegetation communities exists in all but the most modified reach (reach 4) that flows through the Latrobe Valley; the river supports numerous fauna species of high conservation significance including fish and birds; and it provides an essential source of freshwater to the Ramsar listed Gippsland Lakes system (44% of annual average inflows, including the Thomson River), of which the lower Latrobe wetlands are an important part.

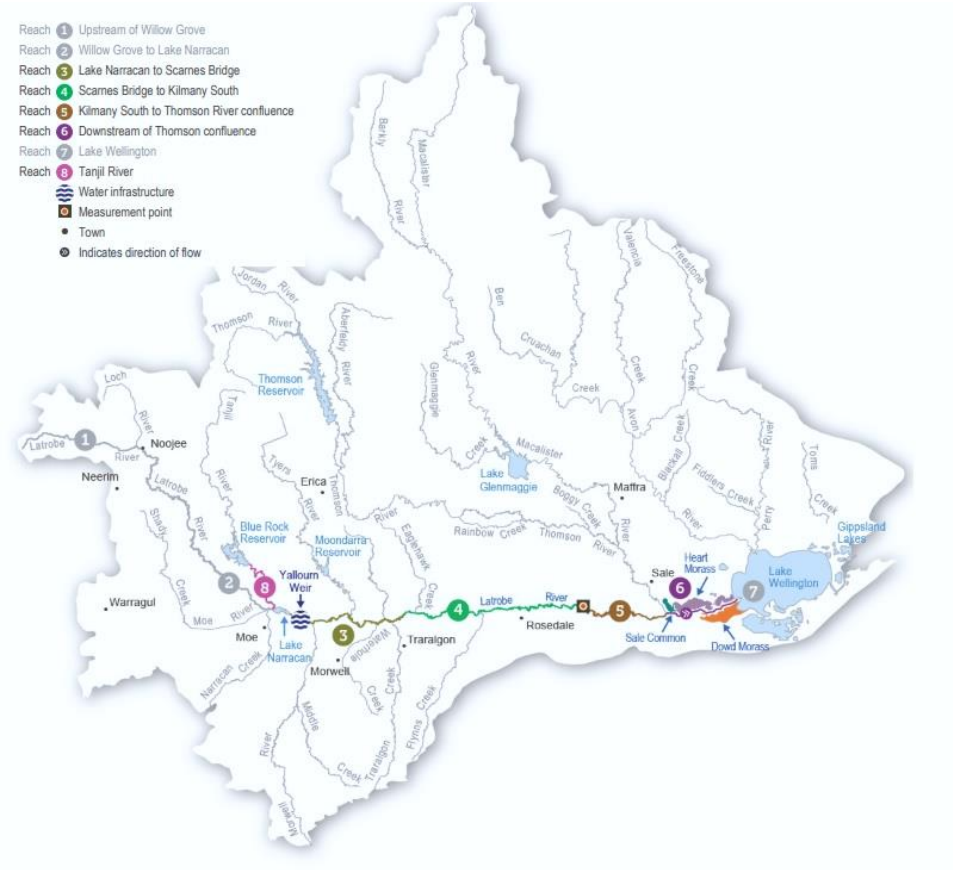


Figure 1-2 Map of the Latrobe River and tributaries with associated reach numbers

1.2.2 Thomson River

The Thomson River catchment drains an area of 1,522 km^2 extending from Mt Gregory (1,011 m) to Sale, where it joins the Latrobe River. It receives inflows from the Aberfeldy River and Jordon River in the upper reaches, and the Macalister River in the lowest reach. Two major structures exist on the Thomson River: Thomson Reservoir (the major potable water storage for metropolitan Melbourne) and Cowwarr Weir (a regulating structure providing irrigation water to the Macalister Irrigation District). Environmental water is managed via water holdings held in the Thomson Reservoir.

The Thomson River has been divided into 6 major reaches (see Figure 1-3). Hydrologic compliance is assessed at two locations: Reach 3 at Coopers Creek gauge (225208) and Reach 6 at Bundalaguah gauge (225232). From Reach 3, the Thomson passes through Cowwarr Weir. This marks a major regulation point, with flows divided between Reach 4a and 4b (the 29 km Thomson channel, and the shorter 14 km anabranch of Rainbow Creek) and an irrigation channel off-take. Rainbow Creek and the Thomson River converge again near Heyfield.

The Thomson River is one of a network of coastal rivers across Gippsland and south-eastern Australia that sustains populations of nationally significant migratory fish species, including the Australian grayling (EPBC-listed), tupong and Short- and Long-finned eel.

Reach 3 (from Aberfeldy River to Cowwarr Weir) has heritage river status, with largely intact native riparian vegetation communities and fish populations, including the protected Australian grayling. Reach 6 is also used to assess the continuity of environmental flow releases down the system and is a known spawning location for Australian grayling.

The recent completion of the Horseshoe Bend fishway reconnects the Thomson with upstream reaches in the Victorian Alpine bioregion, unlocking an additional 22 km of waterway to fish passage, as well as access to an additional 64 km of the Aberfeldy River.

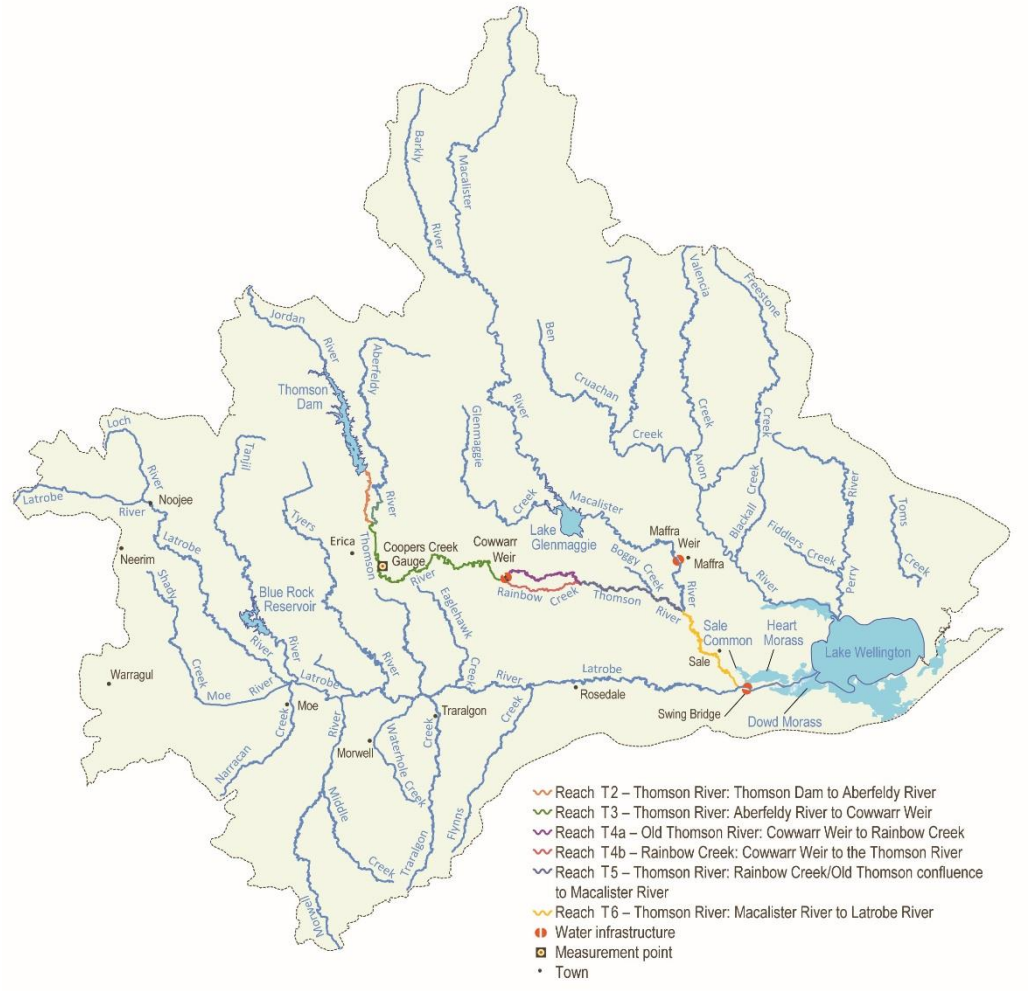


Figure 1-3. Map of the Thomson River and tributaries with associated reaches

Located adjacent to the Thomson River is the Heyfield wetlands, a site jointly managed by DELWP and the Heyfield Wetlands Committee of Management. After being used for multiple recreational purposes, the area has been converted to a functioning wetland.

The initial objective of re-establishing Heyfield wetlands was to filter stormwater and agricultural run off before it entered the Thomson River. This initiative assisted in decreasing the levels of turbidity and reducing the nutrient load entering the river and ultimately entering the Ramsar-listed Gippsland Lakes. As the site has been developed, it now hosts walking trails, interpretative signage, a visitor information centre, and extensive areas of native plantings (both terrestrial and aquatic).

The wetlands are deemed an important environmental feature of the area as the surrounding land is used for industrial and agricultural purposes with nearby rivers harvested for irrigation. The Heyfield wetlands serve as a refuge for wetland and migratory bird species, a feature which is lacking in the immediate surrounding landscape. Since 2019, this site has also received environmental water deliveries to support vegetation and habitat objectives.

1.2.3 Macalister River

The Macalister River drains from a catchment area of 2,330 km^2, beginning in the southern slopes of the Great Dividing Range below Mt Howitt, through to its confluence with the

Thomson River upstream of Sale. It receives inflows from Wellington River and Glenmaggie Creek. The river is regulated by two in-stream structures: Lake Glenmaggie (190 GL at full capacity) and Maffra weir (~ 500 ML diversion weir).

The cleared floodplains surrounding the lower Macalister River are part of the Macalister Irrigation District (MID). This is a 53,000 hectare irrigation district; the largest south of the Great Dividing Range. Over half of the MID is irrigated land, with 90% dedicated to pasture. The Macalister River is the main source of irrigation water for the MID, as well as a potable water supply for Gippsland Water.

The Macalister River has been divided into 2 major reaches (see Figure 1-4); downstream of Lake Glenmaggie to Maffra weir (Reach 1); downstream of Maffra weir to the Macalister-Thomson river confluence (Reach 2). The *Macalister River Environmental Entitlement 2010* (herein, the Macalister River EE) utilises storage capacity in Lake Glenmaggie. Hydrologic compliance is monitored at three locations: Lake Glenmaggie tailwater (225204), Maffra weir tailwater (225242A) and Riverslea (225247). The compliance point selected is dependent on the underpinning target ecological objective. Streamflow at these locations is also considered during the annual planning process.

Reach 2 contains a greater abundance and diversity of fish species compared to Reach 1, particularly for the six migratory species, including Australian grayling, tupong and Common galaxias. This is attributable to the presence of Maffra Weir, and its downstream knife-edge weir, which limit movement and act as a block to fish passage both into and out of Reach 1. Reach 1 offers high quality habitat, with a relatively continuous riparian zone, improved water clarity, sand-cobble substrate, and riffle-pool sequences. As such, re-establishing connectivity at Maffra Weir is expected to greatly improve the existing abundance, distribution, and diversity of native fish species in the lower Macalister River.

Figure 1-4. Map of the Macalister River and tributaries with associated reaches

1.2.4 Lower Latrobe wetlands

The lower Latrobe wetlands are situated along the Latrobe River between its confluence with the Thomson River and Lake Wellington (Figure 1-5 and Figure 1-6) and form part of the Gippsland Lakes Ramsar Site. The wetlands include: Sale Common (230 ha) and Heart Morass (1,870 ha) on the northern floodplain, and Dowd Morass (1,500 ha) on the southern floodplain. Sale Common and Dowd Morass are wholly Crown land reserves managed by Parks Victoria (PV). Heart Morass is comprised of Crown land (managed by PV) and private land. Nearly 60% of the Heart Morass is owned by the Wetlands Environmental Taskforce (WET) Trust.

Together, the lower Latrobe wetlands provide habitat for a diverse range of water-dependent species, especially plants, waterbirds and frogs, including threatened species and communities. Individually, each wetland provides a range of ecological benefits.

Sale Common is one of only two remaining freshwater wetlands in the Gippsland Lakes system and provides sheltered feeding, breeding and resting habitat for a very diverse range

of waterbirds for its relatively small size, particularly species that prefer densely vegetated freshwater and fish/frog feeders.

Dowd Morass is a large, brackish wetland that regularly supports an important rookery of colonial nesting waterbirds which can include White and Straw-necked ibis, Little Black and Little Pied cormorants, Royal Spoonbills and Great Egrets.

Heart Morass is also a large brackish wetland. Its open expanses provide shallow feeding habitat for large numbers of waterfowl including Black Swans, Eurasian Coots and numerous species of ducks, waders and other waterbirds.

Many of the fauna that these wetlands support are threatened, including some that are listed under the State's Flora and Fauna Guarantee (FFG) Act 1988, the Commonwealth's Environment Protection and Biodiversity Conservation (EPBC) Act 1999 or international agreements (Japan-Australia Migratory Birds Agreement (JAMBA), China-Australia Migratory Birds Agreement (CAMBA) and the Bonn Convention). For example:

- Great Egret (vulnerable in Victoria, FFG, JAMBA & CAMBA)
- Intermediate Egret (critically endangered in Victoria & FFG)
- Australasian Bittern (endangered in Victoria, FFG & EPBC (endangered))
- Royal Spoonbill (vulnerable in Victoria)
- White-bellied Sea-Eagle (vulnerable in Victoria, FFG, JAMBA & CAMBA)
- Dwarf Galaxias (vulnerable in Victoria, FFG & EPBC (vulnerable))
- Green and Golden Bell Frog (EPBC (vulnerable))
- Growling Grass Frog (endangered in Victoria, FFG & EPBC (vulnerable)).

The wetlands also contain vegetation types that are threatened in the Gippsland Plain Bioregion such as:

- Swamp Scrub (endangered)
- Brackish Herbland (rare)
- Aquatic Herbland (rare).

Culturally, the lower Latrobe wetlands were an important resource for the indigenous Gunaikurnai people. Dowd Morass is of high cultural significance with over thirty registered indigenous cultural heritage sites such as scarred trees, artefact scatters, earth features and shell deposits.

Figure 1-5 Map showing the locations of the lower Latrobe wetlands within the West Gippsland Catchment.

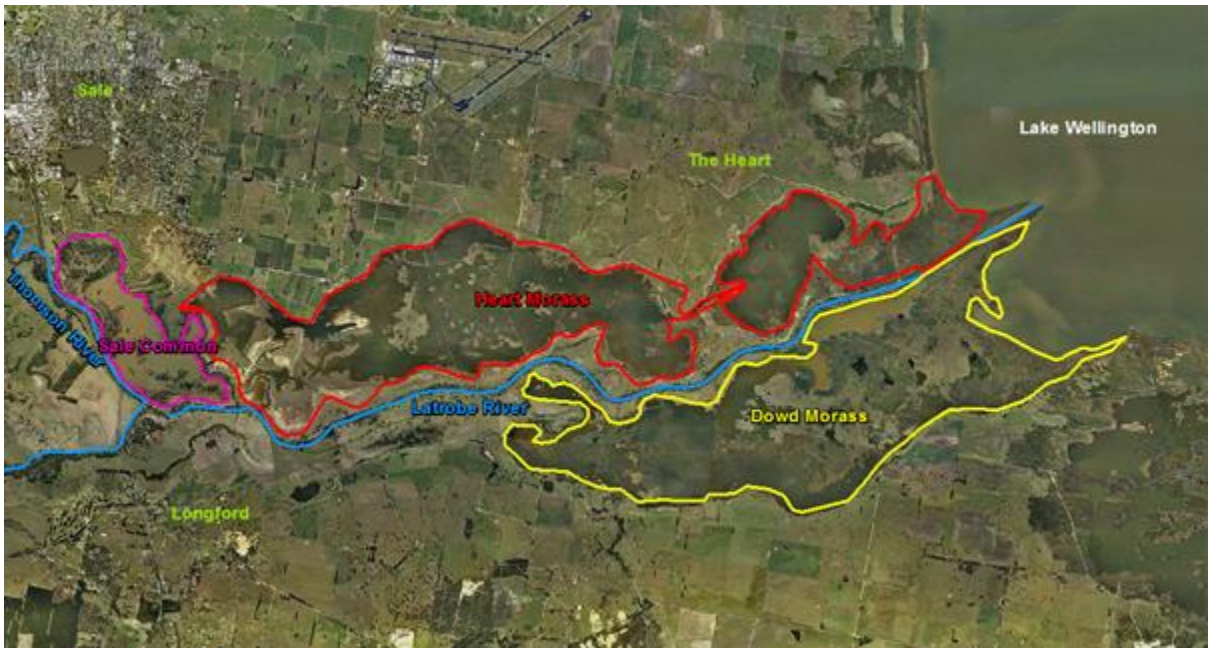
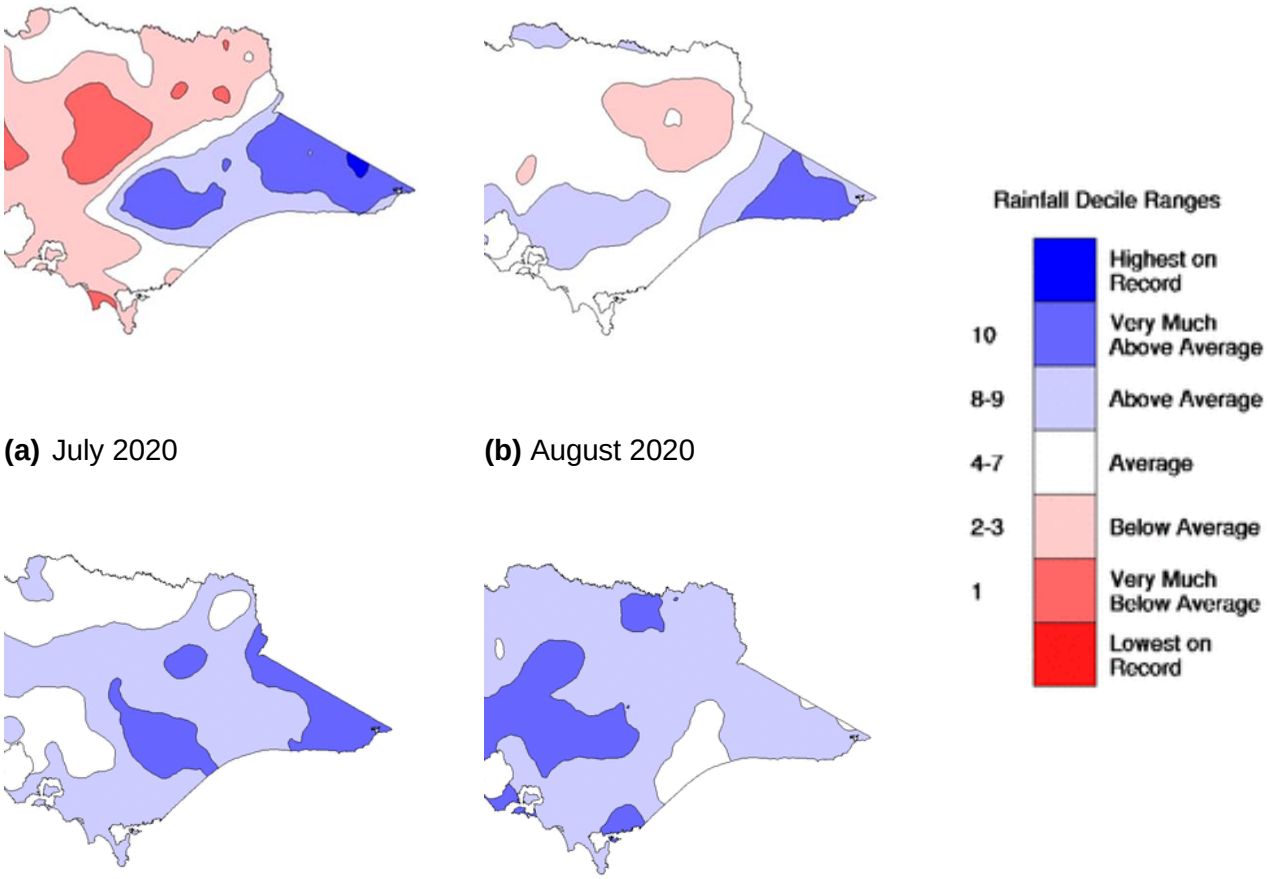


Figure 1-6 Satellite image showing the extent of Dowd Morass, Heart Morass and Sale common.

1.3 Climate review and Climate outlook

1.2.5 2020-21 Climate

The 2020-21 climate saw West Gippsland experiencing wetter than average conditions driven by a large scale La Nina event. Rainfall was average to above average through July-August across the catchment, with above average rainfall again in October 2020 and January 2021 (BoM, 2021)(Figure 1-7).



(a) July 2020 **(b)** August 2020

(c) October 2020 **(d)** January 2021

Figure 1-7 (a-d) Rainfall deciles for eastern Victoria 2020/21 (BoM, 2021)

Increased winter-spring rainfall was experienced across the whole Lake Wellington catchment and brought about consistently high river flows in the Latrobe, Thomson and Macalister rivers.

The Latrobe River experienced high flows for most of the year with sustained minor flooding in the lower reaches. Increased river flows, along with high rainfall also saw the lower Latrobe wetlands remaining full. Wetland water quality benefitted from this extensive flooding, with water quality for both Dowds Morass and Heart Morass staying close to fresh for most of the year, and Heart Morass maintained good pH values. Sale Common remained full due to consistent freshwater inflows, Lake Wellington is the freshest it has been since 2012.

The Thomson river experienced multiple natural freshes in the system early in the water year (July – August). During this period a short maximum flow peak of >6,000 ML/d occurred, with two more peaks achieving >2,000 ML/d and another just shy of this at 1,800 ML/d. Large rainfall events in the spring resulted in two more large flows ranging from 1,000 ML/d to 2,900 ML/d. A natural flow event also occurred in January 2021, providing a >1,000 ML/d fresh. These natural events were able to meet some of the environmental flow demands, and as such some of the planned environmental releases were not required. Two freshes are scheduled for April and May 2021, to trigger downstream fish migration, with low flows also provided in between events and continuously afterwards, until the end of the water year.

No water for the environment was delivered to the Heyfield wetlands in 2020-21 as significant rainfall across the catchment filled the wetlands in winter and water levels were maintained throughout spring.

Figure 1-8 Thomson River, Reach 5 (photo credit: Phil Miller)

The Macalister River experienced several large flow events throughout July – September 2020, thanks to catchment rainfall increasing inflows to Lake Glenmaggie and triggering operational spill management from the 1st of July. Releases in accordance with Southern Rural Water's (SRW) spill management plan saw several peaks in flow of >4000 ML in July, August, September, and again in October and November. These releases reflect the increased inflow entering Lake Glenmaggie, following significant rainfall events in the Macalister catchment. These releases were able to meet, and in several cases, exceed the flow demands of planned environmental deliveries, and as such no environmental deliveries were required over the winter-spring period.

Two freshes are scheduled for April and May 2021, to trigger downstream fish migration, with low flows also provided in between events and continuously afterwards, until the end of the water year.

Figure 1-9 Macalister River, Reach 2 (Photo credit: Christos Iliopulos)

1.2.6 Outlook

Available forecast information from the Bureau of Meteorology (BOM) indicate that the El Niño–Southern Oscillation (ENSO) has recently returned to a neutral state. Model outlooks indicate neutral ENSO conditions will remain until at least early spring. A neutral ENSO state has little influence on Australian climate.

BoM climate outlooks for April-June 2021 are predicting continued wet conditions through to June, with April rainfall likely to be the wettest of the next three months as La Nina impacts may still be present. Streamflow conditions are predicted to be high through to May.

The accuracy of these forecasts through the autumn months is lower than at other times of the year, due to the natural cycle of ENSO. Figure 1-10 illustrates the BoM rainfall outlook across the region for the next three months (April – June 2021).

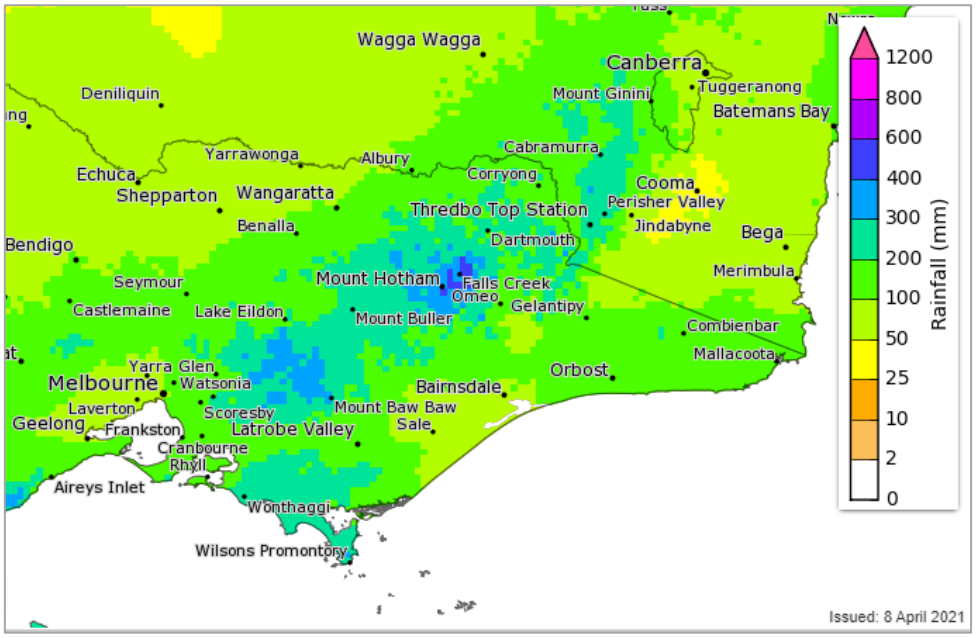


Figure 1-10 Three-month rainfall outlook for Victoria (BoM, 2021)

2. Latrobe River seasonal watering proposal

The following section provides details for the Latrobe River 2021-22 proposed watering actions.

2.2 Long-term Environmental objectives

Objectives for environmental flows in the Latrobe River are derived from the Latrobe Environmental Water Requirements Investigation (LEWRI) (Alluvium, 2020c). For this investigation, the environmental objectives were reviewed and updated based on the previous environmental water studies conducted throughout the Latrobe system. The objectives were refined through direct consultation with stakeholders associated with the Latrobe River including Traditional Owners, landholders, urban water suppliers and environmental interest groups through a Project Advisory Group (PAG).

The objectives reflect the environmental values considered important by the PAG. Objectives were determined in the context of the current water resource management, likely environmental conditions, including the likely trajectory of the system over the next 50 years, and the social and economic values of the region. In any given year the level at which an objective can be met will vary depending on the extant weather and climate conditions. For this reason, the overarching goals for environmental water management varies over four climactic conditions. These goals are as follows:

- Drought — **Protect** high priority environmental assets, key functions, and priority refuges to ensure chance of future recovery and avoid catastrophic events such as low dissolved oxygen or algal blooms
- Dry — **Maintain** high priority environmental assets, key functions, and priority refuges to ensure chance of future recovery and avoid catastrophic events such as low dissolved oxygen or algal blooms
- Average — **Recover** by improving ecological health and resilience and enhance recruitment opportunities for key flora and fauna
- Wet — **Enhance** by maximising recruitment opportunities for flora and fauna species.

Table 2-1 shows the overarching long-term environmental objectives for environmental water management in the Latrobe River. The specific values and functions achieved addressing each objective are shown in Table 2-4.

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Table 2-1 Overarching long-term environmental objectives for Latrobe River (adapted from Alluvium, 2020).

Symbol	Value	Overarching objective
	Fish	Maintain or improve fish (migratory, resident and estuary) and eel populations
	Invertebrates	Improve abundance of all macro- and micro-invertebrates
	Platypus and Rakali	Maintain or improve extent of platypus and rakali populations
	Turtles	Maintain abundance of freshwater turtle populations
	Vegetation	Improve condition, extent and diversity of submerged, emergent, and riparian vegetation or control invasive species
	Water quality	Avoid adverse water quality conditions
	Geomorphic	Maintain or improve instream geomorphic diversity
	Flush estuary/wetland watering	Provide freshwater to the Latrobe estuary and lower Latrobe wetlands (requires contribution from Thomson catchment)

2.3 Flow requirements

2.2.1 Delivery

Options to deliver environmental water to the Latrobe via the Tyers River are being considered for 2021-22.

The Tyers River is a highly flow stressed river largely due the retention of flows in Moondarra reservoir. Despite an average annual environmental water deficit of 32 GL/yr., the Tyers River contains approximately 25 km of high-quality habitat downstream of Moondarra Reservoir. Delivering water to the Latrobe via this river would support the ecosystem, particularly vegetation and non-migratory fish (barriers to fish movement currently exist) of the Tyers. The delivery will also provide a proof on concept for future environmental water flows.

Water for any delivery in the Tyers would be deducted from the Blue Rock environmental entitlement and would be transferred to Gippsland water either physically (through existing Gippsland Water infrastructure between Blue Rock Reservoir and Moondarra Reservoir) or as part of a temporary trade arrangement.

Operating arrangements will be developed with stakeholders including an assessment of risks and benefits.

2.2.2 Target reach

Watering actions for the Latrobe River are aimed at meeting environmental objectives in reach five and in the Latrobe estuary, with flow recommendations for the estuary reliant on flows from the Thomson River. Reach five has a considerable flow constraint restricting flows to less than approximately 1,100 ML/day. Water heights in the lower portion of this reach are influenced by tidal and backwater effects from Lake Wellington. As a result, flows above approximately 1,100 ML/day have the potential to inundate private landholders (depending on river heights). This constraint leads to significant environmental water deficit for upper reaches of the regulated Latrobe River (reach 3 and reach 4) as well as the Latrobe Estuary (Alluvium 2020).

2.2.3 Seasonality

Flow recommendations have been developed and expressed as either “Summer-Autumn” or “Winter-Spring” to reflect the expected climactic conditions. The “Summer-Autumn” recommendations cover the period from December to May which are typically drier and hotter months. The “Winter-Spring” period covers June to November which is typically cooler and wetter (Table 2-2). Flow frequencies expressed as ‘per season’ denote the number of events in the “Summer-Autumn” or “Winter-Spring” (i.e. a six-month period) expression. For example, a Summer-Autumn fresh with a frequency of six per season would occur a total of six times across the December – May period.

2.2.4 Flow components

Flow recommendations for each “season” have two components: low flows and freshes. The former are long sustained flows aimed at maintaining instream habitat while the latter are short events and are aimed at creating migration or breeding opportunities as well as maintaining water quality in pools.

Table 2-2 Hydrological description of each of the flow components and the seasons they are aligned with (Alluvium, 2020c).

Flow component	Hydrological description
Summer-Autumn low flows	Summer-Autumn low flows are the natural dry period flows or ‘low flows’ that maintain water flowing through the channel, keeping in-stream habitats wet and pools full
Summer-Autumn freshes	Summer-Autumn freshes are frequent, small, and short duration flow events that last for one to several days because of localised rainfall during the low flow period
Winter-Spring low flows	Winter-Spring low flows refer to the persistent increase in low or low flow that occurs with the onset of the wet period
Winter-Spring Freshes	High flow freshes refer to sustained increases in flow during the high flow period because of sustained or heavy rainfall events
Bankfull flow	Bankfull flows fill the channel, but do not spill onto the floodplain More common in the wet period but can occur in the dry period
Overbank flow	Overbank flows are higher and less frequent than bankfull flows and spill out of the channel onto the floodplain. More common in the wet period but can occur in the dry period

2.3 Scenario planning and prioritisation

2.3.1 Observations and provision of flow recommendations

The last ten years in the Latrobe River catchment has seen stream flow decrease annually since the “Millennium Drought” ended with widespread flooding in the 2010 and 2012 water years (Figure 2-1). The 2018 water year was the driest over the last ten years with no overbank or bankfull flows observed (Table 2-3). Summer-Autumn freshes have the lowest compliance with flow recommendations for average climatic conditions. This is largely due to the longer duration required for the “fish and vegetation” freshes and the increased frequency required for the “water quality” freshes.

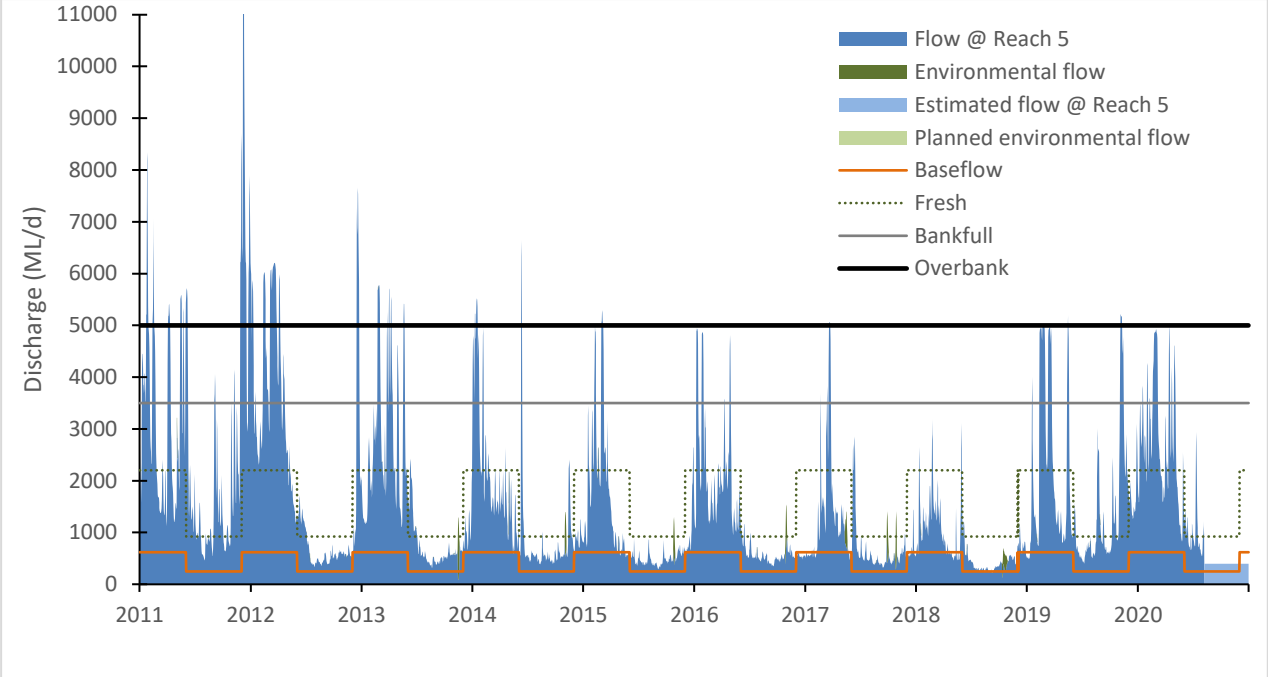

Figure 2-1 Hydrograph of managed and unmanaged flows occurring in reach five of the Latrobe River between the 2011 and 2020 water years, as well as the estimated low flows and planned freshes for the remainder of 2020-21.

Table 2-3 Hydrological achievement of flow components over time for the Latrobe River (reach five) against the average climactic condition flow recommendations. Numbers in each cell indicate the number of freshes observed, or, for low flows, the number of noncompliance days. E = managed environmental water release, * = includes planned environmental water deliveries, [a] = Assessment based on partial data set only; [b] = Flow component deemed undeliverable due to downstream flooding risk and capacity constraints. Bold line indicates commencement of Latrobe River Environmental Bulk Entitlement.

Flow Component	Hydrologic characteristics	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21*
Summer-Autumn Fresh (fish and vegetation)	Dec-May; Up to 920 ML/d; 3-5 days; 1-3/yr	5	0	1 (E)	3 (1 E)	1 (E)	1 (E)	3 (2 E)	0	4 (2 E)	3
Summer-Autumn fresh (water quality)	Dec-May; Up to 920 ML/d; 1 day; 4-6/yr	5	0	1 (E)	4 (1 E)	1 (E)	3 (1 E)	4 (2 E)	0	3 (2 E)	3
Winter-Spring Fresh[b]	Jun-Nov Up to 2,200 ML/d; 2 days; 1-4/yr	3	1	5	2	3	4	2	3	4	3
Summer-Autumn Low flow	Dec-May; Up to 250 ML/d	0	0	0	0	0	0	0	14	0	0
Winter-Spring Low flow	Jun-Nov Up to 620 ML/d	0	1	0	3	24	27	62	43	11	0
Bankfull flow[b]	3,500 ML/d	7	4	3	2	2	3	1	0	4	3
Overbank flow[b]	>5,000 ML/d	7	4	3	2	2	2	1	0	3	0

Key	Low flow compliance level	Fresh compliance level
Flow component completely provided	80-100%	100%
Flow component partially provided	60-80%	>50%
No significant part of the flow component achieved	<60%	<50%

To date, in the 2020-21 water year, no managed freshes or low flows have been delivered as they have been provided by unmanaged/natural river flows. Consistent rainfall throughout the year has seen Blue Rock reservoir spill intermittently, providing bankfull and overbank flows to the lower sections of the river (Figure 2-2).

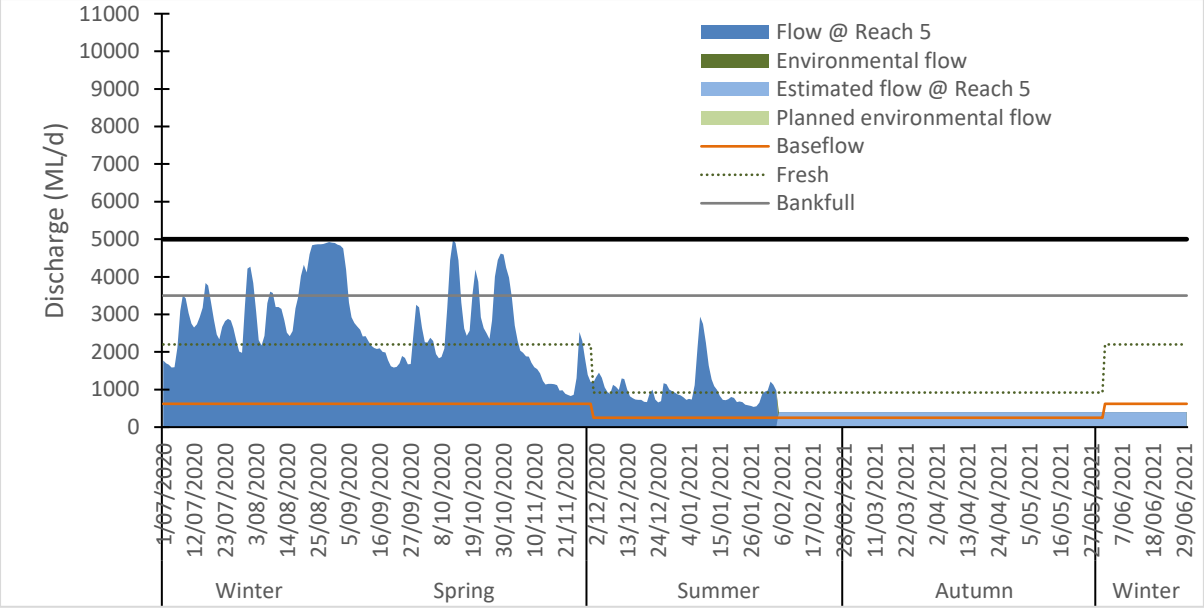

Figure 2-2 Hydrograph of managed and unmanaged flows occurring in reach five of the Latrobe River in the 2020-21 water year, as well as the estimated low flows and planned freshes for the remainder of 2020-21

2.3.2 Potential watering actions

Potential watering actions for 2021-22 are focused on enhancing achievements from 2020-21 and protecting high priority environmental assets as well as protecting key ecohydrological functions and high priority refuges. The watering actions are also aimed at preventing catastrophic reduction in water quality resulting in fish kills and algal blooms. Prioritised potential watering actions for 2021-22 are shown in Table 2-4

Table 2-4 Prioritised potential watering actions for the Latrobe River (reach 5) and Latrobe estuary in 2021-22. Note: these flow components are subject to change with the finalisation of the Latrobe Environmental Water Requirements Investigation

<table>
<tr><th>Potential Watering Action</th><th>Expected Watering Effects</th><th colspan="2">Environmental Objectives</th><th>2021-22 Flow Details</th><th>2021-22 Rationale</th><th>2021-22 Priority (H/M/L)</th></tr>
<tr><td rowspan="6">Summer-Autumn low flow – 380 ML/d * (December – May)</td><td rowspan="6">Support healthy country, fishing (Bunjil Tambun) / hunting (Woorngan) and platypus (Balagen), by:
• providing pool habitat (adequate depth up to 2 m) to support migratory and resident freshwater fish, macroinvertebrates, aquatic mammals, turtles, and submerged vegetation.
• Limit terrestrial vegetation encroachment to support emergent macrophyte vegetation.
• Maintain dissolved oxygen levels in pools
• Effects will be observed in Reach 4 as well as Reach 5.</td><td></td><td>Maintain or improve fish (migratory, resident and estuary) and eel populations</td><td rowspan="6">The flow recommendation is to provide low flows on a continuous basis. However, if dry conditions prevail, shorter pulses may be utilised to meet environmental objectives. Pulses should be no shorter than 10 days.
Flow rates may also be lowered to 250 ML/d if drought conditions prevail to maintain flows over a longer period.
Under most climate conditions, these flows are met naturally or with passing flows, however under drought conditions, managed release are likely to be required.</td><td rowspan="6">Summer Autumn Low flows are critical to meeting the long-term objectives for the Latrobe Rivers and maintains a high priority. They ensure flora and fauna have adequate water depth to prevail in dryer conditions between freshes.
A higher magnitude than is recommended for reach five has been adopted for this watering action as it will see the benefits extend over a larger portion of the river and is deliverable within the existing constraints.</td><td rowspan="6">H</td></tr>
<tr><td></td><td>Maintain or improve extent of platypus and rakali populations</td></tr>
<tr><td></td><td>Improve abundance of all macro- and micro-invertebrates</td></tr>
<tr><td></td><td>Maintain abundance of freshwater turtle populations</td></tr>
<tr><td></td><td>Improve condition, extent and diversity of submerged, emergent, and riparian vegetation or control invasive species</td></tr>
<tr><td></td><td>Avoid adverse water quality conditions</td></tr>
<tr><td rowspan="3">Summer/Autumn water quality fresh - 920 ML/d for one day (December – May)</td><td rowspan="3">Supporting healthy country by:
• flushing sediment (sands) from pools and velocity for pool turnover.
• Provide flows that maintain pool depth and abrade algae on riffles and large wood through by scouring fine sediment from bed of pools.
• Flush pools to maintain dissolved oxygen levels, low salinity, and low nutrients in the water column to support aquatic ecosystems (e.g. fish, macroinvertebrate populations and zooplankton)</td><td></td><td>Maintain or improve instream geomorphic diversity</td><td rowspan="3">These are short duration freshes with a high frequency designed to maintain water quality conditions. They are particularly important in drought and dry conditions where natural flows may not be adequate, and the “fish and vegetation” freshes are less likely to be observed.
Climate / Frequency / Duration (days)
Drought / 4 / 1
Dry / 5 / 1
Average / 6 / 1
Wet / 6 / 1</td><td rowspan="3">The focus of 2021-22 is to enhance the benefits seen in 2020-21 from the high flows. This means a higher priority is given to fish and vegetation freshes, required to maintain or improve fish populations and vegetation diversity. Water quality freshes may still be required if drought or dry conditions are experienced.</td><td rowspan="3">M</td></tr>
<tr><td></td><td>Avoid adverse water quality conditions</td></tr>
<tr><td></td><td></td></tr>
<tr><td rowspan="3">Summer/Autumn fish and vegetation fresh – 920 ML/d - 3 to 5 days (December – May)</td><td rowspan="3">Supporting healthy country, fishing (Bunjil Tambun) / hunting (Woorngan) and platypus (Balagen) by:
• inundating benches to maintain habitat, support growth of emergent macrophyte vegetation and sustain macroinvertebrate and zooplankton communities, and breeding substrate for Blackfish.
• Longitudinal connectivity for aquatic mammals, migratory</td><td></td><td>Maintain or improve fish (migratory, resident and estuary) and eel populations</td><td rowspan="3">These are longer duration freshes are designed to support fish migration and breeding as well as support vegetation growth on instream benches. They are particularly important in drought and dry conditions where natural flows may not be adequate.
Duration of these may be extended to up to 10 days to meet Latrobe Estuary requirements and provide access to freshwater for the Lower Latrobe Wetlands. This will rely on sufficient inflows form the Thomson River.</td><td rowspan="3">H</td></tr>
<tr><td></td><td>Maintain or improve extent of platypus and rakali populations</td></tr>
<tr><td></td><td>Improve abundance of all macro- and micro-invertebrates</td></tr>
</table>

<table>
<tr><th>Potential Watering Action</th><th>Expected Watering Effects</th><th colspan="2">Environmental Objectives</th><th>2021-22 Flow Details</th><th>2021-22 Rationale</th><th>2021-22 Priority (H/M/L)</th></tr>
<tr><td></td><td>fish, and estuary residents; including depth over benches for Grayling.</td><td>  </td><td>Improve condition, extent and diversity of submerged, emergent, and riparian vegetation or control invasive species</td><td rowspan="3"><table><tr><td>Climate</td><td>Frequency</td><td>Duration (days)</td></tr><tr><td>Drought</td><td>1</td><td>4</td></tr><tr><td>Dry</td><td>2</td><td>3</td></tr><tr><td>Average</td><td>3</td><td>4</td></tr><tr><td>Wet</td><td>3</td><td>5</td></tr></table></td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td></td><td></td><td>  </td><td>Avoid adverse water quality conditions</td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain or improve instream geomorphic diversity</td></tr>
<tr><td>Winter-Spring low flow – 620 ML/d (June-November)</td><td>Supporting healthy country by providing Summer / Autumn low flow functions plus flushing of sediment (sands) from pools.</td><td>  </td><td>Maintain or improve instream geomorphic diversity</td><td rowspan="8">This flow is designed to provide low flows on a continuous basis. However, if dry conditions prevail, shorter pulses may be utilised to meet environmental objectives. Pulses should be no shorter than 10 days.
Under most climate conditions, these flows are met naturally, however under drought conditions, managed release are likely to be required.</td><td rowspan="8">Winter-Spring low flows are an important flow component for protecting critical habitat and water quality, particularly in drought conditions. These flows have been met in each the last ten years naturally and are likely to be met naturally this year unless drought conditions prevail.
Accordingly, these flows are a low priority for 2021-22</td><td rowspan="8">L</td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain or improve fish (migratory, resident and estuary) and eel populations</td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain or improve extent of platypus and rakali populations</td></tr>
<tr><td></td><td></td><td>  </td><td>Improve abundance of all macro- and micro-invertebrates</td></tr>
<tr><td></td><td></td><td>  </td><td>Maintain abundance of freshwater turtle populations</td></tr>
<tr><td></td><td></td><td>  </td><td>Improve condition, extent and diversity of submerged, emergent, and riparian vegetation or control invasive species</td></tr>
<tr><td></td><td></td><td>  </td><td>Avoid adverse water quality conditions</td></tr>
</table>

2.3.3 Delivery constraints

Competition for, and total, outlet capacity as well as risk of downstream flooding are the key operating constraints (Table 2-5). Operating constraints have been considered in the development of this proposal, and in the operating arrangements for the Environmental Entitlement, and will be further considered as required in the implementation of the seasonal watering plan. Effective implementation will require coordination by the storage manager (SRW) and cooperation/negotiation with other entitlement and land holders.

Table 2-5 Delivery constraints for carrying out the watering regime for the Latrobe River

Potential constraints	Impact on priority watering action
Available outlet capacity share (e.g. during periods of high electricity demand)	Limits release volume/timing
Total available outlet capacity	Limits release volume
Flooding risks of private land in Tanjil River reach	Limits ability to release larger volumes from Blue Rock reservoir
Inundation of private land in reach five of the Latrobe River	Limits ability to release larger volumes from Lake Narracan subsequently limiting the impact of flows in the estuary and upstream reaches
Maintenance of water levels in Lake Narracan during ski season (January – March) (impact on other entitlement holders)	Reduces capability to charge Lake Narracan with releases from Blue Rock to allow for larger releases into Latrobe River (related to previous constraint).

2.3.4 Triggers for action

Priority watering actions will be delivered in the following sequence in all climatic scenarios; summer/autumn freshes; winter/spring freshes; winter/spring low flows; then summer/autumn low flows.

There are no critical dependencies between the proposed watering actions or any other flow components. Watering decisions will therefore be principally driven by seasonal conditions and operating constraints.

Seasonal conditions:

A monthly evaluation will be undertaken of past, current and projected seasonal conditions against the seasonal watering plan to inform actual watering decisions throughout the year. The evaluation will use recent data on storage inflows and flows in the target reach, seasonal outlooks for rainfall and streamflow, environmental water availability, environmental conditions and other relevant information and observations.

Proposed triggers for the release of freshes are summarised below (Table 2-6). They consider the full range of potential circumstances. The proposed timing is a compromise between:

- spreading freshes out relatively evenly across the target seasons
- not making artificial releases too early in each season in case the freshes are delivered naturally.

The trigger for the augmentation of low flows is water availability, river conditions and seasonal outlook at the end of April 2021. Triggers for the provision of Summer-Autumn low flows would ideally be based on water quality (e.g. dissolved oxygen), but the cost of implementing a monitoring system to support a water quality trigger is not considered to be warranted at this time.

Triggers for action will be further considered and refined during implementation of the 2021-22 seasonal watering plan.

Table 2-6 Proposed release triggers for fish and vegetation freshes in 2021-22

Decision matrix for the second month of spring (Oct), summer (Jan) and autumn (Apr)				
Natural freshes (in the season to date)	Watering action and recommended frequency/season			
	Drought (1 fresh)	Dry (2 freshes)	Average (3 freshes)	Wet (3 freshes)
No freshes	Consider release[1]	Consider release[1]	Consider release[1]	Consider release[1]
1 fresh	No release required[2]	No release required[2]	Consider release[1]	Consider release[1]
2 freshes	No release required[2]	No release required[2]	No release required[2]	Consider release[1]
3 or more freshes	No release required[2]	No release required[2]	No release required[2]	No release required[2]
Decision matrix for the third month of spring (Nov), summer (Feb) and autumn (May				
Total freshes (in the season to date)	Watering action and recommended frequency/season			
	Drought (1 fresh)	Dry (2 freshes)	Average (3 freshes)	Wet (3 freshes)
No freshes	Consider release[1]	Consider release[1]	Consider release[1]	Consider release[1]
1 fresh	No release required[2]	Consider release[1,3]	Consider release[1,3]	Consider release[1,3]
2 freshes	No release required[2]	No release required[2]	Consider release[1,3]	Consider release[1,3]
3 freshes	No release required[2]	No release required[2]	No release required[2]	Consider release[1,3]
4 or more freshes	No release required[2]	No release required[2]	No release required[2]	No release required[2]

Notes: 1 Considerations include: river flows, seasonal outlook, environmental conditions, e-water availability; **2** Recommended frequency of freshes achieved; **3** If no fresh has already been released in that season.

2.3.5 Scenario planning

Four climatic scenarios were selected for the Latrobe River system for 2021-22: drought, dry, average and wet. These scenarios were developed in conjunction with SRW and are consistent with the number of scenarios developed for the connected systems for which seasonal watering proposals are also being prepared i.e. the Thomson and Macalister Rivers and the lower Latrobe wetlands. The Latrobe River scenarios are defined in terms of the percentage of inflows to Blue Rock Reservoir and Lake Narracan relative to average annual inflows over the period 1990-2012. Inflows to these two storages capture the major

climatic influences on the Latrobe River system. Limiting the analysis to the most recent 20 years is a compromise between reflecting the drier climate experienced since the late 1990s that is predicted to continue and having a period of enough length to capture inter-annual climatic variation.

One water year during 1990-2012 was selected to represent each of the four scenarios, for estimating the likely unaugmented flow regime under each scenario:

- DROUGHT (<50% average inflows to Blue Rock and Lake Narracan): 2006/2007;
- DRY (75% average inflows to Blue Rock and Lake Narracan): 1999/2000;
- AVERAGE (100% average inflows to Blue Rock and Lake Narracan): 2004/2005;
- WET (>150% average inflows to Blue Rock and Lake Narracan): 2011/2012.

Preference was given to using more recent years during the range 1990-2012, as they are more likely to reflect current system operations. For each representative year, daily gauge data from the environmental flow compliance point in the priority reach was used to represent the likely current (unaugmented) flow regime in that reach for each scenario. The daily data was manually adjusted where necessary to better reflect anticipated flows in 2021-22. Hydrological compliance of all flow components was then assessed for each scenario, to help inform the relative need to augment flows in reach five in 2021-22 under different climatic conditions.

Operating constraints were also factored into the selection of priority watering actions for the four climatic scenarios (see the scenario descriptions below). Delivery of priority flow components is most problematic in dry and drought years, and potentially also in average years in some instances, due primarily to competition for outlet capacity. This is especially so for low flows. The volume of environmental water is also a significant constraint to the full delivery of all flow components.

The 2021-22 priority watering actions under each scenario are shown in Table 2-7 and 2-8. Watering actions are divided into two categories, **Tier 1 and Tier 2**. Tier 1 priorities are those which can be achieved within the current physical constraints of the river system and Tier 2 are those which cannot be met due to these constraints (e.g. landholder inundation). Tier 1 priorities are further spilt into two categories, “a” and “b”. Tier 1a priorities are those which are achievable with estimated water availability. Tier 1b priorities are those which currently are not achievable with the estimated water availability but will be delivered if water becomes available.

Table 2-7. Environmental objectives and expect river conditions for scenario planning

		Drought	Dry	Average	Wet
Environmental objectives		PROTECT Protect high priority environmental assets to ensure chance of future recovery. Protect key functions of high priority refuges Avoid catastrophic events such as large-scale fish kills or toxic blue green algae blooms and critical loss	MAINTAIN Maintain high priority environmental assets to ensure chance of future recovery. Maintain river functioning with reduced reproductive capacity. Maintain key functions of high priority refuges. Avoid catastrophic events such as large-scale fish kills or toxic blue green algae blooms and critical loss	RECOVER Improve ecological health and resilience. Enhance recruitment opportunities for key flora and fauna species. Maximise opportunities for natural inflows to meet in-channel environmental objectives (i.e. piggybacking)	ENHANCE Maximise recruitment opportunities for key flora and fauna species. Restore key floodplain and wetland linkages. Maximise opportunities for natural inflows to meet in-channel, floodplain and wetland objectives
Expected river conditions (e.g. storage levels and potential spills, likely consumptive demands and delivery patterns, likely contribution of passing flows and unreg flows)	Passing flows	Rosedale: min. 450 or natural; 500 ML/d averaged over 7 days or natural Likely seasonal minimums at Kilmany South (e-flow compliance point): spring (320 ML/d) 4; summer (200 ML/d) 3; autumn (220 ML/d); winter (325 ML/d)	Rosedale: min. 450 or natural; 500 ML/d averaged over 7 days or natural Likely seasonal minimums at Kilmany South (e-flow compliance point): spring (415 ML/d) 4; summer (320 ML/d) 3; autumn (340 ML/d); winter (500 ML/d)	Rosedale: min. 450 or natural; 500 ML/d averaged over 7 days or natural Likely seasonal minimums at Kilmany South (e-flow compliance point): spring (900 ML/d); summer (470 ML/d) 3; autumn (495 ML/d) ; winter (490 ML/d) 4	Rosedale: min. 450 or natural; 500 ML/d averaged over 7 days or natural Likely seasonal minimums at Kilmany South (e-flow compliance point): spring (1,100 ML/d) 4; summer (470 ML/d) 3; autumn (615 ML/d); winter (1,630 ML/d)
	Unregulated flows	Small contributions from unregulated reaches and tributaries. Industry returns (gauged) up to 50 ML/d at times (SRW can use up to 50%) – release patterns 12 hr on and off: from Morwell River and Traralgon Creek, diverters pick it up d/s of Morwell R confluence (most d/s of Toms Bridge)	Some unregulated flows contributing to base flows and freshes. Industry returns (gauged) up to 50 ML/d at times (SRW can use up to 50%) – release patterns 12 hr on and off: from Morwell River and Traralgon Creek, diverters pick it up d/s of Morwell R confluence (most d/s of Toms Bridge)	Summer/autumn low flows. Winter spring low flows and freshes. Potential spills from Blue Rock. Industry returns (gauged) up to 50 ML/d at times (SRW can use up to 50%) – release patterns 12 hr on and off: from Morwell River and Traralgon Creek, diverters pick it up d/s of Morwell R confluence (most d/s of Toms Bridge)	Strong summer/autumn low flows. Good freshes and high flows. Spills from Blue Rock and Moondarra. Industry returns (gauged) up to 50 ML/d at times (SRW can use up to 50%) – release patterns 12 hr on and off: from Morwell River and Traralgon Creek, diverters pick it up d/s of Morwell R confluence (most d/s of Toms Bridge)
	Consumptive water	Diverters: releases from Blue Rock during Jan-Mar: 15 ML/d for 100 days = 1,500 ML in total; use of industry returns (3-4,000ML/d in total @25 ML/d – delivery preference), small amount of base flows and some freshes (run of river @ 20 ML/d). May also purchase drought reserve water. Power companies: 70% of total use from Blue Rock during Jan-Mar: daily releases of 200-300 ML (Tru Energy take every day @ 80-100 ML/d; Loy Yang A & B have storage 120 ML/d for 7 days and shut off for 4 days); 30% of total use from run of river supply and Narracan (releases during July-Dec & Apr-Jun: 100 ML/d). May purchase from drought reserve. Gippsland Water pumping from Blue Rock to Moondarra	Diverters: releases from Blue Rock BE during Jan-Mar: 5 ML/d for 100 days = 500 ML in total; use of industry returns (3-4,000ML/d in total @ 25 ML/d – delivery preference), mostly run of river (20 ML/d). Power companies: 50% of total use from Blue Rock during Jan-Mar: daily releases of 200-300 ML/d (Tru Energy take every day 80-100 ML/d; Loy Yang A & B have storage 120 ML/d – run for 7 days and shut off for 4 days); 50% of total use from run of river supply and Narracan (releases during July-Dec & Apr-Jun: 100 ML/d). Gippsland Water pumping from Blue Rock to Moondarra	Diverters: release from Blue Rock BE during Jan-Mar: 5 ML/d for 100 days = 500 ML in total; use of industry returns (3-4,000ML/d in total @ 25 ML/d – delivery preference), mostly run of river (20 ML/d). Power companies: 20% of total use from Blue Rock during Jan-Mar: daily releases of 200-300 ML/d (Tru Energy take every day 80-100 ML/d; Loy Yang A & B have storage 120 ML/d – run for 7 days and shut off for 4 days). 80% of total use from run of river supply and Narracan (releases during July-Dec & Apr-Jun: 200 ML/d)	No significant releases from consumptive Bulk Entitlements in Blue Rock Reservoir or Lake Narracan. Run of river use only by diverters and power companies

Table 2-8 Scenario planning for watering actions for the Latrobe River at reach five and the Latrobe estuary in 20201-22. [1] Based on current account volume and forthcoming planned watering events. [2] The estimated annual share of inflows is discounted by 50% because no inflows or internal spills are accounted to the EE when it is full. [3] Passing flow used for Summer-Autumn estimated volume calculations. [4] Passing flow used for Winter-Spring estimated volume calculations. [5] Annual total minus tear 1a estimated environmental water demand

	Drought		**Dry**		**Average**		**Wet**	
Expected water availability	<50% average annual inflows to Blue Rock Reservoir and Lake Narracan		75% average annual inflows to Blue Rock Reservoir and Lake Narracan		100% average annual inflows to Blue Rock Reservoir and Lake Narracan		>150% average annual inflows to Blue Rock Reservoir and Lake Narracan	
	Starting Volume: 18 GL[1]		Starting Volume: 18 GL[1]		Starting Volume: 18 GL[1]		Starting Volume: 18 GL[1]	
	Share of inflows: ≤ 3 GL[2]		Share of inflows: ≤ 4 GL[2]		Share of inflows: ≤ 5 GL[2]		Share of inflows: ≤ 8 GL[2]	
	Internal spills: 0 GL		Internal spills: 1 GL		Internal spills: 5 GL		Internal spills: 10 GL	
	Annual total: ≤ 21 GL		Annual total: ≤ 23 GL		Annual total: ≤ 28 GL		Annual total: ≤ 36 GL	
Tier 1a potential watering actions	Watering action	Estimated volume	Watering action	Estimated volume	Watering action	Estimated volume	Watering action	Estimated volume
	Summer-Autumn low flow: (250-380 ML/day, Feb)	1.4 - 5 GL (assuming 200 ML/d passing flows)	Summer-Autumn low flow: 380 ML/day,	Met naturally	Summer-Autumn low flow: 380 ML/day,	Met naturally	Summer-Autumn low flow: 380 ML/day,	Met naturally
	Summer-Autumn fish and vegetation fresh (920 ML/day for 4 days)	5.2 GL (assuming 200 ML/d passing flow)	Summer-Autumn fish and vegetation fresh (920 ML/day, 2 freshes for 3 days) Or Extend Summer-Autumn fresh (920 ML/d) for up to 10 days to meet estuary requirements (assuming adequate flow in the Thomson)	6 GL (assuming 320 ML/d passing flow). Or Total 7.2 GL (assuming 320 ML/d passing flow).	Summer-Autumn fish and vegetation fresh (920 ML/day, 3 freshes for 4 days) Or Extend three Summer-Autumn freshes (920 ML/d) for up to 10 days to meet estuary requirements (assuming adequate flow in the Thomson)	6.6 GL (assuming 470 ML/d passing flow) Or Total 14.4 GL (assuming 470 ML/d passing flow)	Summer-Autumn fish and vegetation fresh (920 ML/day, 3 freshes for 5 days) Or Extend three Summer-Autumn fresh (920 ML/d) for up to 10 days to meet estuary requirements (assuming adequate flow in the Thomson)	7.8 GL (assuming 470 ML/d passing flow) Or Total 14.4 GL (assuming 470 ML/d passing flow)
	Summer-Autumn water quality fresh (920 ML/day, two freshes for 1 day)	6 GL (assuming 200 ML/d passing flow)	Summer-Autumn water quality fresh (920 ML/day, four freshes for 1 day).	7.2 GL (assuming 320 ML/d passing flow)	Summer-Autumn water quality fresh (920 ML/day, one fresh for 1 day)	0.8 GL (assuming 470 ML/d passing flow)	Summer-Autumn water quality fresh (920 ML/day, one fresh for 1 day)	0.8 GL (assuming 470 ML/d passing flow)
					Winter-Spring low flow (620 ML/day,)	Met naturally in Spring	Winter-Spring low flow (620 ML/day)	Met naturally
Tier 1b potential watering actions	Summer-Autumn low flow: (250-380 ML/day, remaining months)	7.5 - 9 GL (assuming 200 ML/d passing flow)	Additional extended Summer-Autumn fresh (920 ML/d) for up to 10 days to meet estuary	Total 7.2 GL (assuming 320 ML/d passing flow)	Winter-Spring low flow (620 ML/day,)	12 GL (winter months) assuming 490		

	Extended Summer-Autumn fresh (920 ML/d) for up to 7 days to meet estuary requirements (assuming adequate flow in the Thomson)	7.3 GL (assuming 200 ML/d passing flow)	requirements (assuming adequate flow in the Thomson)			ML/d passing flow		
	Remaining Summer-Autumn water quality fresh (920 ML/day, one fresh for 1 day)	3 GL (assuming 200 ML/d passing flow)						
	Winter-Spring low flow (620 ML/day, one month)	9 GL per month (assuming 320ML/d passing flow) 54 GL required to meet recommendation (continuous)	Winter-Spring low flow (620 ML/day, one month)	6.2 GL per month (assuming 415 ML/d passing flow) 37 GL required to meet recommendation (continuous)				
Tier 1 estimated environmental water demand	Tier 1a = 16.2 GL Tier 1b = 28.3 GL		Tier 1a = 14.4 GL - 20.4 GL Tier 1b = 7.2 GL		Tier 1a = 7.4 GL – 15.2 GL Tier 1b = 12 GL		Tier 1a = 8.6 GL – 15.2 GL	
Tier 2 potential watering actions	Nil		Nil		Nil		Nil	
Tier 2 estimated environmental water demand								
Estimated carryover[5]	4.8 GL		2.6 GL - 8.6 GL		12.8 GL – Full entitlement (18 GL)		Full entitlement (18 GL)	

3. Thomson River seasonal watering proposal

The following section provides details for the Thomson River 2021-22 proposed watering actions.

3.1 Environmental objectives

The environmental objectives and related flow recommendations used in this proposal are detailed in the Thomson River Environmental Flows and Management Review (Streamology, 2020) and the watering actions evaluated and prioritised in this proposal are consistent with those in this study. The Thomson River objectives were refined through direct consultation with stakeholders associated with the Thomson River, Traditional Owners, landholders, urban and rural water suppliers and environmental interest groups through a Project Advisory Group (PAG).

The objectives reflect the environmental values considered important by the Thomson PAG. Objectives were determined in the context of current water resource management, likely environmental conditions, including the likely trajectory of the system over the long-term, and the social and economic values of the region. In any given year the level at which an objective can be met will vary depending on the extant weather and climate conditions, and overall water allocation.

The overarching environmental objectives for the flow components are summarised in Table 3-1.

Table 3-1 Thomson River environmental values and objectives

Symbol	Value	Overarching objective
	Fish	Maintain/enhance native fish community structure
	Macroinvertebrates	Restore or maintain the natural macroinvertebrate and microinvertebrate community
	Birds, turtles, frogs, reptiles	Maintain populations of birds, turtles, frogs and reptiles
	Platypus	Increase the abundance of platypus
	Vegetation	Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity
	Geomorphology	Maintain or enhance physical form and functioning of the stream bed
	Connectivity	Maintain and improve in-stream habitat diversity and connectivity

As Heyfield wetlands does not currently have an environmental management plan in place, and was not part of the past or current Thomson flow review, the objectives for the wetlands are:

- Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species

- Enhance the resilience of semi-aquatic species
- Provide freshwater refuge habitat for migratory wetland birds within the Gippsland Plains landscape
- Maintain the existing frog populations and provide suitable habitat.

The WGCMA, Heyfield Wetlands Committee of Management, delivery partners (Gippsland Water & Southern Rural Water), GLaWAC and DELWP are currently working on a draft Environmental Water Management Plan for the Heyfield Wetlands. This is intended to be finalised for the 2022-23 seasonal watering proposal.

3.2 Flow Requirements

3.2.1 Target reach

The Thomson River itself is viewed as a connected system, from the headwaters in the mountains through to the Gippsland Lakes, and finally into the ocean. The long-term vision for the River is:

A living river, from mountains to sea, that sustains social, cultural and ecological values, contributing to the health and prosperity of the Gippsland lakes and broader region

Operationally, environmental flows are ordered to meet volume targets at the Coopers Creek gauge in reach 3 (from Aberfeldy River to Cowwarr Weir) 23 kms downstream of Thomson Reservoir, as this is a compliance point for Melbourne Water. The upper section of reach 6 is also a compliance point for Southern Rural Water (SRW) and is used to assess the continuity of environmental releases down the system. reach 6 also contains the upper Thomson estuary. With updated information from the Lower Latrobe and Thomson River E-flow Response Assessment (Water Tech, 2017), the flow requirements of the upper Thomson estuary and how it interacts with the lower Latrobe estuary and wetlands are better understood.

3.2.2 Flow components & Seasonality

The flow recommendations were developed using the framework of the standardised State-wide method for determining environmental water requirements in Victoria, referred to as the FLOWS method, Edition 2.

The proposed flow regime for the Thomson was categorised into three components - low flows, freshes and sub-bankfull flows, each of which are important for maintaining ecosystem health, functions, and processes. Each of the flow components are broken down into relative season; Summer/Autumn (December - May) and Winter/Spring (June - November) to align with natural, pre-regulation, conditions more closely.

3.3 Scenario planning and prioritisation

The past three water years 2017 – 2020 saw the Thomson River experience largely dry conditions, with environmental watering over this time focussed on the provision of freshes and increased baseflows over the winter and spring period.

The 2020-21 water year was quite different. Considered a wet year in terms of planning scenarios, rainfall and river flow was consistently high from July through to September (winter – spring). Increased unregulated flows in the River often achieved and at times exceeded the priority flow components. This also includes a flow of >3000 ML/d, a volume considered to achieve bankfull objectives in Reach 3.

At the writing of this proposal, there have only been two environmental flow deliveries in the Thomson for the 2020-21 water year. A spring fresh of 800 ML/d over 7 days was delivered in September 2020, and a low flow fresh of 230 ML/d for 7 days during March 2021. Three planned deliveries remain for the 2020-21 water year, from April through to June 2021 (i.e., a continuous low flow and 2 freshes). No water for the environment was delivered to the Heyfield wetlands in 2020-21 as significant rainfall across the catchment filled the wetlands in winter and water levels were maintained throughout spring.

Figure 3-1 illustrates the streamflow in reach 3 of the Thomson River (at the Coopers Creek gauge) from July 2017 – 30 June 2021, with low flow, fresh and bankfull recommendations overlain in black.

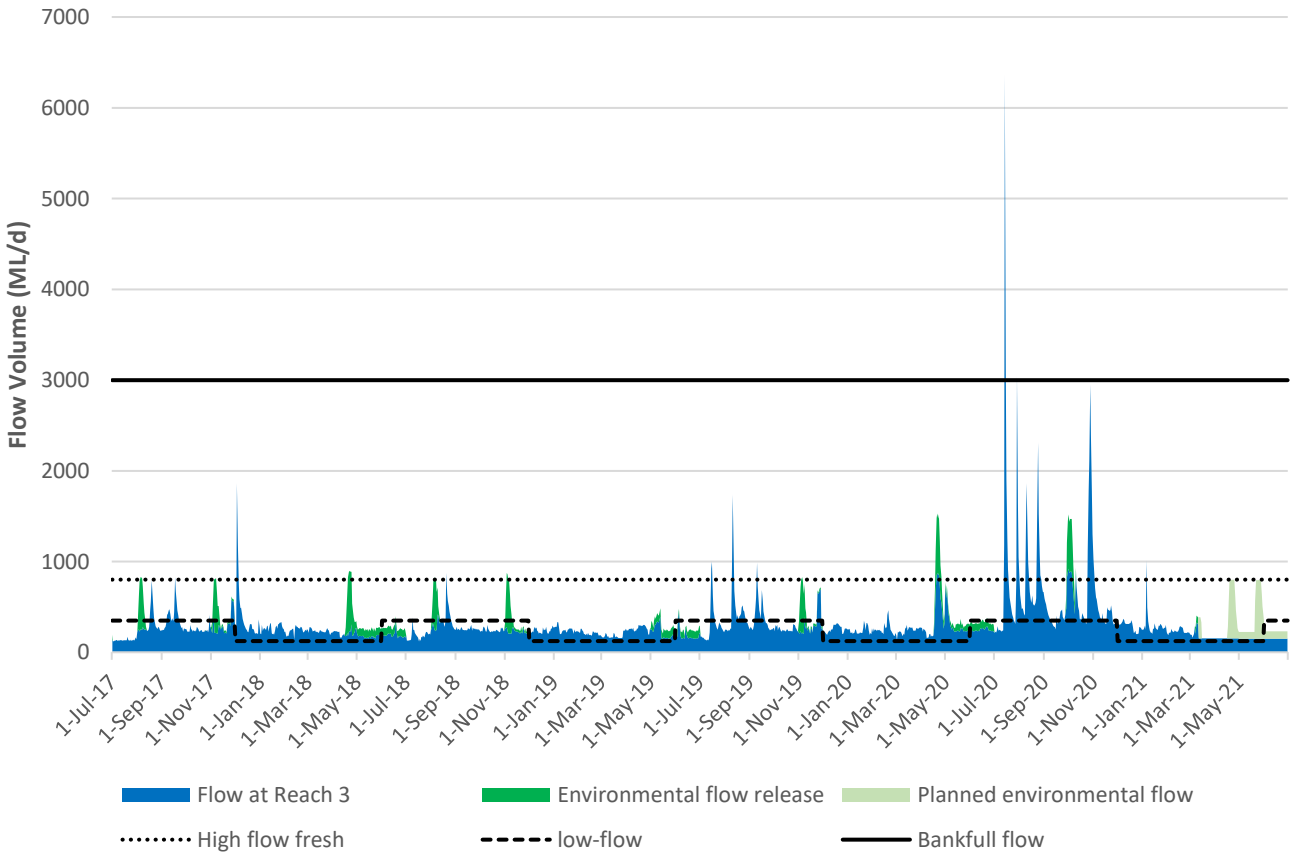

Figure 3-1 Hydrograph of managed and unmanaged flows occurring in the Thomson River (at Coopers Creek gauge) from July 2017-July 2021.

The following paragraphs provide some of the logic associated with evaluating system conditions used in the decision-making process of planned environmental releases.

3.3.1 Scenario selection

To determine the current climatic scenario, thresholds were established using Probability of Exceedance (POEs) for storage inflows. Storage inflows are the primary determinant of the climatic scenario. The preceding season's conditions are also considered. For example, the impact of a dry winter would be reduced if it followed a wet autumn. Also, flows from the Aberfeldy River may be greater than inflows into Thomson Reservoir, thereby contributing high flows to the Thomson River downstream of the storage. For this reason, the actual flows in the target reach are also to be considered in scenario selection.

In assessing the likely impact of current seasonal conditions and selecting the most suitable management scenario, the following will be taken into consideration:

- Previous and current months inflows comparison to POE's
- 1-3 monthly climate outlook (BoM)
- Projected trend in season conditions and inflows
- Flow data at Coopers Creek (target reach).

3.3.2 Ecological objective evaluation

Ecological objectives may be met by natural flows, thereby negating, or lessening the requirement to release environmental water. For example, a spawning flow event for Australian grayling is best timed between late April and mid-May. If a natural event occurs at the end of April under a dry scenario no release will be required, however under a wet scenario a release in May could be undertaken. Or, if several high flow freshes occur in winter, this water may be used to release an additional autumn fresh.

3.3.3 Allocation of Entitlement

Ability to deliver flows is dependent on the availability of water held in storage. This proposal has been developed so proposed flow components can be achieved by the predicted volumes in storage for each scenario.

However, storage spills, emergency releases in cases of very poor water quality, qualification of rights, significant water shortages or other factors may result in a shortfall of environmental water to meet all flow components. When water availability is unexpectedly reduced the volume required to meet priority flow components will be recalculated against projected allocations. Flows under each scenario have been assigned a priority so any shortfall will result in the lower priority flow event not being delivered. Please note that all flow components outlined are considered as ecologically important flows, assigning a priority ranking allows water managers to manage the annual allocation with those flows deemed critical each year being given highest priority. In some cases, providing a specific event may be considered a lower priority, as its volumetric demand would preclude the delivery of other higher priority watering. This information is summarised in Table 3-7.

3.3.4 Observations and provision of flow recommendations

Assessment of hydrologic compliance involved assessing the provision of flow events based on a set of specified rules – these rules correspond with the flow recommendations for the Thomson River (Streamology, 2020). The rules include the target magnitude, minimum duration and time of year of each flow event. The compliance table has been updated to

reflect the current flow recommendations (updated in 2020) the past historical flow compliance tables can be found in previous proposals.

Streamflow was assessed at two hydrologic compliance points in the Thomson River (i.e., Coopers Creek confluence and Bundalaguah). Table 3-2 summarises the results from the Coopers Creek confluence assessment, indicating the extent to which the flow recommendations have been delivered via managed and natural flows. Table 3-3 summarises the delivery results for Heyfield Wetlands.

At the time of writing, an autumn-winter low flow and two freshes are planned for the Thomson River, with flows intended to provide connectivity between habitats, fish passage (autumn-winter low flow), and important spawning and migration cues for native fish species in April 2021 (Autumn fresh) and May 2021 (Winter fresh).

The Arthur Rylah Institute completed fish surveys on the Thomson River in February 2020, as part of the VEFMAP Stage 6 surveys. Preliminary results indicate the highest catch rate of Tupong in the Thomson River in the 17-year history of VEFMAP. Based on findings from this survey and previous stages of VEFMAP, maintenance of baseflows is important to promote the upstream dispersal and survival of these new Tupong recruits. Two Tupong were also captured upstream of Horseshoe bend tunnel, and a total of 19 Australian grayling were captured in the mid- to lower reaches.

Table 3-2 Environmental flow compliance in reach T3 of the Thomson River

Updated flow recommendations were adopted from 20/21 water year onwards. A portion of past water years have been reassessed based on the 2020 flow recommendations. Details of previous compliance can be found in the 2019-20 seasonal watering proposal.

Name	**Detail**	**17/18**	**18/19**	**19/20**	**20/21***	**Ecological outcomes/observations 2020/21**
Autumn high flow fresh	Apr-May; 800 ML/d; 7 days. 2/yr	E	1	E	E	These are planned environmental water deliveries, the first in April and the second in May 2021. The timing of the April delivery is to trigger downstream migration and spawning of Australian grayling. The May delivery provides these migration cues for tupong and Australian bass. Recent fish surveys (undertaken in Feb 2021) reported the highest catch rates of tupong in the Thomson River in the 17-year history of VEFMAP sampling. This was thanks to high catches of young-of-year in the mid- to lower reaches. Also, 19 Australian grayling were captured in the mid- to lower reach samples. Tupong were also captured above the horseshoe bend fishway. This year, the April fresh has also been timed to coincide with the Baw Baw extreme multisport event, providing a shared benefit of increased river flows during the kayaking leg of the race.
Winter-Spring low flow	June - Nov;350 ML/d; continuous	E/O/U	E/O/U	E/O/U	E/O/U	Partially met through a combination of flows, typically between 200 – 300 ML/d. Full provision of this baseflow is currently considered a low priority, as delivering it would preclude the delivery of other higher priority watering actions due to its large volumetric demand
Summer- Autumn low flow	Dec – May; 125 ML/d; continuous	O/U	O/U	O/U	O/U	Fully provided through passing flow arrangements
Spring fresh	Sep-Nov: 800 ML/d; 7 days. 2/yr	E	E	E	E	A spring fresh was provided through a managed release late September-early October 2020, to encourage recruitment of juvenile migratory fish species from the estuary into freshwater reaches. The ARI 2021 Thomson fish survey detected a large recruitment event, with high catches of young-of-year tupong in the mid- to lower reaches, along with 19 Australian grayling
Summer fresh	Dec-Jan; 350 ML/d; 7 days; 1/yr	O/U	O/U	O/U	O/U	Operational and unregulated flows partially met this flow component, with flows of 350 ML/d frequently met but not sustained for the recommended duration (i.e., 7 days)
Summer-Autumn low flow fresh	Feb-Mar; 230 ML/d; 7 days; 1/yr	O/U	O/U	O/U	E	A Summer-Autumn low flow fresh was fully provided through an environmental delivery in March 2021.
Bankfull/sub bankfull	Anytime; 3,000 ML/d; 1 days	2	2	U	U	Two high flow events in July 2020 saw flows >3000 ML/d, with the first event lasting for 2 days reaching 6358 ML/d, and the second reaching 3039 ML/d for a single day. Although much smaller in magnitude, there were also some >1000 ML/d flows in August, and some >2000ML/d in October.

Key		**Footnotes**
	Flow component has been fully provided	*Note: This assessment is as of 12th March 2021 1This flow was not delivered in 2018-19 due to the construction of the Thomson fishway 2 Due to flooding risks, only unregulated flows are able to provide for this flow component
	Flow component has been partially provided	
	No significant part of the flow component provided either naturally or through managed flows	
	Planned environmental delivery	
E	Managed environmental water release	
O	Consumptive water enroute/other managed flows	
U	Unregulated flows	

Table 3-3 Heyfield Wetlands Historical environmental delivery compliance

Heyfield Wetlands (Western Ponds)	**17-18**	**18-19**	**19-20**	**20-21**	**Ecological outcomes/observations**
Winter Watering	N/A*	N/A*	E	U	With significant rainfall and runoff widespread across the catchment, no environmental deliveries were required to meet the 2020-21 fill and top-up watering actions. Water levels held very well across the autumn and spring, again providing habitat for water birds, frogs, and turtles. Birdlife volunteer bird surveys detected 46 species, including another sighting of the migratory visitor Latham's Snipe. Covid-19 restrictions reduced the capacity of both WGCMA staff and volunteers to do more formal water quality and frog response monitoring in 2020-21. In November 2020, the Heyfield Wetlands Committee of Management planted over 1400 native aquatic plants into the wetlands, with naturally sustained water levels providing favourable conditions for their survival on site.
Spring Watering	N/A*	N/A*	E	U	
Key					
	No significant part of the water regime provided naturally or through environmental deliveries				
	Water regime partially provided				
	Water regime completely provided				
N/A	No watering				
U	Unregulated flows				
E	Managed environmental delivery				
Footnotes	*These wetlands were constructed in 2017 and remained dry until receiving environmental water in 2019-20				

Figure 3-2 illustrates the streamflow in reach 3 of the Thomson River (at the Coopers Creek gauge) from 1 July 2020 – 30 June 2021.

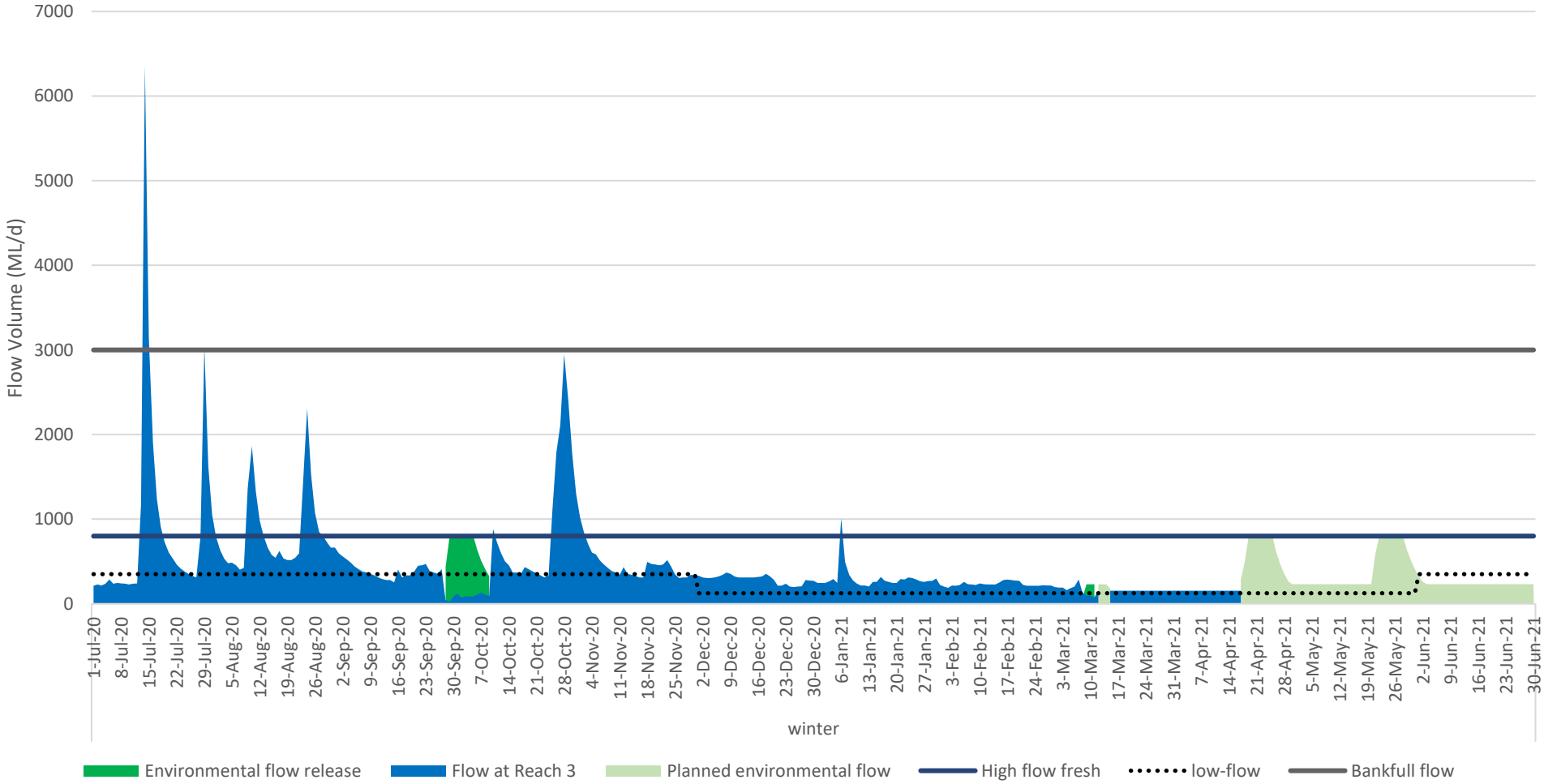

Figure 3-2 Thomson River Hydrograph (at Coopers Creek gauge) July 2020-30 June 2021.

3.3.5 Potential watering actions

Potential watering actions for the Thomson River in 2021-22 have been prioritised in Table 3-4, based on the recent historical streamflow, latest known condition of target ecological values, the likelihood of achieving the ecological objectives and the potential for the watering action to be provided via other water sources (e.g., unregulated flows, consumptive water delivery). The table has been updated to reflect the VEWH's 2021-22 seasonal watering proposal guidelines (VEWH, 2020).

The recent Latrobe FLOWS Study review has detailed estuary flow recommendations and environmental objectives, including specific flow volumes required from the Thomson and Latrobe to meet recommendations for the upper-, mid- and lower estuary. As the Latrobe, Thomson and Macalister all contribute to flows in the estuary (and the lower Latrobe wetlands), there are times when high flow releases for river objectives across all systems can be delivered in a coordinated approach to have benefits for both the river systems and the estuary. Where flows have benefits for the estuary and/or lower Latrobe wetlands, this has been included in the rationale for priority watering actions.

Heyfield Wetlands priority watering actions are presented separately in Table 3-5.

Table 3-4 Potential watering actions in the Thomson River for 2021 - 22

Thomson River – Site Details	
Environmental Watering Reach	Operationally, environmental flows are ordered to meet volume targets at the Coopers Creek gauge in Reach 3 (from Aberfeldy River to Cowwarr Weir) 23 kms downstream of Thomson Reservoir, as this is a compliance point for Melbourne Water. The upper section of Reach 6 is also a compliance point for Southern Rural Water (SRW) and is used to assess the continuity of environmental releases down the system. The updated 2020 flow and management review includes a vision statement related to a consistent flow regime down the length of the river. The river itself is viewed as a connected system, from the headwaters in the mountains through to the Gippsland Lakes, and finally into the ocean.
Measurement Point	Thomson River @ Coopers Creek (#225208B), Thomson @ Wandocka (#225212A)

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***	***2021-22 Flow Details***	***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Autumn fresh 800 ML/d for 7 days (April)	Cue for downstream migration for Australian grayling, adult Short-finned eel, adult Long-finned eel, adult Australian bass, and adult Common galaxias. Cue for upstream migration for juvenile Long-finned eel and spent Australian grayling. Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, non-woody fringing vegetation, and water-dependent taxa of existing EVCs in the riparian zone. Periodic higher flows to permit downstream dispersal of seeds and propagules of native non-woody fringing vegetation, submerged plants and other water-dependent species in the riparian zone. Periodic higher flows to scour existing biofilms and generate new colonisation sites Maintain physical form and functioning of the channel through mobilising fine sediments, turnover of sediment, preventing infilling of pools, and depositing sediments on existing bars and benches	 Maintain/enhance native fish community structure  Maintain or enhance physical form and functioning of the stream bed  Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**).	The objective of this flow is to provide a trigger for downstream migration and spawning of Australian grayling. At a minimum, this flow is required every 2 out of 3 years. Monitoring in Feb 2021 detected Australian grayling in the middle – lower reaches of the Thomson River. As grayling are an EPBC listed species, and regarded a significant value in the Thomson, it is a high priority to deliver flows in 2021-22 that support their migration, spawning and recruitment. At a catchment scale, the provision of this flow also has secondary benefits, particularly when timed to coincide with Macalister River delivery, as it provides a full flushing flow to the upper Thomson estuary. This will provide freshwater to sustain macroinvertebrate communities and flush sediments. This estuary flow requirement is likely to be **partially, if not fully achieved** in 2021-22 during the combined Macalister and Thomson rivers Autumn fresh delivery in Apr-May.	**H**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Spring fresh 800 ML/d for 5-7 days (Oct – Nov)	Cue for the upstream migration of juvenile Australian grayling, adult lamprey (Pouched and Short-headed), juvenile Short-finned eel, juvenile Tupong, adult and juvenile Australian bass, juvenile Common galaxias, and Broad-finned galaxias. Cue for downstream migration for juvenile Short-headed lamprey and adult Short-finned eel. Providing flows that can disturb biofilms and maintain habitat quality Providing flow variability to maintain zonation of vegetation according to elevation and flow requirements, and periodic higher flows to permit downstream dispersal of seeds and propagules (of submerged, woody and non-woody plant species) Maintaining physical form and functioning through the turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches		Maintain/enhance native fish community structure	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**). In a **drought scenario** the duration can be reduced to 5 days rather than 7, to reduce the delivery volume. In all other scenarios, the duration is 7 days.	Spring freshes are considered important for the recruitment of juvenile migratory native fish species from estuarine/marine habitats, particularly Australian grayling. Monitoring in Feb 2021 detected Australian grayling and high numbers of young-of-year tupong in the middle – lower reaches of the Thomson River. Delivering flows that support migration, spawning and recruitment are of high priority for 2021-22. At a catchment scale, the provision of this flow also has secondary benefits for the upper Thomson estuary providing a full flush. This flow will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands. This estuary flow requirement is likely to be **partially achieved, if not fully**, in 2021-22 during the combined Macalister and Thomson rivers Spring fresh delivery in Sept-Nov.	**H**
			Restore or maintain the natural macroinvertebrate and microinvertebrate community			
			Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity			
			Maintain or enhance physical form and functioning of the stream bed			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Autumn fresh 800 ML/d for 7 days (May)	Cue for the upstream migration of juvenile Australian grayling, adult lamprey (Pouched and Short-headed), juvenile Short-finned eel, juvenile Tupong, adult and juvenile Australian bass, juvenile Common galaxias, and Broad-finned galaxias. Cue for downstream migration for juvenile Short-headed lamprey, adult Short-finned eel, and adult tupong. Providing flows that can disturb biofilms and maintain habitat quality Providing flow variability to maintain zonation of vegetation and downstream dispersal of seeds and propagules (of submerged, woody and non-woody plant species) Maintaining physical form and functioning through the turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches		Maintain/enhance native fish community structure	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**). In a **drought scenario** the duration can be reduced to 5 days rather than 7, to reduce the delivery volume. In all other scenarios, the duration is 7 days.	The primary objective of this flow is to act as a cue for fish migration, specifically for species such as tupong and Australian bass. It also has benefits for vegetation, macroinvertebrates and geomorphic objectives.	**H**
			Restore or maintain the natural macroinvertebrate and microinvertebrate community			
			Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity			
			Maintain or enhance physical form and functioning of the stream bed			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Summer-Autumn fresh 230 ML/d for 7 days (Feb – Mar)	Cue for downstream migration for adult Short-finned eel, adult Long-finned eel. Cue for upstream migration for juvenile Short-finned eel, juvenile long-finned eel, juvenile Australian bass, juvenile common galaxias. Connectivity to facilitate localised movement between habitats for large-bodied fish species Maintain physical form and functioning of the channel through mobilisation of fine sediments Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, non-woody fringing vegetation, and water-dependent taxa of existing EVCs in the riparian zone		Maintain/enhance native fish community structure	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**).	Summer freshes provide fish passage during the dry season to enable movement of fish and other fauna into available habitats. They also improve habitat for macroinvertebrates and plants by scouring out sediment that has deposited in riffles.	**H**
			Maintain or enhance physical form and functioning of the stream bed			
			Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity			
			Maintain and improve in-stream habitat diversity and connectivity			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Autumn – Spring low flow, 125 – 350 ML/d continuous (May – Nov)	Diversity of instream habitat to support macroinvertebrates and the whole native fish assemblage Provide adequate water quality (DO and temperature) through pools and riffles to facilitate respiration of macroinvertebrates Maintain continuous connectivity for localised movement of native small-bodied fish species and platypus. Extended connectivity to allow upstream migration of adult Short-headed lamprey and adult Pouched lamprey. Extended connectivity for downstream migration of Australian bass, Tupong, juvenile lamprey (Short-headed and Pouched), and Common galaxias. Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, non-woody fringing vegetation, and water-dependent taxa of existing EVCs in the riparian zone. Periodic higher flows to permit downstream dispersal of seeds and propagules of native non-woody fringing vegetation, submerged plants and other water-dependent species in the riparian zone. Periodic inundation of low-lying benches and lower parts of the riparian zone to prevent encroachment of inundation intolerant terrestrial weed species.		Restore or maintain the natural macroinvertebrate and microinvertebrate community  Maintain and improve in-stream habitat diversity and connectivity  Maintain/enhance native fish community structure  Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity  Increase the abundance of platypus	In a **drought and dry scenario**: 125 – 230 ML/d, dropping to this magnitude is still within a range to provide benefits, with adequate depth to allow small bodied fish and platypus to have local movement. Passing flow volumes over this period do not drop below 150 ML/d so the lower range of this flow recommendation is met. **Average-Wet scenario**: 125 – 350 ML/d. Augmenting the passing flow volume up to 350 ML/d allows for increased benefit for vegetation outcomes	Winter-Spring baseflows provide important longitudinal connectivity and enable fish and other fauna to move freely between habitats. This is particularly important during this time as it is considered the juvenile recruitment period for native diadromous species, such as Australian grayling and tupong. <u>Additional benefits for Reach 6 (upper Thomson estuary)</u>: The objective of this flow is to partially flush the upper portion of the water column, providing freshwater above the halocline for fish. It would also reduce the salinity enough to support emergent macrophyte vegetation. Baseflows from the Thomson and Macalister may **partially** meet the volumes and duration required for this estuary flow. Full provision of this baseflow is currently considered a low priority, as delivering it would preclude the delivery of other higher priority watering actions due to its large volumetric demand	**H-M**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Winter-Spring Fresh, **800 - 900 ML/d for 7 days** **(Sept)**	Providing flows that can disturb biofilms and maintain habitat quality Providing flow variability to maintain zonation of vegetation according to elevation and flow requirements, and periodic higher flows to permit downstream dispersal of seeds and propagules Periodic inundation of stream, low-lying benches and lower parts of the riparian zone to prevent encroachment of terrestrial weed taxa intolerant of prolonged submergence Maintaining physical form and functioning through the turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches		Restore or maintain the natural macroinvertebrate and microinvertebrate community  Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity  Maintain or enhance physical form and functioning of the stream bed	**Drought-Dry scenario**: As there are no direct fish objectives associated with this September fresh, the Oct-Nov fresh could be delivered instead if water availability is an issue. **Average scenario**: if water availability allows, this can be delivered as the 800 ML/d flow. In a **wet scenario,** where appropriate to do so (considering rainfall and natural river flows from the Aberfeldy River), this flow can be increased to 900 ML/d to reach higher on the areas of vegetation up the bank. In a wet scenario this flow could be delivered in lieu of a bankfull event, providing a proportion of the ecological objectives associated with bankfull.	The timing of this fresh provides hydrological and vegetation benefits, assisting in maintaining the vertical zonation and successful recruitment of water-dependent fringing. The receding waterfront after the freshes is also important for vegetation recruitment, reed and rush establishment and the transport of sexual propagules of plants. As there are no direct fish objectives associated with this September fresh, if limited water is available, the 800 fresh in Oct-Nov could be delivered instead. It should be noted, however, that this is not the recommended approach for multiple years as there could be ongoing impacts to breeding, recruitment and habitat formation if continually missed. At a catchment scale, the provision of this flow also has secondary benefits for the upper Thomson estuary providing a full flush. This flow will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands. This estuary flow requirement is likely to be **partially achieved, if not fully**, in 2021-22 during the Spring fresh delivery in Sept-Nov.	**M**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Summer fresh, 350 ML/d for 7 days (Dec – Jan)	Adequate volume and flow of water to maintain submerged water dependent vegetation, biofilms, non-woody fringing vegetation, and water-dependent taxa of existing EVCs in the riparian zone Maintain physical form and functioning of the channel through mobilisation of fine sediments		Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity		The objective of this flow is to wet vegetation during the seasonally dry December - January summer months, as without a fresh the fringing vegetation is likely to undergo a 3-month period over summer without inundation.	**M**
			Maintain or enhance physical form and functioning of the stream bed			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Summer-Autumn low flow, 125 ML/d continuous (Dec – April)	Provides diversity of instream habitat to support macroinvertebrates and the whole native fish assemblage Provides connectivity to facilitate localised movement between habitats for small-bodied fish species and platypus Provides adequate water quality (DO and temperature) through pools and riffles to facilitate respiration of macroinvertebrates Periodic inundation of low-lying benches and lower parts of the riparian zone to prevent encroachment of inundation intolerant terrestrial weed species		Maintain/enhance native fish community structure	This flow is typically provided through passing flow arrangements and as such is not considered a high priority for delivery in 2021-22.	The objective of this flow is to provide connectivity and habitat availability for macroinvertebrates and fish. This flow is typically provided through passing flow arrangements and as such is not considered a high priority for delivery in 2021-22. For the upper Thomson estuary, this flow also partially flushes the upper portion of the water column, providing freshwater above the halocline for fish and maintaining dissolved oxygen levels. It would also reduce the salinity enough to support emergent macrophyte vegetation. Baseflows from the Thomson and Macalister may **partially** meet the volumes and duration required for this flow. Full provision of this baseflow is currently considered a low priority, as delivering it would preclude the delivery of other higher priority watering actions due to its large volumetric demand	**L**
			Maintain and improve in-stream habitat diversity and connectivity			
			Restore or maintain the natural macroinvertebrate and microinvertebrate community			
			Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity			
			Increase the abundance of platypus			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Bankfull/Sub bankfull 3000 ML/d for 1 day (anytime)	Provide lateral connectivity between the main channel and low-lying freshwater wetlands Creation of pools, building bars and benches, and inundating flood runners and anabranches		Maintain or enhance physical form and functioning of the stream bed	Not a proposed delivery for 2021-22	Although considered an ecologically important flow, providing this bankfull event is considered a low priority, as delivering it would preclude the delivery of other higher priority watering actions due to its large volumetric demand. Delivery of this event would also elevate the risk of personal injury or damage to property.	**L**
			Maintain/enhance native fish community structure			
			Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity			
			Restore or maintain the natural macroinvertebrate and microinvertebrate community			
			Maintain populations of birds, turtles, frogs and reptiles			
			Maintain and improve in-stream habitat diversity and connectivity			

Table 3-5 Heyfield Wetlands Potential Watering Actions for 2021-22

Heyfield Wetlands – Site Details	
Environmental Watering Reach	Heyfield Wetlands – Reach 4a
Measurement Point	Thomson River @ Coopers Creek (#225208B) and Rose St – Gippsland Water Raw Water Pump Station

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Winter inundation Full inundation **Up to 10-15 ML (August)** **Water depth ~ 0.6 m**	Wet ponds to capacity to stabilise the banks and support the spring growth of semi-aquatic vegetation Provide freshwater habitat for waterbirds and frogs		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	In 2020-21, rainfall and runoff in the area were able to naturally provide the inundation events outlined in the watering proposal. In an average-dry or drought scenario, the likelihood of this event happening naturally is a lot lower. The ability to deliver this event in the absence of natural filling is important for supporting the flora and fauna of the site as it is still in the early stages of establishing. The objective of this delivery is to improve the ecological value of the wetlands by supporting spring growth of semi-aquatic vegetation; increasing the availability of surface water and habitat for fauna; and continue to stabilize the banks of the ponds.	**H**
			Provide freshwater refuge habitat for migratory wetland birds within the Gippsland Plains landscape		
			Maintain the existing frog populations and provide suitable habitat		

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Spring-summer top-ups to full **Up to 10-15 ML (Sep-Dec)** **Water depth ~ 0.6 m**	Top up ponds before summer to maintain the existing vegetation and enhance its recruitment by triggering seed dispersal Provide freshwater habitat for waterbirds and frogs		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	In 2020-21, rainfall and runoff in the area were able to naturally provide the inundation events outlined in the watering proposal. In an average-dry or drought scenario, the likelihood of this event happening naturally is a lot lower. The ability to deliver this event in the absence of natural filling is important for supporting the flora and fauna of the site as it is still in the early stages of establishing. The objective of this delivery is to improve the ecological value of the wetlands by supporting the growth and potential seed dispersal of aquatic plants and riparian vegetation; and sustaining the surface water available to fauna. This release is designed to fill the ponds prior to summer, when they will be allowed to follow a natural drying cycle before possible autumn/winter rains in 2022. <u>If required</u>: Should climate conditions reflect those of 2019-20, with an extremely dry catchment, little to no rainfall, and accelerated drawdown in the ponds, a second delivery could be provided to ‘top up’ the ponds, providing continuous inundation prior to the summer drawdown.	**H**
			Provide freshwater refuge habitat for migratory wetland birds within the Gippsland Plains landscape		
			Maintain the existing frog populations and provide suitable habitat		

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Summer-autumn partial drawdown Partial drawdown	Water level fluctuations replicating a natural drying event over the drier summer-autumn months 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		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species Provide freshwater refuge habitat for migratory wetland	The objective of the partial drawdown is to replicate a natural drying event over the summer months. This drawdown will allow for the breakdown of accumulated organic matter, nutrient recycling, oxygenation of surface soils and provide increased mudflat and shallow water habitats for water birds as water levels recede.	**M**

3.3.6 Delivery constraints

The main constraints and issues associated with delivery of the priority watering actions in the Thomson River are described in Table 3-6.

Table 3-6 Constraints associated with effective environmental water delivery for the Thomson River

Constraint	Description	Implications for environmental watering
Outlet capacity sharing	• Water can be released from the Thomson reservoir to the river via the hydropower station (max. capacity of 480 ML/d) • There are also two other outlets with a combined capacity of 2,300 ML/d – however these maximums are achieved only when the reservoir is full, and capacity is lower as the water level drops	• To date the hydropower plant has been able to deliver sufficient releases for environmental and consumptive water demands • It is unlikely that outlet capacity sharing will impact on the watering actions proposed for 2021-22
900 ML/d volume delivery constraint	• As per the Thomson operating arrangements, to reduce the risk of flooding adjoining property, releases from Thomson Reservoir shall not exceed 900 ML/d without development of a detailed risk and flood assessment.	• This approach is not expected to impact on the ability to meet the majority of desired environmental flow regime (with most freshening flows up to a maximum of 800 ML/d). At times when releases from storage are made to meet an environmental release order immediately downstream of the Thomson Reservoir, rather than at Coopers Creek, it will be necessary to consider the potential impact of these release volumes on flooding downstream of the Aberfeldy River confluence.

Constraint	Description	Implications for environmental watering
Notification requirements	• The minimum 2 week period required for notifications to the public and storage operators, prohibits a flexible planning environment, prohibiting storage operators from being able to release environmental watering event more dynamically based on rainfall and a lull in irrigation demand (due to outlet capacity sharing constraints – see above) • This lack of flexibility also precludes the ability for environmental watering events to piggyback on naturally occurring, which may allow for greater water savings, permitting the delivery of more watering actions	• Environmental water delivery will not be able to piggyback onto naturally occurring events • A dynamic environmental flow delivery system (using shorter notification times – or providing flexibility with delivery timing) means that a watering event can be timed to follow a rainfall event, and therefore potentially deliver greater ecological benefits (as the ecosystem anticipates a rise in streamflow) • In future, all partners should work together to establish a real time notification resource (e.g. a website) that consolidates planned releases – whether it be consumptive/environment. This would reduce the need for such a long notification period, and greatly reduce the effort required to notify various groups.

3.3.7 Triggers for action

In administering the environmental water entitlement for the Thomson River, the West Gippsland Catchment Management Authority use several decision support tools:

- Data and reports from monitoring programs within the systems
- Latest scientific knowledge/understanding relevant to the systems
- System understanding and emerging issues
- Climatic predictions
- Flow modelling and scenario evaluation tool
- Ecological condition
- Historical environmental flow compliance.

This information is used to determine the current and predicted watering operation scenario and flow deliveries for the systems throughout the watering year.

In managing the environmental water entitlement there are several considerations to be made in planning for flow releases:

Thomson modified passing flows

Passing flows may be reduced as part of a consultative decision-making process that was established in 2017 between WGCMA, VEWH, SRW, Melbourne Water and Gippsland Water. This reduction in passing flows is based on a year-to-year decision making process, from which potential water savings are passed onto the environmental entitlement to be used later, typically to provide additional low flow in June. To mitigate for any impacts to river

diverters, any loss of normal harvest that was called upon will also be reimbursed through accrued water savings or if insufficient, through the Thomson BE. As such, it is important that this risk is considered each year when determining whether to reduce passing flows. In the future, it is important to consider whether a volumetric buffer should be established to safeguard any possible losses from the Thomson BE.

The current approach was established using the 2003 flow recommendations. Work is now required to test the approach based on the 2020 flow recommendations, to ensure potential risk and benefits are adequately addressed.

Flows at Cowwarr Weir

Flows at Cowwarr Weir can be split between the Thomson River (T4a) and Rainbow Creek (T4b). Unless notified otherwise, passing flows shall be split 2/3 in T4a and 1/3 in T4b (TMEFTF, 2004). Environmental flow releases under section 5.2 shall preferentially be passed through T4a, except for autumn and spring freshes which will be split as per passing flow arrangements.

3.3.8 Scenario planning

Four scenarios are considered for the Thomson River: drought, dry, average and wet (Table 3-7). The logic and evaluation process used for the scenarios is outlined in section 3.3.

Table 3-7 Climate scenario summary for the Thomson River

		Drought	Dry	Average	Wet
Environmental Objectives		**PROTECT** →Protect high priority ecological assets (e.g. threatened species) ensuring chance of future recovery →Maintain key functions of high priority refuges →Avoid catastrophic events (e.g. blackwater) and critical loss of species	**MAINTAIN** →Maintain high priority ecological assets ensuring chance of future recovery →Maintain river functioning with reduced reproductive capacity (i.e. for vegetation and fish species) →Maintain key functions of high priority refuges →Avoid catastrophic events and critical loss of species	**RECOVER** →Improve ecological health and resilience →Enhance recrutiment opportunities for key flora and fauna species (e.g. Australian grayling, tupong) →Maximise opportunities for natural inflows to meet in-channel environmental objectives through piggy-backing with environmental water	**ENHANCE** →Maximise recruitment opportunities for key flora and fauna species →Restore key floodplain and wetland linkages →Maximise opportunities for natural inflows to meet in-channel, floodplain and wetland objectives
Expected River Conditions (e.g. storage levels and potential spills, consumptive demands, passing flows, unregulated flows, etc)	**Passing Flows**	Passing flows at Coopers Creek as per BE for all months Reduced passing flows at Wandocka (50 ML/d or higher)	Passing flows at Coopers Creek as per BE for all months Reduced passing flows at Wandocka (50 ML/d or higher)	Passing flows at Coopers Creek as per BE for all months	Passing flows at Coopers Creek as per BE for all months
	Unregulated Flows	No unregulated flows	Some unregulated flows from the Aberfeldy River potentially contributing to baseflows and freshes	Unregulated flows from the Aberfeldy River likely to contribute to baseflows and freshes	Unregulated flows from the Aberfeldy River highly likely to contribute to baseflows and freshes
	Consumptive Water	100% delivery of SRW share (45 GL) 300-400 ML/d continuous (Nov-Mar)	Delivery of a portion of SRW share (10 GL) ~300ML/d 1 month duration (Dec, Feb-Mar)	Delivery of a portion of SRW share (3-3.5 GL) ~150 ML/d, 1-2 week duration (Dec, Feb-Mar)	Delivery of a portion of SRW share (1 GL) ~150 ML/d, 1-2 week duration (Dec, Feb-Mar)

The scenario planning for proposed 2021-22 watering actions are outlined in Table 3.8.

Table 3-8 Scenario planning for watering actions in the Thomson River over 2020-2021 based on allocation as of March 2021*

	Drought	Dry	Average	Wet
Expected allocation volume (GL)	10 - 13 GL	13 - 16 GL	16 - 19 GL	19 - >22 GL
Expected Carryover (GL)	15.7*	15.7*	15.7*	15.7*
Tier 1a **Priority Watering Actions**	Summer-Autumn fresh 350 ML/d, 7 days (Dec - Jan) Summer-Autumn fresh 230 ML/d, 7 days (Feb -Mar) Autumn high flow fresh 800 ML/d, 7 days (April) Autumn-Winter low flow 125-230 ML/d continuous (May-June) Autumn fresh 800 ML/d, 5 days (May) Spring fresh 800 ML/d, 5 days (Oct - Nov) Summer-Autumn low flow, 125 ML/d, continuous (Dec – April) (typically met by passing flow provisions) Heyfield 1 x 15 ML fill (Aug) and 1-2 top-ups 5-15 ML (Sep-Dec)	Summer-Autumn fresh, 350 ML/d, 7 days (Dec - Jan) Summer-Autumn fresh 230 ML/d, 7 days (Feb -Mar) 2 x Autumn freshes 800 ML/d, 7 days (April and May) Autumn-Winter low flow 230 ML/d continuous (May-July) Spring fresh 800 ML/d, 7 days (Oct - Nov) Summer-Autumn low flow, 125 ML/d, continuous (Dec – April) (typically met by passing flow provisions) Heyfield 1 x 15 ML fill (Aug) and 1-2 top-ups 5-15 ML (Sep-Dec)	Summer-Autumn fresh 350 ML/d, 7 days (Dec - Jan) Summer-Autumn fresh 230 ML/d, 7 days (Feb -Mar) 2 x Autumn fresh 800 ML/d, 7 days (April and May) Autumn-Winter low flow 350 ML/d, continuous (May-July) Spring fresh 800 ML/d, 7 days (Nov) Summer-Autumn low flow, 125 ML/d, continuous (Dec – April) (typically met by passing flow provisions) Heyfield 1 x 15 ML fill (Aug) and 1-2 top-ups 5-15 ML (Sep-Dec)	Summer-Autumn fresh 350 ML/d, 7 days (Dec - Jan) Summer-Autumn fresh 230 ML/d, 7 days (Feb -Mar) 2 x Autumn fresh 800 ML/d, 7 days (April and May) Autumn-Winter low flow 350 ML/d continuous (May-July) Spring fresh 800 ML/d, 7 days (Nov) Winter-Spring fresh 800 ML/d, 7 days (Sep) Summer-Autumn low flow, 125 ML/d, continuous (Dec – April) (typically met by passing flow provisions) Heyfield 1 x 15 ML fill (Aug) and 1-2 top-ups 5-15 ML (Sep-Dec)
Tier 1a Water Demand (GL)	**22 GL**	**25 GL**	**34.5 GL**	**39.5 GL**
Tier 1b	Winter-Spring low flow (350 ML/d) continuous (July - Nov), additional 15.7 GL 1 x additional Spring fresh 800ML/d, 7 days (Sep) = additional 5 GL Winter-Spring fresh 900 ML/d, 7 days (Sep), in lieu of bankfull = additional 6.5 GL (*delivery of this higher magnitude would replace the Tier 1b Spring fresh) Spring fresh 800 ML/d (Oct - Nov), 7 days = additional 1.6 GL (i.e. an additional 2 days high flow) Winter fresh 800 ML/d (May), 7 days = additional 1.6 GL (i.e. an additional 2 days high flow)	Winter-Spring low flow 350 ML/d, continuous (Aug - Nov) = additional 11.6 GL 1 x additional Spring fresh 800 ML/d, 7 days (Sep) = additional 5 GL Winter-Spring fresh 900 ML/d, 7 days (Sep), in lieu of bankfull = additional 6.5 GL (*delivery of this higher magnitude would replace the Tier 1b Spring fresh) Winter-Spring low flow 350 ML/d, continuous (may-July) (i.e. increasing the volume from 230 ML/d) = additional 7.3 GL	Winter-Spring low flow 350 ML/d, continuous (Aug - Nov) = additional 11.6 GL 1 x additional Spring fresh 800 ML/d, 7 days (Sep) = additional 5 GL Winter-Spring fresh 900 ML/d, 7 days (Sep), in lieu of bankfull, (*delivery of this higher magnitude would replace the Tier 1b Spring fresh) = additional 1.6 GL	Winter-Spring low flow (350 ML/d) continuous (Aug - Nov) = additional 11.6 GL Winter-Spring fresh 900 ML/d, 7 days (Sep), in lieu of bankfull(*delivery of this higher magnitude would replace the Tier 1a Spring fresh) = additional 1.6 GL
Tier 1b Water Demand (GL)	**30.4 GL**	**30.4 GL**	**18.2 GL**	**13.2 GL**
Tier 2				
Tier 2 Water Demand (GL)	**0 GL**	**0 GL**	**0 GL**	**0 GL**
High Priority Carryover Requirements	**2.6 GL** (300 ML/d July continuous low flow for 2022-23)	**2.6 GL** (300 ML/d July continuous low flow for 2022-23)	**2.6 GL** (300ML/d July continuous low flow for 2022-23)	**2.6 GL** (300ML/d July continuous low flow for 2022-23)

4. Macalister River seasonal watering proposal

The following section provides details for the proposed watering actions for the Macalister River 2021-22.

4.1 Environmental objectives and flow recommendations

The ecological objectives and flow recommendations for the lower Macalister River are detailed in the Macalister River Environmental Water Management Plan (Alluvium, 2015).

Objectives, values, and flow recommendations are summarised in Table 4-1.

Table 4-1 Macalister River environmental values and objectives.

Symbol	Value	Overarching objective/s
	Fish	Increase the distribution and abundance of Australian grayling Increase the distribution and abundance of all native fish species Improve spawning and recruitment opportunities for native migratory fish species
	Macroinvertebrates	Increase the abundance and number of functional groups of macroinvertebrates
	Birds, turtles, frogs	Maintain the abundance of frog, turtle, and waterbird communities
	Platypus and rakali	Increase the abundance of platypus and rakali
	Vegetation	Improve native emergent (non-woody) and fringing woody vegetation Re-instate submerged aquatic vegetation
	Geomorphology	Improve physical habitat

4.1 Flow Requirements

4.1.1 Target reach

The relevant target reach(es) are identified based on the ecological objective. For example, M2 is the target reach for winter freshes peaking at 700ML/d as the ecological objective for this watering action is to trigger downstream migration of tupong and Australian bass. Only this reach has unimpeded connectivity to the coast for this objective to be achieved (reach M1 is separated by Maffra Weir).

4.1.2 Flow Components

The proposed flow regime for the Macalister has been categorised into three components - low flows, freshes and bankfull flows, each of which are important for maintaining ecosystem health, functions and processes.

4.1.3 Flow Recommendations

The watering actions evaluated in this proposal are consistent with those Alluvium (2015), with two major change detailed below:

- **Autumn fresh in M2 to trigger Australian grayling spawning**: the recommended magnitude for this event is 140 ML/d, however irrigation releases are generally of this magnitude during this time. Australian grayling require a rise in flow to commence downstream migration (Koster et al. 2009) and as such, the M1 magnitude for this event (350 ML/d peak) has been adopted. The recommended duration of this event will vary depending on the climatic scenario, but a minimum of six days is recommended before the event begins to ramp down.
- **Summer-Autumn protecting low flows:** Drought conditions in 2018-19 saw reduced passing flows in reach M2, due to reduced inflows to Lake Glenmaggie. With reduced flow and decreasing water quality, a formal variation to use environmental water was required to keep the river flowing and maintain water quality. As such, it is now written into drought and dry scenarios to protect these low flows and avoid catastrophic events such as critical drops in water quality and fish deaths.

4.2 Scenario planning and prioritisation

The previous two water years (i.e., 2018-19, 2019-20) have seen the Macalister River experience largely dry conditions. In comparison, 2020-21 has been a wet year, in terms of planning scenarios, with consistently high rainfall, dam inflow and river flow. Leading into the water year, inflows to Glenmaggie put storage levels above the average volume for that time of year. Continued inflows and rainfall from July onwards saw increased SRW operational releases to manage the storage levels. SRW, the VEWH and WGCMA communicated regularly prior to and throughout planned spilling events. The WGCMA was able to provide advice on the preferred spill shaping (i.e., ramp up and ramp down rates), and early communications from SRW meant that prior to the water year beginning on July 1st 2020, a winter fresh was delivered (June 2020), before the remainder of carryover water was lost to spill from July 1st.

Increased flow in the River with these operational releases saw volumes achieving and at times exceeded the priority flow components. This also includes multiple flow events of >4000 ML/d, a flow considered to partially achieve bankfull objectives in Reach 1 and 2. At the time of writing this proposal, there have been no environmental flow deliveries in the Macalister for the 2020-21 water year. Three planned deliveries remain for the 2020-21 water year from April through to June 2021 (i.e., continuous low flow and 2 freshes).

Figure 4-1 illustrates the streamflow in Reach 2 of the Macalister River, from July 2016 through to remaining planned flows in June 2021. Flow volume recommendations for low flows, low flow freshes and high flow freshes have been included on the hydrograph.

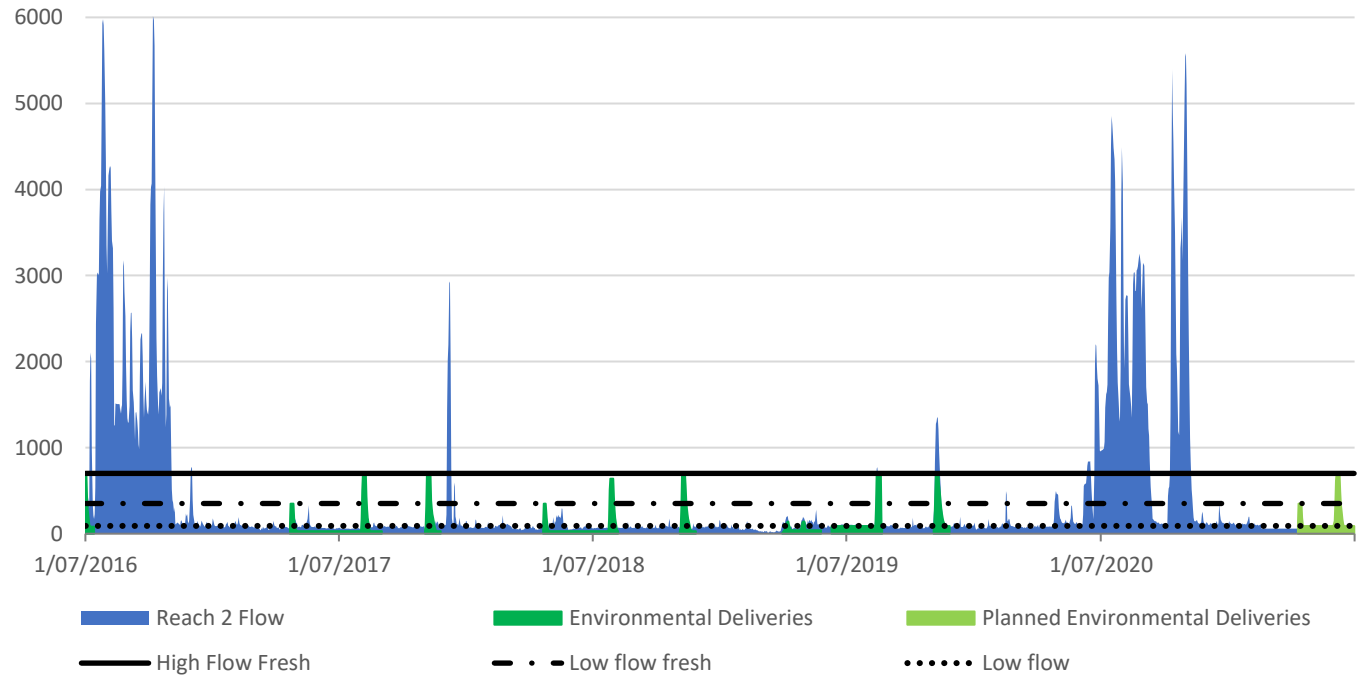

Figure 4-1 Hydrograph of managed and unmanaged flows occurring in the Macalister River in Reach 2 (Riverslea gauge) from July 2016 – June 2021

The following paragraphs provide some of the logic associated with evaluating system conditions used in the decision-making process of planned environmental releases.

4.2.1 Scenario selection

To determine the current climatic scenario, thresholds were established using Probability of Exceedance (POEs) for storage inflows. Storage inflows are the primary determinant of the climatic scenario. The preceding season's conditions are also considered. For example, the impact of a dry winter would be reduced if it followed a wet autumn.

In assessing the likely impact of current seasonal conditions and selecting the most suitable management scenario, the following will be taken into consideration:

- Previous and current months inflows comparison to POE's
- 1-3 Monthly climate outlook (BoM)
- Projected trend in season conditions and inflows
- Flow data at Riverslea and below Lake Glenmaggie (Target reaches).

4.2.2 Ecological objective evaluation

Ecological objectives may be met by natural flows, thereby negating, or lessening the requirement to release water. For example, a spawning flow event for Australian grayling is best timed between late April and mid-May. If an event occurs at the end of April under a dry scenario no release will be required, however under a wet scenario a release in May could be undertaken. Or, if there have been several high flow freshes in winter, this water may be used to release an additional autumn fresh.

4.2.3 Allocation of Entitlement

Ability to deliver flows is dependent on the availability of water held in storage. This proposal has been developed so all flow components specified can be achieved by the predicted volumes in storage for each scenario.

However, storage spills, emergency releases in cases of very poor water quality, qualification of rights, significant water shortages, or other factors may result in a shortfall of environmental water to meet all flow components. When water availability is unexpectedly reduced the volume required to meet priority flow components will be recalculated against projected allocations to identify any shortfalls. Flows under each scenario have been listed in order of priority so any shortfall will result in the lowest priority flow event not being delivered.

4.2.4 Observations and provision of flow recommendations

Assessment of hydrologic compliance involved assessing the provision of flow events based on a set of specified rules – these rules correspond with the flow recommendations for the Macalister River. The rules include the target magnitude, minimum duration and time of year of each flow event. The compliance table has been updated to reflect the current flow recommendations the past historical flow compliance tables can be found in previous proposals.

Streamflow was assessed at the two hydrologic compliance points in the Macalister River (i.e. D/S of Lake Glenmaggie and Riverslea). Table 4-2Table 4-2 summarises the results from the Riverslea gauge, indicating the extent to which the flow recommendations specified in the Macalister Environmental Flows Study (Alluvium, 2015) have been delivered via managed and natural flows. This compliance point is of particular interest as it is placed at

the end of reach M2, indicating the flow experienced by this reach and receives minimal inflows from other tributaries. Figure 4-2 presents the streamflow in M2 of the Macalister River (at Riverslea) from July 2020 to June 2021.

At the time of writing, an autumn-winter low flow and two freshes are planned for the Macalister River, with flows intended to provide connectivity between habitats, fish passage (autumn-winter low flow), and important spawning and migration cues for native fish species in April 2021 (Autumn fresh) and May-June 2021 (Winter fresh).

Duncan Fraser (EWAG member and field naturalist at Bellbird Corner) provided an update of observations from Bellbird Corner in a blog post (February 2021), reporting lush growth of two species of *Persicaria* on the riverbank. This species benefits from higher flows that maintain soil moisture on the bank. Flowering of these plants attracted native bee species, 1 of which is a new species to the area (the Honey-headed masked bee). You can find out more about this fantastic sighting here:
http://www.bencruachan.org/naturality/2021/02/22/bee-for-bellbird-corner/

The Arthur Rylah Institute carried out fish surveys in the Macalister River in March 2021 as part of VEFMAP Stage 7. VEFMAP sites from 2005-2016 were revisited in this survey. Preliminary results show high catch rates of young-of-year tupong relative to previous surveys. Based on the findings of this, and previous surveys, ARI suggest maintenance of baseflows is important to promote the upstream dispersal and survival of these new Tupong recruits.

Table 4-2 Historical environmental flow compliance in reach M2 of the Macalister River (Riverslea).

Name	Detail	16/17	17/18	18/19	19/20	20/21*	Ecological outcomes/observations 2019/20
Low flow	All year; 35 ML/d	O	O	O/E	O	O/U	These flows were provided, and often exceeded throughout 2020-21 thanks to managed flow releases from Lake Glenmaggie. Even during the typically drier summer months, low flows were well above the 35 ML/d minimum.
Autumn-Winter Low flow	Apr-Aug; 35-90 ML/d	U/E	U/E	U/E	U/E	U/E	This is a planned environmental water delivery. The timing provides continuous connectivity for fauna to access habitat and food resources during the typical filling period for Lake Glenmaggie.
Spring-Summer Low flow	Sep-Dec; up to 90 ML/d	U	U/E	U/E	U/E	O/U	These flows were provided, and often exceeded throughout 2020-21 thanks to managed flow releases from Lake Glenmaggie. Even during the typically drier summer months, low flows were well above the 35 ML/d minimum.
Winter-Spring Low flow	Jun-Nov; 300 ML/d	U	[1]	[1]	[1]	O/U	This flow component was partially achieved via operational releases. The 300 ML/d recommendation was exceeded for the majority of June – October. November was the only month to experience flows below the recommendation.
Summer-Autumn fresh	Dec-May; 140 ML/d; 3 days (or min 20 days in DRT)	U	U	E	U	O/U	With flows in the Macalister River being >100 ML/d over December – March, the objectives of this fresh have been provided, in that water quality has not been reduced throughout this period. Should this change from March – May, there is still sufficient allocation to allow for an environmental delivery. It should be noted that blue-green algae have been detected in Lake Glenmaggie, so the WGCMA will continue to observe flow and water quality over the autumn months.
Autumn fresh	Apr-May; 350 ML/d; 3 days	E	E	[2]	E	E	This is a planned environmental water delivery. The timing of this delivery is to trigger downstream migration and spawning of Australian grayling.
Autumn-Winter fresh	May-Aug; 700 ML/d; 3 days	U/E	E	E	E	E	This is a planned environmental water delivery. The timing of the delivery provides migration cues for tupong and Australian bass.
Spring fresh	Sep-Oct; 700 ML/d; 3 days	U	E	E	E	O/U	These flow components were fully achieved and exceeded via operational/unregulated releases in September, October, and November. In September river flows reached >1500 ML/d for a continuous 7 day duration. Even leading into September, August had increased river flow of >3000 ML/d. In October river flows reached >4000 ML/d for a continuous 5 day duration, and in November flows reached >1500 ML/d for a continuous 5 day duration. Recent fish surveys (undertaken in Feb 2021) reported the highest catch rates of tupong in the Thomson River in the 17-year history of VEFMAP sampling. This was thanks to high catches of young-of-year in the mid- to lower reaches. Also, 19 Australian grayling were captured in the mid- to lower reach samples. Tupong were also captured above the horseshoe bend fishway. Fish survey results for the Macalister have not been received yet, however it is highly likely that a large recruitment event has occurred here as well thanks to the wet conditions and high flows during key migration, spawning and recruitment periods for native migratory fish species.
Spring-Summer fresh	Sep-Dec; 700 ML/d; 3 days	U	E	E	E	O/U	
Spring-Summer fresh	Sep-Dec; 1500 ML/d; 3 days	U	U	[3]	U/E	O/U	
Fresh	Anytime; 1500 ML/d; 3 days	U	U	[3]	U/E	U	
Bankfull	Anytime; 10,000 ML/d; 1 day	U	[4]	[4]	[4]	O	No bankfull events 0f 10,000 ML/d have occurred to date, and this event is unlikely to occur in the remainder of the water year. This flow component was partially achieved throughout the year, with multiple operational release events exceeding 3000 ML/d throughout July – October.

Key	Footnotes
	*Note: This assessment is as of 12th March 2021
	[1]This flow event is not currently deliverable through managed environmental releases as its requirements far exceed the current entitlement volume.
	[2]This event was not delivered in 2018-19 due to ongoing drought conditions. A small freshening flow of 140 ML/d was delivered in late April to maintain river water quality
	3This event was not met by unregulated flows in 2018-19 due to drought conditions
	[4]Bankfull events may only be provided by unregulated flows, due to flooding risks
E	
O	
U	

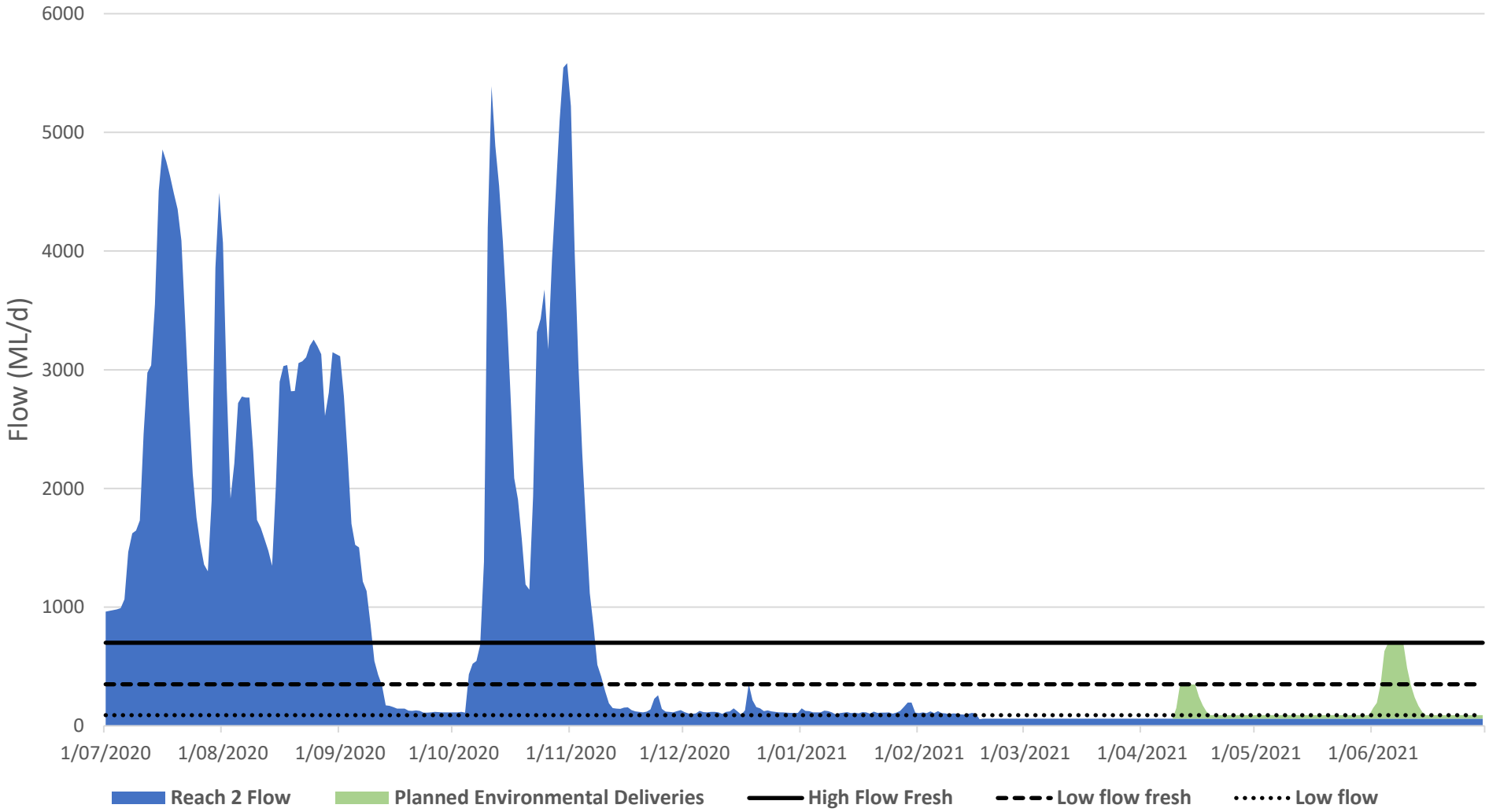

Figure 4-2 Macalister River streamflow recorded at Riverslea (Reach M2) from July 2020 to June 2021.

4.2.5 Potential watering actions

The priority flow components for the Macalister River over 2021-22 are listed in Table 4-3. Priorities were determined based on the hydrologic compliance assessment (refer to Table 4-2), latest known condition of the target ecological value, likelihood to achieve the desired flow function and the potential for other flows to provide the event (e.g., consumptive water delivery, storage spills).

The priority watering activities in this proposal are adopted from the recommendations and learnings articulated from the Macalister River Environmental Flows Study (Alluvium, 2015), the draft Macalister River Environmental Water Management Plan (WGCMA, 2017) and the Macalister Shortfalls Report (Alluvium, 2019).

The relevant target reach(es) are identified based on the ecological objective. For example, M2 is the target reach for winter freshes peaking at 700ML/d as the ecological objective for this watering action is to trigger downstream migration of tupong and Australian bass. Only this reach has unimpeded connectivity to the coast for this objective to be achieved (reach M1 is separated by Maffra Weir).

As part of the recent Lower Latrobe and Thomson River E-flow Response assessment (Water Tech, 2017), flow recommendations for the upper Thomson estuary have been determined. The review has detailed estuary flow recommendations and environmental objectives, including specific flow volumes required from the Thomson-Macalister to meet upper-, mid- and lower estuary recommendations. As the Latrobe, Thomson and Macalister all contribute to flows in the estuary (and the lower Latrobe wetlands), there are times when high flow releases for river objectives across all systems can be delivered in a coordinated approach to have benefits for both the river systems and the estuary. Releases from the Macalister will at times assist in meeting these flow recommendations, where climatic conditions, timings and other constraints allow. Where flows have benefits for the estuary and/or lower Latrobe wetlands, this has been included in the rationale for priority watering actions.

Table 4-3 Priority watering actions in the Macalister River for 2021-22.

Macalister River – Site Details	
Environmental Watering Reach	The relevant target reach(es) are identified based on the ecological objective. For example, **M2** is the target reach for winter freshes peaking at 700ML/d as the ecological objective for this watering action is to trigger downstream migration of tupong and Australian bass. Only this reach has unimpeded connectivity to the coast for this objective to be achieved (reach **M1** is separated by Maffra Weir).
Measurement Point	**M1:** Macalister River @ D/S Lake Glenmaggie (#225204D) **M2:** Macalister River @ Riverslea (#225247)

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Flow Details***	***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Autumn-winter low flow 35-90 ML/d continuous (Mar – Aug)	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native **fish** species	Flow delivery the same across each scenario (drought-dry-average-wet) Proposed flow delivery throughout June to mid-August 2021, then from mid-April 2022 through to the end of June 2022, continuous provision of 90 ML/d	For reach **M1**, this flow provides complete longitudinal connectivity, allowing aquatic fauna to move between different habitats to access refuge areas and food sources. Such connectivity is routinely provided through consumptive water deliveries during the irrigation season, and if Lake Glenmaggie spills. However, this connectivity is not continuous throughout the reservoir filling period (autumn to early winter). Providing this baseflow may also provide additional benefit if provided in conjunction with a fresh, as it provides fish passage for migratory species completing (i.e. Australian grayling) or about to complete (i.e. Tupong, Australian bass) migration in reach **M2**.	**H**
	Provide permanent wetted habitat through minimum water depth in pools		Increase the abundance and number of functional groups of **macroinvertebrates**			
	Provide longitudinal connectivity for local movement, protection from predation, access to		Increase the abundance of **platypus and rakali**			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
	food sources and to maintain refuge habitats					

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Spring-summer low flow **M1 & M2:** **35 - 90 ML/d continuous** **(Sep – Jan)**	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native fish species	Flow delivery the same across each scenario (**drought-dry-average-wet**) Providing 90 ML/d for 7 days following the Spring fresh delivery	For reach **M1**, this flow provides complete longitudinal connectivity, allowing for aquatic biota to move between different habitats Providing this flow may also provide additional benefit if provided in conjunction with a spring fresh, as it provides fish passage for migratory species completing or about to complete migration in reach **M2**. At a catchment/connected rivers scale, large numbers of young-of-year tupong detected in the Thomson River in Feb 2021. The ARI advice is to maintain baseflows that allow upstream migration, dispersal and survival of these recruits.	**H**
	Provide permanent wetted habitat through minimum water depth in pools		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide longitudinal connectivity for local movement, protection from predation, access to food sources and to maintain refuge habitats		Increase the abundance of platypus and rakali			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Autumn fresh 350 ML/d, 5 days (April – May)	**M2:** Delivers a trigger for downstream migration and spawning of Australian grayling.		Provide flows cues through increases to water depth to promote downstream migration and spawning for Australian grayling, tupong and Australian bass	This flow has been scheduled for late April-early May 2021, coinciding with an Autumn fresh in the Thomson River – which provides secondary benefits to the upper Thomson estuary.	At a landscape scale, the 2019-2020 bushfires in East Gippsland will have impacted greatly on the migratory fish populations of coastal streams in the neighbouring catchment. This makes targeted fish migration flows in West Gippsland extremely important for supporting the wider diadromous fish population, either as a refuge location or as a source population of species such as Australian grayling. Monitoring in Feb 2021 detected Australian grayling in the middle – lower reaches of the Thomson River. As grayling are an EPBC listed species and regarded a significant value in the Thomson and Macalister, it is a high priority to deliver flows in 2021-22 that support their migration, spawning and recruitment.	**H**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Spring Fresh 700 ML/d, 5 days (Sep – Nov)	Provide flows cues through increases to water depth to promote upstream migration of adult anadromous species (e.g. short-headed lamprey), and recruitment of juvenile		Increase the distribution and abundance of Australian grayling Increase the distribution and abundance of all native fish species	Flow delivery the same across each scenario (**drought-dry-average-wet**)	The objective of this flow is to promote the upstream migration of adult and juvenile migratory fish species. It also provides some wetting of fringing woody vegetation. The provision of this fresh, particularly when timed to coincide with freshening	**H**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
	catadromous (e.g. tupong, common galaxias, Australian bass, short and long-finned eels) and amphidromous species (e.g. Australian grayling)		Improve spawning and recruitment opportunities for native migratory fish species	Proposed flow delivery in late October – early November. Where possible, delivery of this fresh will be timed to coincide with flows in the Latrobe and Thomson which provides secondary benefits to the upper Thomson estuary.	flows in the Thomson will also provide flushing flows to the Upper Thomson estuary. This will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands.	
	Inundate a greater area of stream channel (increasing water depth) to limit terrestrial vegetation encroachment Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation Inundate mid-level benches to provide water level variability for fringing vegetation		Improve native emergent (non-woody) and fringing woody vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
Winter Fresh 700 ML/d, 5 days (May – Aug)	Provide flows cues through increases to water depth to promote downstream migration and spawning for tupong and Australian bass, and another opportunity for Australian grayling		Increase the distribution and abundance of Australian grayling Increase the distribution and abundance of all native fish species	Flow delivery will be the same across the **Dry-Average-Wet scenario**:	For reach **M2**, the objective of this flow is to provide a flow trigger for the downstream migration of fish species, such as Tupong and Australian bass. Fish surveys in the Thomson (Feb 2021) have detected young-of-year tupong. Providing flows that encourage spawning of these species is important	**H**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
			Improve spawning and recruitment opportunities for native migratory fish species	In a **drought scenario** this flow would not be considered a priority delivery, particularly if providing the flow threatened the ability to carryover water for baseflow top-up provision in July 2022.	for maintaining and improving the native fish population in both the Macalister and the Thomson. The timing of this flow coincides with the filling period for Lake Glenmaggie, so the majority of upper catchment river inflows are harvested. The provision of this fresh, particularly when timed to coincide with freshening flows in the Thomson will also provide flushing flows to the Upper Thomson estuary. This will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands.	
	Flush pools to improve water quality Increase wetted area to provide habitat		Increase the abundance and number of functional groups of macroinvertebrates			
	Inundate a greater area of stream channel (increasing water depth) to limit terrestrial vegetation encroachment Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation Inundate mid-level benches to provide water level variability for fringing vegetation		Improve native emergent (non-woody) and fringing woody vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
Summer-autumn freshening pulse, 140 ML/d	Maintain a minimum depth in pools to allow for turnover of water and slow potential water quality degradation		Improve physical habitat	**Average-Wet Scenario:** Provide 3 x 140 ML/d pulses, 3 day duration	The objective of this flow in an **<u>average to wet scenario</u>** is to provide opportunities for biota to move between refuges, and to maintain or improve the	**M**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
(Dec – Mar)	Flush pools to improve water quality Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat			***In an average-wet scenario** this is regarded as a "M" priority	condition of available refuges (e.g. by flushing stagnant water and improving water quality).	
	Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation		Improve native emergent (non-woody) and fringing woody vegetation Re-instate submerged aquatic vegetation			
	Flush pools to improve water quality Increase wetted area to provide increased wetted habitat		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native fish species			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Summer-autumn freshening pulse and baseflow, 140 ML/d (Dec – Mar) ***trigger-based (when passing flows drop below 60 ML/d)**	Maintain a minimum depth in pools to allow for turnover of water and slow potential water quality degradation Flush pools to improve water quality Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat		Improve physical habitat	**Dry-Drought Scenario:** Provision of 40 ML/d baseflow (5-13 days) with a 3-day 140 ML/d pulse ***In a dry-drought scenario this flow would be considered a "H" priority**	This objective of this flow is to provide opportunities for biota to move between refuges, and to maintain or improve the condition of available refuges (e.g. by flushing stagnant water and improving water quality). This need becomes more pronounced in a **dry-drought scenario**, with the increased likelihood of passing flow volumes from Lake Glenmaggie being reduced to match inflow volumes (i.e. when inflows fall below 60 ML/d). In this scenario, the duration of a freshening flow would likely need to be extended beyond the minimum 3 days, to achieve improved water quality in refuge habitats. In a drought-dry scenario the intention is to protect assets and reduce the likelihood of a catastrophic water quality event.	**H-M***
	Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation		Improve native emergent (non-woody) and fringing woody vegetation Re-instate submerged aquatic vegetation			
	Flush pools to improve water quality Increase wetted area to provide increased wetted habitat		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native fish species			

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Flow Details*	*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
Spring fresh 1500 ML/d, minimum 3 days (Sep – Oct)	Inundate a greater area of stream channel to limit terrestrial vegetation encroachment Inundate low benches to provide water level variability and facilitate longitudinal dispersal of emergent vegetation Inundate mid-level benches to provide water level variability for fringing vegetation Inundate higher benches to provide water level variability for fringing woody vegetation		Improve native emergent (non-woody) and fringing woody vegetation (**M1**: wetting intact riparian vegetation, in particular tea tree and paperbark)	**<u>Average-Wet Scenario only</u>**: Spring freshes can potentially be provided during the storage spill season, however the duration and shape of these events many not meet the target flow volumes and durations required for fringing vegetation species in **M1**. Provision of this flow can be achieved in small spill years (i.e. <4000 ML/d), by augmenting/piggy-backing the spill volume with an environmental release to meet not only the recommended duration of flow (1500 ML/d, 3	As forecasts are pointing towards a wetter than average autumn, it is highly likely that Lake Glenmaggie will spill in 2021-22. As unregulated release (aka spills) may not carry through the entire length of reach **M2**, the release of this flow ensures that these functions occur throughout this reach. Depending on the timing of such an event, this flow would also provide volumes that promote upstream migration of adult and juvenile migratory fish species. This flow would also have benefits for the Upper Thomson estuary and Lower Latrobe wetlands, providing a full flush. This will improve water quality by displacing the salt wedge and contribute freshwater flows to the lower Latrobe wetlands. To provide these flows with environmental water alone would create shortfalls in other possible deliveries, so they are not currently considered a high priority watering action (i.e. this flow is only to be delivered if a spill event occurs).	**M**
	M2: Provide flows with sufficient shear stress to enable scouring of biofilms and other food sources and prevent accumulation of fine sediment **M2**: Inundate higher benches to move organic material into the channel to provide habitat and food sources		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide flows cues through increases to water depth to promote upstream migration of		Increase the distribution and abundance of Australian grayling			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
	adult anadromous species (e.g. short-headed lamprey), and recruitment of juvenile catadromous (e.g. tupong, common galaxias, Australian bass, short and long-finned eels) and amphidromous species (e.g. Australian grayling)		Increase the distribution and abundance of all native fish species Improve spawning and recruitment opportunities for native migratory fish species	days), but also to ensure the ramp down rate is conducive to the ecological objective and reduces the risk of bank slumping issues.		
	Improve physical habitat		Flush pools to improve water quality Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
Summer-Autumn low flow 35 – 90 ML/d continuous (Dec – May)	Maintain a minimum depth in pools to allow for turnover of water and slow water quality degradation Expose and dry lower channel features for re-oxygenation		Improve physical habitat	**Average-Wet Scenario:** Passing flows in the Macalister (60 ML/d) provide this baseflow requirement in both reaches.	With current forecasts predicting a return to neutral conditions, Lake Glenmaggie likely to spill in 2021-22, and with the Summer-Autumn freshening pulse PWA listed as a High priority, this PWA has been given a lower priority for 2021-22.	**L**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
	Provide flows with low water velocity and appropriate depth and to improve water clarity and enable establishment of in-stream vegetation		Re-instate submerged aquatic vegetation	As such delivery is not planned. **Drought-Dry:** To provide these flows in their entirety with environmental water alone would likely exceed the EE or create shortfalls in other possible deliveries. Should baseflows be required, the Summer-Autumn pulse PWA will be delivered	In **average and wet scenarios**, passing flows (60 ML/d) would typically provide this flow component in **M2**. Drought conditions in 2018-19 saw reduced passing flows in reach M2, due to reduced inflows to Lake Glenmaggie. With reduced flow and decreasing water quality, a formal variation to use environmental water was required to keep the river flowing and maintain water quality. As such, it is now written into drought and dry scenarios to protect these baseflows and avoid catastrophic events such as critical drops in water quality and fish deaths.	
	Provide longitudinal connectivity for local movement, protection from predation, access to food sources and to maintain refuge habitats		Increase the abundance of platypus and rakali			
	Provide hydraulic habitat through sufficient water depth in pools Provide fish passage for local movement through minimum depth over riffles		Increase the distribution and abundance of all native fish species			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
Spring-Summer Fresh 2500 ML/d, 3 days	Inundate higher benches to move organic material into the channel to provide habitat and food sources		Increase the abundance and number of functional groups of macroinvertebrates		Although considered an important flow ecologically for the river and the upper Thomson estuary, providing this flow would require a significant volume and precludes the ability to release other	**L**

(Sep – Dec)	Inundate higher benches to provide water level variability for fringing woody vegetation		Improve native emergent (non-woody) and fringing woody vegetation		priority watering actions in an average climate scenario. Spill releases from Lake Glenmaggie in early spring may naturally provide for the desired objectives in reach **M1**, and as such delivery of this event is not considered an effective use of the environmental entitlement given current volumetric constraints	

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Flow Details***	***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Fresh, anytime 3000 ML/d, 1 day	Provide flows with sufficient shear stress to enable scouring of biofilms and other food sources and prevent accumulation of fine sediment		Increase the abundance and number of functional groups of macroinvertebrates	**<u>Average-Wet Scenario only</u>**: Freshes can potentially be provided during the storage spill season. Provision of this flow can be achieved in small spill years (i.e. <4000 ML/d), by augmenting/piggy-backing the spill volume with an environmental release to meet the recommended magnitude of	Although considered an ecologically important flow for the river and the Upper Thomson estuary, providing this fresh would require a large proportion of the entitlement and preclude the ability to release other priority watering actions. The delivery of this event is not considered an effective use of the environmental entitlement given current volumetric constraints. Spill release from Lake Glenmaggie in early spring have in the past achieved this magnitude for short durations and can naturally provide for the desired objectives of reach **M1**.	**L**
	Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat		Improve physical habitat			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
				flow (3000 ML/d, 1 days), but also to ensure the ramp down rate is conducive to the ecological objective and reduces the risk of bank slumping issues.		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
Spring low flow 300 ML/d, continuous (June – Nov)	Provide fish passage for local movement		Increase the distribution and abundance of all native fish species	In a **dry-drought** and **potentially average scenario** (depending on volume), this flow will not be delivered. In a **wet scenario**, there may be an opportunity to extend baseflows throughout the	Although considered an ecologically important flow for both the river and the Upper Thomson estuary, providing the minimum duration of this baseflow needs to exceed 120 days to achieve partial objectives for reducing vegetation encroachment, which would still require a volume over and above the current entitlement As providing this baseflow at shorter durations (i.e. <120 days) is not considered to contribute towards the objective, delivery of this flow is not considered an effective use of the environmental entitlement given current volumetric constraints.	**L**
	Provide permanent wetted habitat in pools		Increase the abundance and number of functional groups of macroinvertebrates			
	Provide sustained wetting of low-level benches (increasing water depth) to limit terrestrial vegetation encroachment		Improve native emergent (non-woody) and fringing woody vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
				winter and spring months If Lake Glenmaggie does spill, and carryover is "lost" from the account, it may mean there is insufficient water to sustain baseflows for extended periods		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Flow Details	2021-22 Rationale	2021-22 Priority (H/M/L)
Bankfull 10,000 ML/d anytime	Inundate to top of bank to disturb and reset fringing vegetation		Improve native emergent (non-woody) and fringing woody vegetation	This flow is not being considered for the 2021-22 flow year	Although considered an ecologically important flow for the river and the Upper Thomson estuary, providing this bankfull event requires a volume that exceeds the current entitlement volume. Providing this flow event would also elevate the risk of personal injury or damage to property.	**L**
	Inundate to top of bank to maintain gross channel form and prevent channel contraction		Improve physical habitat			

4.2.6 Delivery constraints

Releases during irrigation season

Watering actions that occur during the irrigation season (i.e., mid-August to mid-May), will compete for outlet capacity with irrigation demand. This is particularly the case during the spring/summer season in a drought/dry scenario during which irrigation demand will be high. Whilst the releases of low flows may be provided simultaneously with irrigation orders, SRW have trouble releasing freshes (>700 ML/d) whilst simultaneously meeting irrigation demand. Additionally, releases prior to storage spills are also considered a sensitive issue for the district, as watering releases may reduce the probability of Lake Glenmaggie spilling. A spill bestows significant benefits to consumptive water users through the provision of spill entitlement.

To strike the balance between watering and meeting irrigation demands; the WGCMA and SRW will work together ahead of time (i.e., well in advance of when the watering action is due to be delivered), to work out different scenarios that work best to meet both consumptive and environmental needs. If an environmental watering action is to be delivered during this time, the Macalister Customer Consultative Committee should be engaged prior to the release to convey the collaborative process and the purpose of the release.

The main constraints and issues associated with delivery of the high priority watering actions in the Macalister River are described in

Table 4-4.

Table 4-4 Constraints associated with effective environmental water delivery for the Macalister River

Constraint	Description	Implications for environmental watering
Outlet capacity constraints	Flow releases from Glenmaggie weir can be made through the hydropower plant or the environmental offtake on the northern irrigation channel. Both have capacity constraints The capacity at the hydropower gate is limited by the volume of water in the weir due to changes in head pressure Releases from the environmental offtake are limited in the northern channel as a large volume of irrigation orders will reduce the outlet capacity share available for environmental water To deliver watering actions ≥ 1500 ML/d, the reservoir needs to be a minimum of 119 GL, so that the storage can physically deliver such an event	Environmental watering events planned for release within the irrigation season (i.e., spring and summer freshes) may not be released if large irrigation orders overlap with the release timing To deliver watering events during the irrigation season, the CMA should work through different scenarios with SRW to optimise the timing of the event with irrigation orders and storage spills Providing the storage operator flexibility on the timing of the environmental water release (within ecologically appropriate timeframes) will ensure that environmental watering events are still delivered within the irrigation season Watering events > 1500 ML/d are only planned to piggyback with Lake Glenmaggie spilling.

Constraint	Description	Implications for environmental watering
		Outside of this instance, all other freshes peak at 700 ML/d Piggybacking off Lake Glenmaggie spills will mean notice of a potential release < 1 week; the CMA will need to be ready for such an event (in terms of notifications etc)
Maffra weir filling	SRW will also be gradually filling Maffra Weir during the last week of July 2021 in preparation for the irrigation season	The WGCMA will need to work with SRW to plan the timing of 2021 winter freshes (if any) Winter freshes planned in July/Aug should be timed on either end of the Maffra Weir filling period – timing will be co-ordinated with SRW as a piggybacking event
Fish barrier at Maffra weir	Maffra Weir is operational for nine months of the year and is a fish barrier that inhibits movement of fish species into and out of M1 during this time The presence of a low-level stream gauge weir downstream of Maffra weir is only drowned out during high flows (flows approx. >1300 ML/d) These sequential barriers have meant that any migratory fish species in M1 are trapped and unable to complete their life cycle A fish passage and flow measurement scoping study has been completed, recommending the installation of a vertical slot fishway	Priority watering actions for this system are focussed on the restoration of fish populations – watering actions with fish migration objectives are currently focussed entirely on M2 due to the presence of this barrier Lack of fish passage at this weir reduces the effectiveness of low flows that provide a continuous period of longitudinal connectivity The barrier also limits ability of fish downstream of Maffra Weir from recruiting into M1 which contains higher quality in-stream habitat to increase chances of survival
High reliability and low reliability water allocations	There are two key allocation announcements throughout the water year; July - HRWS, December - remaining HRWS. Following this, allocations are reviewed fortnightly with LRWS provided depending on inflows into Lake Glenmaggie During this time the climate scenario may change from a wet winter/spring to a dry summer/autumn, impacting on the LRWS allocations As the highest priority watering actions occur later in the year (i.e., autumn and winter), they are reliant on the provision of the LRWS	If, during the water year, the climate changes from wet winter/spring to average or dry summer/autumn, there will be insufficient water to deliver both the autumn fresh and the autumn-winter low flow to completion The seasonal outlook forecast will be monitored regularly to assess the appropriateness of flow priorities
Maffra weir gate operations	From mid-August to mid-May, Maffra weir's gates are in operation and open and close in a way to maintain a stable weir pool height The opening and closing of the gates occur throughout the day, resulting in fluctuating water levels during the release of flows > 600 ML/d	The fluctuation of water levels impacts on the delivery of watering events > 600 ML/d These impacts are during the irrigation season from late July 2021 to 1 May 2022 when the weir gates are closed

Constraint	Description	Implications for environmental watering
		Although the effectiveness of these freshes is compromised, fish ecologists from ARI have recommended that fish will still sporadically move with increases in water level
		Deliveries of watering events < 600 ML/d during irrigation season will not be impacted, as they will be passed through the bypass which offers greater stability in flow delivery

4.2.7 Triggers for action

In administering the environmental water reserve for the Macalister River, the West Gippsland Catchment Management Authority use several decision support tools:

- Data and reports from monitoring programs within the systems
- Latest scientific knowledge/understanding relevant to the systems
- System understanding and emerging issues
- Climatic predictions
- Flow modelling and scenario evaluation tool
- Ecological condition
- Historical environmental flow compliance
- Entitlement allocation

This information is used to determine the current and predicted watering operation scenario and flow deliveries for the systems throughout the watering year. Implementation of watering actions will be undertaken collaboratively with Southern Rural Water (SRW), such that events are delivered within the appropriate time frame.

In addition to the regular demands on the system, the broader landscape area has been impacted by the recent fires, with many river systems in neighbouring East Gippsland flowing through burnt out areas and having, or likely to have, ongoing runoff related water quality issues.

Given the population dynamics of migratory fish species, such as Australian grayling who migrate out to the ocean, the larger fish population will have been greatly impacted by the East Gippsland fires and related water quality issues. This raises the importance of flow deliveries targeted at migratory fish migration, spawning and recruitment with the Thomson, Macalister and Latrobe rivers highly likely to be important refuges for fish species and potential source communities for population recovery. This makes all flows related to fish migration, spawning, recruitment and refuge protection the highest priority watering actions for delivery under all climate scenarios.

Delivery of Summer freshes will be heavily dependent on the water quality in the lower sections of M2 over the summer and autumn months. Water quality measurements at an appropriate frequency (to be determined) will be taken by the WGCMA, to monitor dissolved oxygen, pH and turbidity levels in the river. Depending on these results, a summer fresh may be delivered to refresh the waterholes in this part of the river.

Releases will be determined based on water availability, and seasonal conditions.

There are two key allocation announcements throughout the year:

1. In July, High Reliability Water Share (HRWS) allocations are announced with a maximum allocation of up to 100% depending on availability of water stored in the Thomson drought Reserve.
2. December 15th HRWS allocations are reviewed, due to the end of the spilling period with a maximum allocation of 100%.

After the Dec 15th announcement, allocation is reviewed fortnightly. Once 100% HRWS is reached and water is paid back to the Thomson Drought Reserve (should it have been used due to dry conditions in previous year), further inflows into Lake Glenmaggie may lead to an announcement of LRWS with a maximum allocation of 100% i.e. a wet year.

4.2.8 Scenario planning

Four scenarios have been identified for the Macalister River: drought, dry, average and wet (Table 4-5). The logic and evaluation process used for the scenarios is outlined in section 4.2, with scenario planning for the 2020-21 water year summarised in Table 4-6.

Table 4-5 Climate scenario summary for the Macalister River

		Drought	Dry	Average	Wet
Environmental Objectives		**PROTECT** →Protect high priority environmental assets to ensure chance of future recovery →Protect key functions of high priority refuges →Avoid catastrophic events such as large-scale fish kills or toxic blue green algae blooms and critical loss	**MAINTAIN** →Maintain high priority environmental assets to ensure chance of future recovery →Maintain river functioning with reduced reproductive capacity →Maintain key functions of high priority refuges →Avoid catastrophic events such as large-scale fish kills or toxic blue green algae blooms and critical loss	**RECOVER** →Improve ecological health and resilience →Enhance recruitment opportunities for key flora and fauna species →Maximise opportunities for natural inflows to meet in-channel environmental objectives (i.e. piggy-backing)	**ENHANCE** →Maximise recruitment opportunities for key flora and fauna species →Restore key floodplain and wetland linkages →Maximise opportunities for natural inflows to meet in-channel, floodplain and wetland objectives.
Expected River Conditions (e.g. storage levels and potential spills, consumptive demands, passing flows, unregulated flows, etc)	**Passing Flows**	Likely reduced passing flow volumes based on inflows: 35-60 ML/d or natural (as per the Bulk Entitlement Rules)	Likely reduced passing flow volumes based on inflows: 35-60 ML/d or natural (as per the Bulk Entitlement Rules)	Passing flows 60 ML/d	Passing flows 60 ML/d
	Unregulated Flows	No unregulated flows	Potential reservoir spill/s in spring, volume dependent on rainfall; up to minor flood level	Potential reservoir spill/s in spring, volume dependent on rainfall; minor to moderate flood level	Potential reservoir spill/s in spring, volume dependent on rainfall; moderate to major flood level
	Consumptive Water	Very high consumptive water delivery throughout the irrigation season (15 Aug – 15 May) – most of this water diverted downstream of Maffra Weir	High consumptive water delivery from late spring (post-spill period) to end of irrigation season – most of this water diverted downstream of Maffra Weir	Moderate to high consumptive water delivery from later spring (post-spill period) to end of the irrigation season – most of this water diverted downstream of Maffra Weir	Low to moderate consumptive water delivery from late spring (post-spill period) to end of irrigation season – most of this water diverted downstream of Maffra Weir

Table 4-6 Scenario planning for watering actions in the Macalister River over 2021-2022 based on HRWS allocation of 100% and LRWS allocation of 100% as of 9th April 2021. Note: M1 = reach 1, M2 = reach 2 (assessed April 2021).

	Drought	**Dry**	**Average**	**Wet**
Expected allocation volume (GL)	70% HRWS 0% LRWS 8.7 GL	100% HRWS 0% LRWS 12 GL	100% HRWS 20% LRWS 14 GL	100% HRWS 100% LRWS 18.5 GL
Expected Carryover (GL)	9.7 GL	9.7 GL	9.7 GL	9.7 GL
Tier 1a **Priority Watering Actions**	Autumn-Winter low flow 90 ML/d continuous (July-mid August) Spring-Summer low flow 90 ML/d, 7 days following spring fresh (Nov) Summer-Autumn protecting baseflow[1] 40 ML/d, 5-13 days, with a 140 ML/d pulse for 3 days Autumn fresh 350 ML/d, 5 days (April-May) Spring fresh 700 ML/d, 5 days (Sep - Nov) Autumn-Winter low flow 90 ML/d continuous (mid-April-June)	Autumn-Winter low flow 90 ML/d continuous (July-mid August) Spring-Summer low flow 90 ML/d, 7 days following spring fresh (Nov) Summer-Autumn protecting baseflow[1] 40 ML/d, up to 13 days, with a 140 ML/d pulse for 3 days Autumn fresh 350 ML/d, 5 days (April-May) Spring fresh 700 ML/d, 5 days (Sep - Nov) Autumn-Winter low flow 90 ML/d continuous (mid-April-June) Winter fresh 700 ML/d, 5 days (May - June)	Autumn-Winter low flow 90 ML/d continuous (July-mid August) Spring-Summer low flow 90 ML/d, 7 days following spring fresh (Nov) Summer-Autumn 3 x pulses, 140 ML/d, 3 days (Dec - Mar) Autumn fresh 350 ML/d, 5 days (April-May) Spring fresh 700 ML/d, 5 days (Sep - Nov)[2] Autumn-Winter low flow 90 ML/d continuous (mid-April-June) Winter fresh 700 ML/d, 5 days (May - June)	Autumn-Winter low flow 90 ML/d continuous (July-mid August) Spring-Summer low flow 90 ML/d, 7 days following spring fresh (Nov) Summer-Autumn 3 x pulses, 140 ML/d, 3 days (Dec - Mar) Autumn fresh 350 ML/d, 5 days (April-May) Spring fresh 700 ML/d, 5 days (Sep - Nov)[2] Autumn-Winter low flow 90 ML/d continuous (March - June) Winter fresh 700 ML/d, 5 days (May - June)
Tier 1a Water Demand (GL)	**11.1 GL**	**16.3 GL**	**18.8 GL**	**21.4 GL**
Tier 1b	Autumn-Winter low flow 90 ML/d continuous (Mar-Aug)(i.e. extending low flow provision) = additional 1.3 GL Spring-Summer low flow 90 ML/d continuous (Sep-Jan) (i.e. extending low flow provision) = additional 4 GL Autumn-Winter fresh 700 ML/d, 5 days (May - June) = additional 4.7 GL	Autumn-Winter low flow 90 ML/d continuous (Mar-Aug)(i.e. extending low flow provision) = additional 1.3 GL Spring-Summer low flow 90 ML/d continuous (Sep- Jan) (i.e. extending low flow provision) = additional 4 GL	Autumn-Winter low flow 90 ML/d continuous (Mar-Aug)(i.e. extending low flow provision) = additional 1.3 GL Spring-Summer low flow 90 ML/d continuous (Sep- Jan) (i.e. extending low flow provision) = additional 4 GL Piggybacking on a 1500 ML/d spill (Sep - Dec) = additional 3.2 GL (used to shape the ramp down from 1500 ML/d)	Autumn-Winter low flow 90 ML/d continuous (Mar-Aug)(i.e. extending low flow provision) = additional 1.3 GL Spring-Summer low flow 90 ML/d continuous (Sep- Jan) (i.e. extending low flow provision) = additional 4 GL Piggybacking on a 3000 ML/d spill (Sep - Dec) = additional 4.1 GL (used to shape the ramp down from 3000 ML/d) Spring low flow 300 ML/d, continuous for a minimum of 120 days (June – Nov) = additional 28.8 GL
Tier 1b Water Demand (GL)	**10 GL**	**5.3 GL**	**8.5 GL**	**38.2 GL**
Tier 2				
Tier 2 Water Demand (GL)	**0 GL**	**0 GL**	**0 GL**	**0 GL**
High Priority Carryover Requirements	1.9 GL (ensuring provision of July-Aug 90 ML/d low flow continuation)	1.9 GL (ensuring provision of July-Aug 90 ML/d low flow continuation)	1.9 GL (ensuring provision of July-Aug 90 ML/d low flow continuation)	1.9 GL (ensuring provision of July-Aug 90 ML/d low flow continuation)

Footnotes:

[1]Delivery of this event will be dependent on water quality and passing flow volumes in the lower sections of M2.

[2]If possible, the spring fresh can piggyback on a spill event from Lake Glenmaggie (provided a spill occurs by early November – for fish recruitment). This scenario requires varying volumes of the environmental entitlement to either (a) extend the duration of a spill event and/or (b) slow down the ramp down rates of the spill release. Refer to Appendix item 10.2 for further information.

5. Lower Latrobe Wetlands seasonal watering proposal

The following section provides details for the lower Latrobe wetlands 2020-21 proposed watering actions.

5.1 Environmental objectives

Objectives for environmental flows in 2020-21 are derived from the Latrobe Environmental Water Requirements Investigation (LEWRI) (Alluvium, 2019). For this investigation, the environmental objectives were reviewed and updated based on the previous environmental water studies conducted throughout the Latrobe system.

The objectives set reflect the environmental values of the Latrobe system considered important by both waterway managers and the community. Objectives were determined in the context of the current water resource management, likely environmental conditions, including the likely trajectory of the system over the next 50 years, and the social and economic values of the region. In any given year the level at which an objective can be met will vary depending on the extant weather and climate conditions. For this reason, the goals for environmental water management (wetting and drying) for each of the four climactic conditions used in this proposal are as follows:

- Drought — **Protect** high priority environmental assets, key functions and priority refuges to ensure chance of future recovery and avoid catastrophic events such as saltwater inundation of ASS activation,
- Dry — **Maintain** high priority environmental assets, key functions and priority refuges to ensure chance of future recovery and avoid catastrophic events such as saltwater inundation of ASS activation,
- Average — **Recover** by improving ecological health and resilience and enhance recruitment opportunities for key flora and fauna,
- Wet — **Enhance** by maximising recruitment opportunities for flora and fauna species.

Table 5-1 shows the overarching environmental objectives for the wetting and drying of the lower Latrobe wetlands. The specific values and functions achieved addressing each objective with the wetting/drying actions are shown in (Alluvium, 2020b).

Table 5-1 Overarching environmental objectives for the lower Latrobe Wetlands (adapted from Alluvium, 2020).

Symbol	Environmental objective
	Maintain or restore condition and diversity of **aquatic, fringing and riparian vegetation**, and reduce extent of **invasive plant species**
	Maintain or enhance **waterbird and threatened fauna** breeding, recruitment, foraging and nesting/sheltering opportunities
	Maintain abundance of freshwater turtle populations
	Maintain abundance of **frog populations**
	Provide suitable **physio-chemical conditions** to support aquatic biota including Acid Sulfate Soil inundation
	Provide critical watering or drawdown to **avoid catastrophic conditions**

5.2 Wetting/drying requirements

5.2.1 Watering components

Table 5-2 summarises functional objectives for the three main watering components for the lower Latrobe wetlands. These components are used to describe the wetting and drying recommendations in section 5.2.2.

Table 5-2 Summary of functional objectives for each watering component for the lower Latrobe wetlands.

Watering component	Objective
Fill/partial fill	inundation event or events sufficient to fill or partially fill the wetland, typically aimed at supporting waterbird or fish breeding as well as inundating aquatic and semi-aquatic vegetation
Drawdown	a period of receding water levels resulting in large areas of the wetland surface drying out. Allowing soil to oxygenate and terrestrial vegetation to set seed
Flushing flow	inflow sufficient to push water into and out of the wetland and fill it. Typically allowing for import and export of nutrients and dissolved organic carbon

5.2.2 Wetting-drying recommendations

The water levels, timing, duration and frequency outlined in the wetting and drying recommendations are derived from objectives, using conceptual models as described in the Latrobe Environmental Water Requirements Investigation (Alluvium, 2020c).

Flushing flows are currently undeliverable flow components at Dowd Morass and Sale Common, due to limitations of infrastructure. Partial flushing flows are achievable at Heart Morass, however, outflows from the wetland are affected by river heights at the outflow regulator limiting the volume of water which can be returned to the river.

5.3 Scenario planning and prioritisation

5.3.1 Observations and provision of wetting/drying recommendations

Table 5-3 Historical achievement of water regime recommendations at Dowd Morass. Blank cells = no data; N=provided naturally; A = provided through active management

Water regime component	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21
Dowd Morass												
Fil/partial fill	N	N	A/N	N	N	N	A/N	A	A	A/N	A/N	A/N
Flushing flow		N	N	N			N			N	N	N
Drawdown			N	N	N	N	A/N	N	N	N	N	N

Heart Morass												
Fil/partial fill	N	N	N	N	N		A/N	A	A	A	A	A
Flushing flow		N	N	N			N		A	A	A	A
Drawdown			N	N	N	N	N	N	N	N	N	N
Sale Common												
Fil/partial fill	N	N	A/N	N	N		A/N	A	A	A	A	A
Flushing flow		N	N									
Drawdown			N	N	N	N	N	N	N	N	N	N

Key to table

	No significant part of the water regime component provided naturally or through active management
	Water regime component partially provided
	Water regime component completely provided

Observations

All three wetlands have received filling flows throughout 2020-21. Overland flows provided most water observed in Dowd Morass, whereas water in Sale Common and Heart Morass was delivered through managed structures.

Minimal monitoring occurred throughout the year due to COVID restrictions however, Birdlife Australia has reported four Male Australian Bitterns at Sale Common, suggesting that breeding may have occurred. While a member of the public submitted a photo of the Musk Duck, also observed at Sale Common, a culturally significant species the Gunaikurnai.

Figure 5-1 Aerial photo of Heart Morass (left) and Dowd Morass (right) after significant inflows in November 2020

Figure 5-2 Photo of a Musk Duck in Sale Common (September 2020, Photo Credit: Mark Riggs)

Figure 5-3 Photo showing high water levels at Sale Common in November 2020 (Photo Credit: Mark Riggs)

5.3.2 Potential watering actions

Potential watering actions for 2021-22 are focused on enhancing the achievements of 2020-21, protecting high priority environmental assets as well as protecting key ecohydrological functions and high priority refuges. The watering actions are also aimed at preventing catastrophic reduction in water quality resulting in vegetation die off and acid events caused by drying and rewetting acid sulfate soils. Each of the wetlands have experienced recent extensive drying, it is important to capitalise on the natural filling experienced this year to ensure good recruitment of wetland vegetation and maintenance of habitat for endangered waterbirds and other fauna such as the Australian Bitterns and the Growling Grass frog. Potential watering actions for 2021-22 are shown in Table 5-4 (Dowd Morass), Table 5-5 (Heart Morass), and Table 5-6 (Sale Common)

Gunaikurnai Dowd Morass watering event(s)

Opportunities to enhance environmental watering with Traditional Owner outcomes are being explored for the Lower Latrobe Wetlands. The Gunaikurnai Land and Water Aboriginal Corporation (GLAWAC) and WGCMA are working together to pursue a Gunaikurnai cultural watering event at Dowd Morass. The overarching objective is to target a section of the morass to support culturally important species that depend on freshwater. The water would be delivered by pumping water further upstream of the Latrobe than the existing regulator through non-permanent infrastructure at a western point of a more confined pool. Initially the water quality will be compared with an adjacent section that will not directly receive the watering. The watering would be at a time aligned with a Gunaikurnai Community event at Dowd morass and appropriate seasonal conditions (species requirements, water quality and weather) for Healthy Country.

Operation of the existing infrastructure will complement the intended outcome of the watering and monitoring of water quality will be conducted before during and after the event.

Preliminary estimated cost of one water delivery event (based on previous estimates received for pumping water into Sale Common) is $30,000 to $50,000 depending on the condition of the wetland at the time of the event. Appropriate works approvals, cultural heritage approvals and risk assessments will be completed in partnership with interested parties (Parks Victoria, GLaWAC and the VEWH).

Table 5-4 Dowd Morass prioritised potential watering actions for 2021-22.

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
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		Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities	In the event of bird breeding, water should be provided to maintain habitat and food to support the breeding event and fledging.	H
Fill with top ups as required to manage 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		Provide critical watering or drawdown to avoid catastrophic conditions Provide suitable physio-chemical conditions to support aquatic biota including Acid Sulfate Soil inundation	This watering action is likely to be triggered if electrical conductivity is rising and reaches 7,000 µS/cm	H
Partial fill with top ups as required to maintain a minimum water depth 0.3 m AHD (April-December)	• 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 water bugs 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		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	Ten partial fills over ten years are the longterm frequency recommendations for Dowd Morass. This watering action, along with the partial drawdown will help maintain the wetland ecosystem after a wet 2019-21.	H
			Maintain abundance of freshwater turtle populations		
			Maintain abundance of frog populations		
			Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities		
Fill with top-ups as required to maintain a minimum water depth of 0.6 m AHD (August-November)	• Reduce salt water incursion from Lake Wellington • Wet reed beds and deep water next to reedbeds to provide waterbird nesting habitat and to stimulate bird breeding • Wet high-elevation banks and 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 water bugs 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		Provide critical watering or drawdown to avoid catastrophic conditions	This watering action has a low priority as it was met last year. It still remains a priority as it is recommended to occur six times in every ten years.	L
			Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species		
			Maintain abundance of freshwater turtle populations		
			Maintain abundance of frog populations		
			Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities		
Partial drawdown (0 m AHD (January- March)	• Oxygenation of sediment for aquatic vegetation germination and recruitment		Maintain or restore condition and diversity of aquatic, fringing and riparian	Partial drawdowns are recommended to occur ten times over ten years. It is likely to occur naturally through evaporation.	M

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Rationale	2021-22 Priority (H/M/L)
	• Provide water level fluctuations for emergent vegetation reproduction and expansion (particularly Swamp Scrub and Tall Marsh) • Breakdown organic matter and promote nutrient cycling • Additional function supported: Minimise European Carp (reduce habitat)		vegetation, and reduce extent of invasive plant species		

Table 5-5 Heart Morass prioritised potential watering actions for 2021-22

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Top ups as required to maintain a minimum water height of -0.3 AHD (anytime)	• Minimise acid sulphate soil risk by keeping high risk areas inundated		Provide suitable physio-chemical conditions to support aquatic biota including Acid Sulfate Soil inundation	This watering action is required in order to minimise the risk of exposing acid sulfate soils to the air.	H
			Provide critical watering or drawdown to avoid catastrophic conditions		
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		Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities	In the event of bird breeding, water should be provided to maintain habitat and food to support the breeding event and fledging.	H
Partial fill with top ups as required to maintain a minimum water depth 0.3 m AHD (August-December)	• Encourage growth and flowering of submerged and emergent vegetation • Provided habitat for frogs and turtles • Provide conditions that support macroinvertebrate and zooplankton communities, and food resources for waterbirds • Additional functions supported: Macroinvertebrate populations expand, and Fish grow		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	Ten partial fills over ten years are the longer term frequency recommendations for Heart Morass. This watering action, along with the partial drawdown will help maintain the wetland ecosystem after a wet 2019-20.	H
			Maintain abundance of frog populations		
			Maintain abundance of freshwater turtle populations		
			Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities		
Fill with top-ups as required to maintain a minimum water depth of 0.5 m AHD (August – November)	• Inundate fringing vegetation reproduction water bird habitat and foraging and terrestrial avian species foraging • Provide connectivity and support food sources for frogs and Turtles , and support nesting for turtles • Inundate fringing wetland vegetation E.g. Floodplain Riparian Woodland (EVC 56) • Allow macroinvertebrate populations to expand, stimulate fish growth and breeding		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	This watering action has a low priority as it was met last year. It still remains a priority as it is recommended to occur six times in every ten years.	L
			Maintain abundance of frog populations		
			Maintain abundance of freshwater turtle populations		
			Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities		
Partial flushing flow (July – November) (combination or fill and drawdown actions	• Export sulfides and salt		Provide suitable physio-chemical conditions to support aquatic biota including Acid Sulfate Soil inundation	Outcomes from previous years suggest this watering action is contributing to the overall decline in salinity and increase in pH. We will continue to provide these flows if the conditions allow.	M
Partial drawdown (-0.3 m AHD (January- March)	• Oxygenation of sediment for aquatic vegetation germination and recruitment • Provide water level fluctuations for emergent vegetation reproduction and expansion		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	Partial drawdowns are recommended to occur five times over ten years. It is likely to occur naturally through evaporation.	L

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2021-22 Rationale	2021-22 Priority (H/M/L)
	(particularly Swamp Scrub and Tall Marsh) • Breakdown organic matter and promote nutrient cycling • Additional function supported: Minimise European Carp (reduce habitat)				

Table 5-6 Sale Common prioritised potential watering actions for 2021-22.

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2021-22 Rationale***	***2021-22 Priority (H/M/L)***
Partial fill with top ups as required to maintain a minimum water height of 0.3 AHD (July to December)	• Encourage growth and flowering of submerged and emergent vegetation • Provided habitat for frogs and turtles • Provide conditions that support macroinvertebrate and zooplankton communities, and food resources for waterbirds • Additional functions supported: Macroinvertebrate populations expand, and Fish grow		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	Ten partial fills over ten years are the longer term frequency recommendations for Heart Morass. This watering action, along with the partial drawdown will help maintain the wetland ecosystem after a wet 2019-21.	H
			Maintain abundance of frog populations		
			Maintain abundance of freshwater turtle populations		
			Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities		
Fill with top ups as required to maintain a minimum water height of 0.4 AHD (August to November) for at least 2 months	• Encourage growth and flowering of submerged and emergent vegetation • Inundate fringing wetland vegetation • Provide food source and connectivity for frogs • Provide food source and nesting opportunities for turtles • Support breeding and provide food source for waterbirds and other threatened fauna • Support terrestrial and water bird foraging by Inundate fringing vegetation • Provide conditions that support macroinvertebrate and zooplankton communities, and food resources for waterbirds • Additional functions supported: Macroinvertebrate populations expand, and Fish grow and stimulated to breed		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	This watering action remains a high priority due to the extended dry period experience between 2017 and 2019. Maximising the fill period will help maintain and restore vegetation, populations intern supporting other ecosystem functions.	H
			Maintain abundance of frog populations		
			Maintain abundance of freshwater turtle populations		
			Maintain or enhance waterbird and threatened fauna breeding, recruitment, foraging and nesting/sheltering opportunities		
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		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	In the event of bird breeding, water should be provided to maintain habitat and food to support the breeding event and fledging.	H
			Maintain or enhance waterbird and threatened fauna breeding, recruitment,		

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2021-22 Rationale*	*2021-22 Priority (H/M/L)*
			foraging and nesting/sheltering opportunities		
Fill/top-up as required to 0.5 AHD (December – January) to drown out and prolong inundation of invasive vegetation	• Discourage undesirable/invasive plant species		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	If warm dry conditions prevail and wetland water levels drop, Giant rush are likely to proliferate. It will be important to provide adequate depth to reduce the extent of giant rush throughout the wetland.	H
Partial drawdown to -0.2 m AHD (December - March)	• Oxygenation of sediment for aquatic vegetation germination and recruitment • Provide water level fluctuations for emergent vegetation reproduction and expansion (particularly Swamp Scrub and Tall Marsh) • Breakdown organic matter and promote nutrient cycling • Additional function supported: Minimise European Carp (reduce habitat)		Maintain or restore condition and diversity of aquatic, fringing and riparian vegetation, and reduce extent of invasive plant species	Partial drawdowns are recommended to occur ten times over ten years. It is likely to occur naturally through evaporation.	L

5.3.3 Delivery constraints

The delivery constraints within the lower Latrobe wetlands expose the wetlands to two major threats. Salinity and Acid Sulfate Soils. The most significant threat to ecological condition, particularly at Sale Common, is the availability of freshwater. Watering of all three wetlands is reliant on Latrobe River heights and hydraulic head difference between the river and wetlands. This is largely because the infrastructure used was originally designed to drain the wetlands for agricultural purposes as opposed to filling them or retaining floodwaters for ecological benefit. Furthermore, the movement of marine water through McLennan Straits to Lake Wellington has acted to increase salinity in the waterways of the lower Latrobe further reducing the availability of suitable water for the wetlands.

Acid Sulfate Soils (ASS) are prevalent in Dowd and Heart Morass. As the wetlands dry, there is a potential for activation of the ASS if the soils oxidise and is then rewet. The ASS risk is most prevalent at Heart Morass where the effected soils are more exposed to drying. With dry conditions, the threat of an acid event in Heart Morass (and Dowd to a lesser extent) is increased.

Operating Arrangements for the Lower Latrobe River Wetlands Environmental Entitlement have been signed by stakeholders (VEWH, SRW, WGCMA & PV, 2015). Refer to this document for delivery and operating processes and constraints. Additional delivery constraints are listed in Table 5-7.

Table 5-7 Delivery constraints for carrying out the watering regime for the lower Latrobe wetlands.

Potential Constraint	Dowd Morass	Heart Morass	Sale Common	Impact
Environmental flows from the Latrobe, Thomson and Macalister rivers not delivered or delayed	✓	✓	✓	Limited capacity to deliver priority actions due to river conditions.
Lack of resources to operate infrastructure.	✓	✓	✓	Missed watering opportunities.
Size of infrastructure		✓	✓	Unable to deliver sufficient volumes of water
Lack of water quality	✓	✓	✓	Limited capacity to deliver priority actions due to river conditions
Lack of river height			✓	Unable to deliver sufficient volumes of water
Only one inlet/outlet structure	✓		✓	Missed watering opportunities or unable to deliver sufficient volumes of water
Infrastructure vulnerable to vandalism	✓		✓	Unauthorised watering or drawdown allowing water of poor quality to enter wetland

5.3.4 Triggers for action

A water management risk assessment performed for the lower Latrobe wetlands (Hale & Boon, 2019). As part of this risk assessment the following recommendations was proposed:

- For Sale Common, it is far better to allow the wetland to dry than to put water in it with a salinity of > 5000 □S/cm. There is some risk to the site at the upper end of this range
- For Dowd Morass, there is only a small risk if water up to 15,000 □S/cm is used to fill the wetland. When it comes to allowing the wetland to dry, however, while a dry cycle would be beneficial, we do not believe that this is likely to be achievable. It is more likely that if there is no (or little) water in Dowd Morass, then much more saline water will flow in from Lake Wellington, and this is a considerable risk, particularly if the site is not able to be flushed and there is a continued build-up of salts
- For Heart Morass, the situation is more difficult to interpret. Certainly, there is low risk in filling the wetland with water in the 5000 – 10,000 □S/cm range. There is a great deal of uncertainty surrounding the potential effects of activation of ASS and using more saline water to fill the wetland. While the empirical evidence would suggest that low pH and high salinity both represent a risk to values, there is historical evidence that the site is resilient to both these conditions. The question remains about how long this resilience can be expected to continue (in the absence of a flushing flow) and are we approaching a critical threshold with respect to the duration, frequency or severity of low pH and / or high salinity at this site

Table 5-8 summarises these recommendations into triggers for actions for each wetland.

Table 5-8 Triggers for the implementation of the seasonal watering proposal for the lower Latrobe wetlands EC = Electrical Conductivity, a measure of salinity. Swing bridge is the location and name of the gauge used to monitor water level and quality in the lower Latrobe River.

Watering action	Wetland	Trigger
Partial fill (April - December)	Dowd Morass	Divert water if Latrobe river EC is substantially less than Lake Wellington, up to 15,000 µS/cm
Acid sulfate soils inundation (any time)	Heart Morass	Divert water in to maintain water levels above -0.3 m AHD, preferable EC < 1,500 µS/cm, however if critical < 10,000 µS/cm may be used
Fill and partial fills (any time)	All	Divert water if EC in the Latrobe River (Swing bridge) at the top of the water column is <1,500 µS/cm. If > 1,500 µS/cm, undertake spot readings at each regulator, open if EC is <1,500 µS/cm (<1,000 µS/cm for Sale Common), Continue to monitor
Fill and partial fills (any time)	Sale Common	Assuming the water quality conditions above are met, divert water in if the water level at Swing Bridge is: a) greater than 0.4 m AHD and will potentially remain above the threshold for more than 10 days (i.e. no strong wind or storm warmings); and b) the water level in Sale Common is not higher than the Latrobe River

5.3.5 Scenario planning

Four scenarios have been identified for the lower Latrobe wetlands system: drought, dry, average and wet. They were developed in conjunction with Southern Rural Water to be

consistent with the scenarios for the rivers that supply the wetlands for which seasonal watering proposals are also being prepared (Latrobe, Thomson and Macalister rivers). The scenarios are defined in terms of the likelihood and magnitude of overbank flooding as this is the major determinant of changes in environmental watering decisions with climatic variation.

Table 5-9 shows the expected climactic conditions, estuary conditions and environmental objectives for each wetland. Table 5-10 shows the scenario planning and tiered watering actions for the 2021-22 water year. Tier 1a actions have been split into those actions which will be met naturally and those which will require intervention. This is particularly relevant for draw down events which are most likely to require intervention in average a wet climate in order to achieve them, however they are likely to occur natural through evaporation in drought and dry conditions.

Table 5-9 Expected climactic and estuary conditions, and environmental objectives for the Lower Latrobe Wetlands.

<table>
<tr><th colspan="2"></th><th>Drought</th><th>Dry</th><th>Average</th><th>Wet</th></tr>
<tr><td rowspan="3">Expected climatic conditions and water availability</td><td>Dowd Morass</td><td rowspan="3">No riverine inflows. Likely to dry completely.</td><td>Minor winter/spring inflows to western Dowd Morass if minor flooding occurs (unlikely). Moderate-substantial drawdown likely over summer/autumn depending on volume of natural inflows</td><td rowspan="3">Moderate winter/spring inflows (some flushing), and possibly also in autumn/winter. Wetland could be filled naturally, with minor drawdown over summer</td><td rowspan="3">Major flushing in winter/spring and probably also autumn/winter. Wetland will be filled naturally, with very minor drawdown over summer</td></tr>
<tr><td>Heart Morass</td><td>Minor winter/spring inflows to eastern Heart Morass if minor flooding occurs (unlikely). Moderate-substantial drawdown likely over summer/autumn depending on volume of natural inflows</td></tr>
<tr><td>Sale Common</td><td>No riverine inflows. Likely to dry completely</td></tr>
<tr><td rowspan="3">Expected estuary conditions</td><td>Upper Estuary</td><td>Low river levels, extended periods of saline conditions</td><td>Low river levels, periods of saline conditions</td><td>Average river levels (fluctuating), 1-2 overbank flows, mostly freshwater conditions</td><td rowspan="3">Extended periods of high river levels, two or more overbank flows, mostly freshwater conditions</td></tr>
<tr><td>Mid Estuary</td><td rowspan="2">Low river levels, saline conditions</td><td rowspan="2">Low river levels, saline conditions</td><td rowspan="2">Average river levels (fluctuating), 1-2 overbank flows, periods of saline conditions</td></tr>
<tr><td>Lower Estuary</td></tr>
<tr><td colspan="2">Environmental objectives</td><td>Protect
Promote oxygenation of surface soils, breakdown of</td><td>Recover
Promote oxygenation of surface soils, breakdown of</td><td>Maintain
Encourage the growth and reproduction of</td><td>Enhance
Maximise colonial waterbird breeding opportunities</td></tr>
</table>

	Drought	Dry	Average	Wet
	accumulated organic matter and nutrient recycling • Encourage the growth and reproduction of wetland plants across the bed of the wetland • Reduce the number and size of European carp • Avoid/mitigate risks to wetland plants and waterbird habitat from adverse salinity/pH conditions (Dowd Morass and Heart Morass) • Mimic the natural inundation regime	accumulated organic matter and nutrient recycling • Encourage the growth and reproduction of wetland plants across the bed of the wetland • Reduce the number and size of European carp • Encourage the growth and reproduction of wetland plants, particularly Swamp Scrub, Tall Marsh, Aquatic Herbland and Brackish Herbland • Discourage the spread of Giant Rush (*Juncus ingens*) (Sale Common). • Provide feeding habitat for wetland fauna, particularly waterbirds • Import organic matter and nutrients. • Reduce salinity and maintain/increase pH • Import seed/propagules. • Avoid/mitigate risks to wetland plants and	wetland plants across the bed of the wetland • Encourage the growth and reproduction of wetland plants, particularly Swamp Scrub, Tall Marsh, Aquatic Herbland and Brackish Herbland. • Provide feeding habitat for wetland fauna, particularly waterbirds • Encourage the growth and reproduction of wetland plants across the bed of the wetland • Discourage the spread of Giant Rush (*Juncus ingens*) (Sale Common). • Import organic matter and nutrients • Reduce salinity and maintain/increase pH (Dowd Morass and Heart Morass) • Import seed/propagules. • Avoid/mitigate risks to wetland plants and waterbird habitat from	• Encourage the growth and reproduction of Aquatic Herbland and Brackish Herbland (Dowd Morass and Heart Morass) and Tall marsh (Sale Commons) • Encourage recolonisation of submerged aquatic plants • Maintain/enhance condition and extent of structurally dominant plants such as Swamp Paperbark (*Melaleuca ericifolia*), Common Reed (*Phragmites australis*) and River Red Gums (*Eucalyptus camaldulensis*). • Maximise waterbird and fauna breeding, recruitment, foraging and sheltering opportunities • Maximise importation of organic matter and nutrients • Export salt and increase pH (Dowd and Heart Morass)

	Drought	Dry	Average	Wet
		waterbird habitat from adverse salinity/pH conditions • Mimic the natural inundation regime	adverse salinity/pH conditions (Dowd Morass and Heart Morass) • Mimic the natural inundation regime. • Reduce the number and size of European carp • Promote oxygenation of surface soils, breakdown of accumulated organic matter and nutrient recycling	• Maximise dispersal of seed/propagules. • Provide breeding habitat for Growling Grass Frog and Green and Golden Bell Frog • Facilitate movement of Dwarf Galaxias (*Galaxiella pusilla*) from/to Flooding Creek and Cox's Bridge populations (Sale Common) • Mimic the natural inundation regime

Table 5-10 Scenario planning for environmental water deliver to the Dowd Morass, Heart Morass and Sale common for 2021-22

		Drought	Dry	Average	Wet
Dowd Morass	Tier 1 potential natural watering	Partial drawdown (January-March)	Partial drawdown (January-March) Partial fill (April- December)	Partial fill (April- December) Fill (August-November)	Partial fill (April-December) Fill (August-November)
	Tier 1 potential watering intervention	Bird breeding top-up (anytime) Salinity management fill (anytime) Partial fill (April- December) Fill (August-November)	Bird breeding top-up (anytime) Salinity management fill (anytime) Fill (August-November)	Bird breeding top-up (anytime) Salinity management fill (anytime) Partial drawdown (January-March)	Bird breeding top-up (anytime) Salinity management fill (anytime) Partial drawdown (January- March)
	Tier 1 estimated environmental water demand	0-9,000 ML	0-9,000 ML	0-9,000 ML	0-9,000 ML

	Tier 2 potential watering actions Tier 2 estimated environmental water demand	Nil			
Heart morass	Tier 1 potential natural watering	Partial drawdown (January-March)	Partial drawdown (January-March)	Partial fill (August- December) Fill (August – November)	Partial fill (August-December) Fill (August – November) Partial flushing flow (July – November)
	Tier 1 potential watering intervention	ASS top ups (anytime) Bird breeding top-up (anytime) Partial fill (August-December) Fill (August – November) Partial flushing flow (July – November)	ASS top ups (anytime) Bird breeding top-up (anytime) Fill (August – November) Partial flushing flow (July – November) Partial fill (August- December)	ASS top ups (anytime) Bird breeding top-up (anytime) Partial flushing flow (July – November) Partial drawdown (January-March)	ASS top ups (anytime) Bird breeding top-up (anytime) Partial drawdown (January- March)
	Tier 1 estimated environmental water demand	0-24,000 ML	0-24,000 ML	0-24,000 ML	0-24,000 ML
	Tier 2 potential watering actions Tier 2 Estimated water requirement	Nil			
Sale Common	Tier 1 potential natural watering	Partial drawdown (December -March)	Partial drawdown (December -March)	Partial drawdown (December -March)	Partial fill (July to December) Fill (August to November)
	Tier 1 potential watering intervention	Partial fill (July to December) Fill (August to November) Bird breeding top-up (anytime) Invasive veg top up (December-January)	Partial fill (July to December) Fill (August to November) Bird breeding top-up (anytime) Invasive veg top up (December-January)	Partial fill (July to December) Fill (August to November) Bird breeding top-up (anytime) Invasive veg top up (December-January)	Bird breeding top-up (anytime) Invasive veg top up (December-January) Partial drawdown (December -March)

	Tier 1 estimated environmental water demand	0-5,000 ML	0-5,000 ML	0-5,000 ML	0-5,000 ML
	Tier 2 potential watering actions	Nil			
	Tier 2 estimated environmental water demand				

6. Risk management & Engagement

6.1. Risk management

A risk assessment workshop hosted by the Victorian Environmental Water Holder (VEWH) was held in February 2021. Risks and mitigation strategies identified at this workshop are shown in Table 6-1.

Table 6-1 Risk assessment for 2021/22 watering proposal – Macalister, Latrobe and Thomson systems (DG Consulting 2021)

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
All	Env	Target flows may not be achieved if tributary inflow contributions are lower than forecast.	Possible	Minor	Low	• Experience from recent events to be reviewed to inform planning. • Rainfall and catchment responses to be closely monitored during events and adjustments made to planned releases as necessary (using data inputs from storage operators).	WGCMA
All	Env	Timing of environmental flow releases adversely impacts on Australian grayling breeding	Unlikely	Moderate	Low	• Base timing for events on monitoring data collected to date and improved knowledge from FLOWS study • Share updated information on Australian grayling behaviour with other relevant waterway managers.	WGCMA
All	Rep	Inability to demonstrate outcomes achieved through environmental watering activities lead to a loss of public/political support for activities	Possible	Moderate	Medium	• Communicate benefits of environmental watering to the broader community and government and clarify various roles in environmental watering activities. • Implement community engagement strategy to communicate local successes and benefits from environmental watering and engage the community & EWAGS in environmental water management.	VEWH WGCMA
All	Env	Current adopted environmental flow recommendations fail to achieve the intended environmental objectives	Unlikely	Major	Low	• Undertake monitoring and research to improve understanding of ecological responses and review flow recommendations if required. • Implement results of recent flow study reviews, including using findings from other systems, and undertake review of flow studies in the Latrobe and Thomson.	WGCMA
All	Legal	Environmental releases cause unauthorised inundation of private land, resulting in impacts on landowner activities and assets.	Possible	Moderate	Medium	• Update and ensure currency of any applicable agreements covering inundation of private land. • Development of cautious release plans designed to avoid overbank flows. • Monitoring of events and providing feedback to the storage operator for adjustment of releases to avoid overbank flows. • Communications to alert community of environmental watering	WGCMA

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
						actions. • Ensure pre-order communications process in Operating Arrangements document are implemented	
All	Env	Constraints to environmental releases such as limited river channel capacity (and risk of flooding private land) and limited discharge capacity at low storage levels constrain environmental releases, leading to a failure to achieve environmental objectives across the system	Possible	Major	Medium	• Update and ensure currency of any applicable agreements covering inundation of private land. • Development of cautious release plans designed to avoid overbank flows. • Monitoring of events and providing feedback to the storage operator for adjustment of releases to avoid overbank flows, particularly where landholder agreements are not in place. • Development of a strategy to address environmental flow limits. *Note: CMA is developing alternate release options to address constraints in the Latrobe, possibly using Moondarra & Narracan reservoirs*	WGCMA
All	Safety	Environmental flow releases lead to safety risks to river users.	Unlikely	Extreme	Medium	• Include ramp-ups and ramp-down phases in release plans to reduce rapid water level changes. • Appropriate communications actions to alert users, especially for high use sites and high use periods. • Encourage river users to subscribe to website notification services of flow plans. • Implement communications plan about environmental water releases *(Note: This risk is still rated as medium after mitigation actions.)*	WGCMA

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
All	Env	Environmental releases do not achieve planned/specified flow targets due to competing demand, outlet capacity constraints or maintenance at reservoirs	Possible	Minor	Low	• Scheduling of maintenance outside high demand periods (i.e. current practice). • Testing seasonal watering proposals with storage operators. • Communications on planned asset outages through BE holders' forums	Storage operator WGCMA Storage Operator
All	Env	Environmental releases do not achieve planned/specified flow targets due to releases being diverted by other users before reaching delivery site.	Unlikely	Minor	Low	• Ensure diversions field staff are aware of planned events and are managing compliance with orders by all users. • CMA and SRW to collaborate to assess the scope of risks associated with diversion of environmental flows	SRW CMA
All	Rep	Environmental deliveries affect water quality for urban purposes, leading to shortfalls in urban supply. *Note: Warragul and Moe urban supplies in the Latrobe system have been interconnected, providing greater resilience for towns in the region. Maffra on the Macalister still remains vulnerable as there is limited urban storage. The upcoming augmentation of the Heyfield Water*	Unlikely	Moderate	Low	• Communication and consultation with urban water authority to understand issues and concerns, and to provide 2 weeks advance notice of flow changes where possible • Modify delivery plans to reduce potential water quality impacts where possible, particularly in peak urban demand periods. • Include consideration of options for meeting demands from Lake Narracan where possible.	WGCMA WGCMA SRW

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
		Treatment Plant to Coongulla system will also provide greater resilience for towns in the region					
All	Env	Works on waterway structures may prevent optimal timing of environmental deliveries, resulting in environmental impacts	Possible	Minor	Low	• Consultation on any proposed works and inclusion of appropriate conditions on works approvals/licences to ensure that there are no unacceptable impacts on timing and flow rates for environmental releases.	WGCMA
All	Repl	Any public safety risks posed by consumptive water releases are misconstrued as environmental water releases and are detrimental to the environmental water brand.	Possible	Moderate	Medium	• Broadcast a year-round public safety message raising awareness that river levels may rise and fall quickly due to irrigation releases and environmental watering. • Notification processes for environmental water delivery clarify the role of environmental water in river operations • Environmental water engagement plan also improves understanding of environmental water actions • Undertake state-wide programs to increase environmental water understanding	Storage operator (&WGCMA) WGCMA WGCMA VEWH
All	Env	Insufficient water available to undertake planned environmental release actions.	Unlikely	Moderate	Low	• Undertake planning that considers the range of seasonal conditions or water availability scenarios that may unfold. • Manage carryover and consider trade as options to lessen the risks posed by supply shortfalls. • Consider options that combine environmental water with other sources (e.g. consumptive water en-route or withheld passing flows) to achieve hydrological objectives • For Thomson optimise passing flows in July/August to create water savings for use later in the season, including consideration of risk allocation for environmental and consumptive entitlement holders. (May require revision to OA document). - *Not for 21/22, further analysis required*	WGCMA VEWH/ WGCMA WGCMA WGCMA

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
All	Env	Debris from bushfires, including ash, or erosion from drought affected areas may enter reservoirs or waterways, leading to adverse environmental impacts	Possible	Moderate	Medium	• Monitor ash related water quality issues and adjust environmental water releases as required to mitigate impacts	WGCMA
All	Rep	Insufficient resources available (including staff, funding for maintenance of roads, regulators etc), across partner organisations to deliver some planned environmental watering actions, leading to cancellation or interruptions of deliveries. *Note: Cumulative impacts of repeated cancellation may increase risk*	Unlikely	Moderate	Low	• Partners notify the CMA and VEWH of resourcing constraints in advance of deliveries and VEWH convenes meetings to consider implications and potential solutions, including seeking access to additional funding. • Continue to actively prioritise actions to match available resources and ensure key actions are delivered. • Reallocation of tasks and available funding.	VEWH WGCMA WGCMA
All	Safety	Environmental watering generates or spreads a BGA bloom resulting in human health risks	Unlikely	Minor	Low	• Warning signage and notifications • Consider amending delivery plans to reduce risks • Activate and participate in regional BGA coordination process	Land manager WG CMA DELWP Gippsland
Thomson	Business Costs	Inaccurate forecasts (underestimate) of tributary inflows may result in environmental flow targets being exceeded at the delivery site, with more environmental water released than necessary	Likely	Minor	Low	• Investigate options for improved control of releases to better match actuals to ordered flows. • Use best available forecasting of tributary flows to determine required releases.	Storage operator

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
Thomson	Service	Rapid filling of Heyfield Wetlands in dry conditions may lead to slumping of wetland pond banks, impacting on environmental values of the wetlands.	Unlikely	Minor	Low	• Monitoring will be undertaken during deliveries to detect any signs of slumping and pumping rates will be reduced if necessary. • Selection of water entry point in the rocky side of the pond to further prevent slumping/erosion	GW
Latrobe River	Business Costs	Inaccurate forecasts (underestimate) of tributary inflows may result in environmental flow targets being exceeded at the delivery site, with more environmental water released than necessary	Unlikely	Minor	Low	• Investigate options for improved control of releases to better match actuals to ordered flows. • Use best available forecasting of tributary flows to determine required releases.	Storage operator
Latrobe River	Env	Environmental releases may conflict with timing of recreational water-skiing events on the Latrobe River, leading to a reduction in environmental releases and inability to achieve environmental benefits.	Unlikely	Moderate	Low	• Communication and early advice of proposed ski events. • Review delivery plans and adjust schedules to reduce or avoid clashes with ski events	Storage Operator WGCMA
Latrobe River	Env	Constraints to environmental releases such as limited river channel capacity (and risk of flooding private land) and limited discharge capacity at low storage levels constrain environmental releases, leading to a failure to achieve environmental objectives	Possible	Moderate	Medium	• Update and ensure currency of any applicable agreements covering inundation of private land. • Development of cautious release plans designed to avoid overbank flows. • Monitoring of events and providing feedback to the storage operator for adjustment of releases to avoid overbank flows, particularly where landholder agreements are not in place. • Development of a strategy to address environmental flow limits. (including consideration of supplements from Moondarra and Narracan	WGCMA
Lower Latrobe Wetlands	Env	Timing of environmental flow diversions into wetlands adversely impacts	Unlikely	Moderate	Low	• Plan regulator operations to minimise potential impacts on Australian grayling eggs and modify wetland filling procedures as required. • Further analysis through VEFMAP to understand risk issues	WGCMA WGCMA

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
		on Australian grayling breeding *Note: need to have regard for grayling impacts in other catchments and the role this system plays in their recovery*					
Lower Latrobe Wetlands	Env	High tides coinciding with low water levels in wetlands could result in saline water intrusions into the wetlands, which may cause negative environmental impacts. *- Based on Sale Common risk, which is the highest risk. Others are Heart - Possible & Moderate Dowds - Likely & Moderate*	Possible	Major	Medium	• Implement findings from saline inflow risk assessment study. • Apply findings from the Latrobe River environmental watering recommendations.	WGCMA
Lower Latrobe Wetlands	Env	Poor condition of wetland side of the Dowd Morass regulator results in PV being unable to operate the structure due to OH&S risks, leading to failure to deliver environmental flows and to achieve environmental objectives.	Unlikely	Minor	Low	• PV (Asset owner) to undertake regular maintenance and pre-event asset inspections on delivery infrastructure. **Note that insufficient resources are likely to limit the asset owner's ability to regularly inspect and maintain infrastructure. Increased resources for these activities may further reduce the likelihood and risk ratings.* • Communicate failures to the CMA • Develop design for upgrading regulating structure and seek funding to implement necessary upgrades in conjunction with land manager (in progress).	PV PV WGCMA
Lower Latrobe Wetlands	Env	Unauthorised access/operation of wetland regulating structures causes environment harm (e.g. saltwater event)	Unlikely	Moderate	Low	• Ensure structures are locked and monitor structure regularly to minimise likelihood of interference. • Educate the community on environmental water needs and benefits. • Erect signage to identify the importance of the assets for environmental water delivery.	PV WGCMA WGCMA

System	Risk category	Risk description	Likelihood	Consequence	Risk Rating	Mitigation actions	Lead organisation for action
Lower Latrobe Wetlands	Env	Inlet capacity is insufficient to enable Sale Common to be watered at low river levels, leading to failure to achieve environmental objectives	Possible	Minor	Low	• Upgrade or replace existing inlet structure to enable access to low river flows for watering the site. *Note: An upgrade strategy has been developed and is expected to be implemented in next few years* • Investigate other water delivery options	WGCMA
Lower Latrobe Wetlands	Env	Inlet capacity is insufficient to enable Dowd Morass to be watered at low river levels, leading to saltwater intrusion from Lake Wellington which results in environmental damage	Likely	Moderate	Medium	• Upgrade or replace existing inlet structure to enable access to low river flows for watering the site. • Consider temporary pumping alternatives	WGCMA WGCMA
Lower Latrobe Wetlands	Env	Inlet capacity is insufficient to enable Heart Morass to be watered at low river levels, leading exposure of acid sulphate soils. which results in environmental damage	Possible	Moderate	Medium	• Upgrade or replace existing inlet structure to enable access to low river flows for watering the site. • Consider temporary pumping alternatives	WGCMA WGCMA
Macalister	Env	Dry seasonal conditions and low inflows may lead to a suspension of minimum passing flows requirements at Maffra Weir. Reversion to release of very low natural inflows may constrain the ability to undertake desired environmental release actions and may also lead to water quality issues.	Possible	Moderate	Medium	• Modify watering strategies to incorporate options for supplementing baseflows during periods of reduced passing flow releases in very dry years. • Proactive communications between SRW, GW and WGCMA to forecast expected changes to passing flows	WGCMA SRW

6.2. Engagement

6.2.1. Latrobe River

This section outlines the engagement that has occurred in the development of the West Gippsland Seasonal Watering Proposal for 2021-22.

This section outlines the engagement that has occurred in the development of the Latrobe River Seasonal Watering Proposal for 2021-22. Significant engagement has been made through the Project Advisory Group for the Latrobe Environmental Water Requirements Investigation. As part of this project participants were informed of the use of environmental objectives and flow recommendations for the seasonal watering proposals. It is anticipated that members from this group will form a new Environmental Water Advisory Group for the Latrobe River in the near future, lifting the level of engagement for most groups from “inform” to “involve” (Table 6-2).

Table 6-2 Summary of engagement undertaken in development of the 2021-22 Seasonal Watering Proposal

Who	Level of engagement	Engaged for the 2021-2022 Seasonal Watering Proposal	Engagement method	Engagement purpose
Program partners 	Collaborate	• VEWH	• Direct engagement • Review of draft seasonal watering proposal • Latrobe Environmental Water Requirements Investigation project advisory group	• Seek input to the development of the proposal • ensure program partners understand and have an opportunity to contribute to the watering proposed and achieve intended outcomes • Identify opportunities to achieve shared benefits • Identify systems constraints to delivery of environmental water • Identify risk for delivering and not delivering environmental water.
	Collaborate	• Southern Rural Water		
Traditional Owners 	Collaborate	• Gunaikurnai Land and Waters Aboriginal Corporation	• Direct engagement • Latrobe Environmental Water Requirements	• Share information and develop environmental water knowledge for future engagement

Who	Level of engagement	Engaged for the 2021-2022 Seasonal Watering Proposal	Engagement method	Engagement purpose
			Investigation project advisory group	
Landholders 	Inform	• Individual landholders	As above	As above plus: • Identify watering objectives relevant to the group/individual
Recreational users 	Inform	• Field and Game Australia	As above	As above
Environment groups 	Inform	• Latrobe Valley Field Naturalists	• Latrobe Environmental Water Requirements Investigation project advisory group	As above
Non-Government Organisation	Inform	• Greening Australia • VR Fish • Native Fish Australia	As above	As above
Other Government agencies 	Consult	• Gippsland Water	• Direct engagement • Latrobe Environmental Water Requirements Investigation project advisory group	As above plus: • Identify opportunities to achieve shared benefits • Identify systems constraints to delivery of environmental water • Identify risk for delivering and not delivering environmental water
	Inform	• Department of Land, Environment, Water and Planning (Latrobe Valley Regional Water Study) • Department of Land, Environment, Water and	• Latrobe Environmental Water Requirements Investigation project advisory group	• Share information and develop environmental water knowledge for future engagement • Identify watering objectives relevant to the group/individual

Who	Level of engagement	Engaged for the 2021-2022 Seasonal Watering Proposal	Engagement method	Engagement purpose
		Planning (Waterways and Catchments) • EGCMA • Parks Victoria		
Local businesses	Inform	• Port of Sale Heritage River Cruises	As above	As Above

6.2.2. Thomson River

Table 6-3 outlines the engagement that has occurred in the development of the Thomson Seasonal Watering Proposal for 2021-22.

Table 6-3 Stakeholder engagement for the Thomson River seasonal watering proposal 2021-2022

Who	IAP2 level of engagement	Engaged on the 2021-22 Watering Proposal	Engagement Method	Engagement Purpose
Program Partners 	Collaborate	VEWH	Direct engagement through support and editing of the 2020-21 seasonal watering proposal	Seek input to development of proposal, and to inform the VEWH of new knowledge and issues that shaped the 2020-21 proposal
	Collaborate	SRW Melbourne Water	Phone, email and face-to-face meetings were held as part of the drafting process for the seasonal watering proposals. SRW and Melbourne Water also had representation on the 2020 Thomson FLOWs review, as members of the PAG	Direct engagement to determine if there were any operational restraints or other issues to consider in delivery of proposed releases; also present an opportunity to identify any shared benefits
Recreational users 	Involve	Tourism Operator VR Fish	VR Fish and a tourism operator had representation on the 2020 Thomson FLOWs review, as members of the PAG	The Thomson PAG provided input into the values and objectives settting for the Thomson FLOWs review. This document directly informs the seasonal watering proposals. It is intended to transition the PAG into a formal EWAG for the Thomson River in November 2021

Who	IAP2 level of engagement	Engaged on the 2021-22 Watering Proposal	Engagement Method	Engagement Purpose
Environment groups 	Involve	Heyfield Wetlands Committee Landcare Environment Victoria Waterwatch volunteers	Heyfield Wetlands Committee have been directly engaged in developing sections of the watering proposal specific to the Heyfield Wetlands. Landcare, and waterwatch each had representation on the 2020 Thomson FLOWs review, as members of the PAG	To seek information necessary to form clear and informed environmental objectives to watering the Heyfield Wetlands The Thomson PAG provided input into the values and objectives settting for the Thomson FLOWs review. This document directly informs the seasonal watering proposals. It is intended to transition the PAG into a formal EWAG for the Thomson River in November 2021
Landholders/farmers 	Involve	Individual landholders	Landholders with Thomson River frontage had representation on the 2020 Thomson FLOWs review, as members of the PAG	The Thomson PAG provided input into the values and objectives settting for the Thomson FLOWs review. This document directly informs the seasonal watering proposals. It is intended to transition the PAG into a formal EWAG for the Thomson River in November 2021
Traditional Owners 	Collaborate	GLaWAC	GLaWAC had representation in the 2020 Thomson FLOWs review project, as members of the Steering Committee and PAG	GLaWAC cultural water officers have completed Aboriginal Waterways Assessment (AWAs), on the Thomson River. It is the intention of the WGCMA to incorporate TO knowledge, values and objectives for the Thomson River into the FLOWs review. This document directly informs the seasonal watering proposals. It is intended to transition the PAG into a formal EWAG for the Thomson River in November 2021

Who	IAP2 level of engagement	Engaged on the 2021-22 Watering Proposal	Engagement Method	Engagement Purpose
Other Government Agencies 	Collaborate	Arthur Rylah Institute (ARI)	Direct engagement – sharing of river and aquatic knowledge and monitoring data ARI also provided input into the 2020 Thomson FLOWs review	Sharing of river and aquatic knowledge allows for the most up-to-date survey information to be reflected in the seasoning proposal ie new evidence emerging of a connection between tupong movement and winter freshes
	Involve	Gippsland Water	GW had representation in the 2020 Thomson FLOWs review, as members of the PAG	The Thomson PAG provided input into the values and objectives settting for the Thomson FLOWs review. This document directly informs the seasonal watering proposals. It is intended to transition the PAG into a formal EWAG for the Thomson River in November 2021
	Involve	DELWP	DEWLP had representation in the 2020 Thomson FLOWs review project, as members of the Steering Committee	The Thomson PAG provided input into the values and objectives settting for the Thomson FLOWs review. This document directly informs the seasonal watering proposals

6.2.3. Macalister River

This Table 6-4 outlines the engagement that has occurred in the development of the Macalister Seasonal Watering Proposal for 2021-22.

Table 6-4 Stakeholder engagement for the Macalister River seasonal watering proposal 2021-22

Who	IAP2 level of engagement	Engaged on the 2021-22 Watering Proposal	Engagement Method	Engagement Purpose
Program Partners 	Collaborate	VEWH	Direct engagement through support and editing of the 2021-22 seasonal watering proposal	Seek input to development of proposal, and to inform the VEWH of new knowledge and issues that shaped the 2021-22 proposal
	Collaborate	SRW	Face-to-face meetings were held as part of the drafting process for the seasonal watering proposals.	Direct engagement to determine if there were any operational restraints or other issues to consider in delivery of proposed releases; also present an opportunity to identify any shared benefits
Recreational users 	Involve	VRFish	VR Fish have representation on the collaborative group Environmental Water Advisory Group (EWAG) that meets twice a year	As part of the EWAG, VR Fish have an opportunity to both learn more about environmental water and relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders
Environment groups 	Involve	Environment Victoria (EV) Maffra and districts Landcare network (MDLN) Native Fish Australia (NFA)	EV, MDLN and NFA have representation in the collaborative group EWAG that meets twice a year	As part of the EWAG, EV, MDLN, NFA have an opportunity to both learn more about environmental water and relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders
Landholders/farmers 	Involve	MID irrigators/diverters	Landholders/farmers that have been identified as community leaders have representation on the collaborative group Environmental Water Advisory Group (EWAG) that meets twice a year	As part of the EWAG, irrigators have an opportunity to both learn more about environmental water and relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders

Who	IAP2 level of engagement	Engaged on the 2021-22 Watering Proposal	Engagement Method	Engagement Purpose
	Inform	MID irrigators/diverters and other landholders	The WGCMA presents spring/spill-period watering plans to the SRW Macalister Customer Consultative Committee	This informs them of our management decisions, communications and planning around the spill period
Traditional owners 	Collaborate	GLaWAC	GLaWAC have representation on the collaborative group Environmental Water Advisory Group (EWAG) that meets twice a year	As part of the EWAG, GLaWAC have an opportunity to both contribute and learn more about environmental water and relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders Where attendance at the EWAG meetings isn't possible, WGCMA water officers and GLaWAC cultural water officers meet informally to discuss the seasonal watering proposal. These sessions provide an opportunity for feedback and review of the watering plans
Other Government Agencies 	Empower	Arthur Rylah Institute	Direct engagement – sharing of river and aquatic knowledge	Sharing of river and aquatic knowledge allows for the most up-to-date survey information to be reflected in the seasoning proposal ie evidence emerging of a connection between tupong movement and winter freshes
	Involve	Gippsland Water	Gippsland Water have representation on the collaborative group Environmental Water Advisory Group (EWAG) that meets twice a year	As part of the EWAG, GW have an opportunity to both learn more about environmental water and relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders

6.2.4. Lower Latrobe Wetlands

This section outlines the engagement that has occurred in the development of the Lower Latrobe Wetlands Seasonal Watering Proposal for 2021-22. Significant engagement was made through the Project Advisory Group for the Latrobe Environmental Water Requirements Investigation. As part of this project participants were informed of the use of environmental objectives and flow recommendations established through for the seasonal watering proposals. It is anticipated that members from this group will for part of the Environmental Water Advisory Group for the lower Latrobe wetlands at commencement of the project soon, lifting the level of engagement from “inform” to “involve”. Levels and purpose of engagement are shown in Table 6-5.

Table 6-5 Summary of the parties engaged and the levels and purpose of engagement for the 2021-22 Seasonal Watering Proposal.

Who	Level of engagement	Engaged for the 2021-2022 Seasonal Watering Proposal	Engagement method	Engagement purpose
Program partners 	Collaborate	• VEWH	• Direct engagement • Review of draft seasonal watering proposal • Latrobe Environmental Water Requirements Investigation project advisory group	• Seek input to the development of the proposal • ensure program partners understand and have an opportunity to contribute to the watering proposed and achieve intended outcomes • Identify opportunities to achieve shared benefits • Identify systems constraints to delivery of environmental water • Identify risk for delivering and not delivering environmental water.
	Collaborate	• Parks Victoria • Field and Game Australia		
Traditional Owners 	Collaborate	• Gunaikurnai Lands and Water Corporation	• Direct engagement • Latrobe Environmental Water Requirements Investigation project advisory group	• Share information and develop environmental water knowledge for future engagement
Landholders 	Inform	• Individual landholders	As above	As above plus: • Identify watering objectives relevant to the group/individual

Who	Level of engagement	Engaged for the 2021-2022 Seasonal Watering Proposal	Engagement method	Engagement purpose
Recreational users 	Inform	• Field and Game Australia	As above	As above
Environment groups 	Inform	• Latrobe Valley Field Naturalists	• Latrobe Environmental Water Requirements Investigation project advisory group	As above
Non-Government Organisation	Inform	• Greening Australia • VR Fish • Native fish Australia	As above	As above
Other Government agencies 	Consult	• Gippsland Water	• Direct engagement • Latrobe Environmental Water Requirements Investigation project advisory group	As above plus: • Identify opportunities to achieve shared benefits • Identify systems constraints to delivery of environmental water • Identify risk for delivering and not delivering environmental water.
	Inform	• Department of Land, Environment, Water and Planning (Latrobe Valley Regional Water Study) • Department of Land, Environment, Water and Planning (Waterways and Catchments) • EGCMA • Parks Victoria	• Latrobe Environmental Water Requirements Investigation project advisory group	• Share information and develop environmental water knowledge for future engagement • Identify watering objectives relevant to the group/individual

Who	Level of engagement	Engaged for the 2021-2022 Seasonal Watering Proposal	Engagement method	Engagement purpose
Local businesses	Inform	• Port of Sale Heritage River Cruises	As above	As Above

7. Shared Benefits

The primary purpose of water supply systems is for the reliable supply of water to entitlement holders for towns, industry, agriculture and environment. The storage, delivery and use of this water may also provide secondary, opportunistic socio-economic and cultural benefits. These benefits are recognised as shared benefits. Through the Water for Victoria plan, the Victorian government has committed to considering opportunities for shared benefits in water and waterway planning.

Environmental water program partners and officers are asked to consider the shared benefits in the environmental water planning, delivery and reporting phases. Shared benefits should be provided, where possible, so long as it does not compromise on the targeted ecological outcome(s). In West Gippsland, there are several known shared benefits provided by environmental watering.

In developing priority watering actions, community groups and other agencies were engaged to identify shared benefits or impacts from environmental watering activities. These are taken into consideration in prioritising watering actions; however, they are not the primary driver for environmental flow planning.

7.1 Latrobe River

The Latrobe River is an important resource for the Indigenous Gunaikurnai people. Numerous registered Indigenous cultural heritage sites and values such as scarred trees, artefact scatters, earth features and shell deposits are located along the river and its tributaries. Through more focused engagement with Gunaikurnai people around the cultural significance of the Latrobe River, further shared benefits will be identified for the use of the Blue Rock reservoir environmental water entitlement. This engagement is planned to continue through the 2021-22 water year.

The timing of environmental water releases takes into consideration water skiing events held at Lake Narracan, typically between January and March. Through communication with the local water ski club, environmental water releases are timed to not impact on the water levels at Lake Narracan during the event. This communication is also part of the environmental entitlement operating arrangement between the VEWH, WGCMA and Southern Rural Water (storage operator). Shared benefits for 2020-21 are summarised in Table 7-1.

Table 7-1 Summary of the shared benefits of the potential watering actions in the Latrobe River, 2020-21.

Who?	Shared Benefit
Recreational fishers **Shooters** **Lake Narracan ski club**	Ski events on Lake Narracan require set and stable water levels. Flow releases shall be managed outside of these planned ski events to avoid conflicting requirements. Freshes linked with recreational fish movements and behaviour (e.g. black bream and estuary perch become active during high flows providing fishing opportunities). Delivering flows for wetland watering improves waterbird diversity and abundance providing game hunting opportunities.

Who?	Shared Benefit
Commercial fishers **Gippsland water** **Irrigators/farmers** **Power companies**	Power generators draw water from the Latrobe River and Blue Rock reservoir. During high electricity demand periods (e.g. v. hot days) there is reduced outlet capacity. Environmental flow releases shall be scheduled around power generator requirements to minimise capacity share issue with other entailment holders. Low flows create continuous instream habitat, providing for fish distributions and increasing commercial fishing abundance. Base flows improve water quality for stock watering and irrigation, while also reducing water treatment required by urban water suppliers.

7.2 Thomson River

In West Gippsland, there are several known shared benefits provided by environmental watering. Table 7-2summarises the Thomson River shared benefits identified in 2020-21.

Table 7-2 Thomson River Shared benefits review for 2020-21.

Who?	Shared benefit
Canoe clubs, outdoor education companies, and recreational canoers/kayakers	Autumn, winter and spring freshes create ideal white water rafting conditions for avid canoers/kayakers in the upper Thomson. The 2021 autumn fresh has been timed to coincide with the Baw Baw Extreme multisport event, to maximise the opportunity for this event to take advantage of the white water rafting conditions. Over 2020-21, several kayakers/canoers have subscribed to receive environmental watering notifications in the Thomson
Recreational bird watchers **Recreational duck/game hunters**	Deliveries to the Heyfield Wetlands provide habitat and attract waterbirds providing bird watching opportunities. Freshening flows from the Thomson, Macalister and Latrobe rivers all contribute to the health of the lower Latrobe wetlands. Freshes bring in waterbirds into these wetlands and provide both bird watching and game hunting opportunities, particularly in the lower Latrobe wetlands
Recreational fishers/anglers	Winter and spring freshes encourage the downstream migration and recruitment of Australia bass and estuary perch, both popular recreational fish species
Local and international tourists (including campers, hikers)	Flushing of waterholes and improved in-stream habitat with environmental watering events, provides high quality swimming and camping opportunities in the upper Thomson River, which is a popular location for recreational users
Landholders with river frontage & public land	Environmental watering contributes to the protection of riverbanks and land loss from erosion through the watering

Who?	Shared benefit
	of riparian vegetation and maintenance of in-channel vegetation
Traditional Owners	Environmental watering contributes to maintaining or improving the health of the river which is important to improve/maintain the integrity of the Country of the Gunaikurnai

7.3 Macalister River

Table 7-3Table 7-3 summarises the Macalister River shared benefits identified in 2020-21

Table 7-3 Macalister River Shared benefits review for 2020-21.

Who?	Shared benefit
Locals and other visitors from outside the region	Watering that refreshes waterholes, particularly over summer, may improve the water quality key waterholes and thus the swimming conditions. Freshes throughout the year, also increase the longitudinal connectivity of the river, improving kayaking conditions
Recreational fishers/anglers	Planned winter and spring freshes encourage the spawning and recruitment of Australia bass, a popular recreational fish species
Landholders with river frontage & public land	Watering in autumn and spring helps to maintain bankside vegetation, preventing erosion and potential land loss. This watering complements any on-ground riparian rehabilitation works also undertaken as part of the WGCMA's Waterway Strategy
Traditional Owners	Environmental watering contributes to maintaining or improving the health of the river which is important to improve/maintain the integrity of the Country of the Gunaikurnai

7.4 Lower Latrobe Wetlands

The shared benefits of potential watering actions across each of the lower Latrobe wetlands are listed in Table 7-4.

Table 7-4 Summary of the shared benefits from wetting and drying in the lower Latrobe wetlands, 2020-21.

Component	Wetland	Who?	Shared Benefit
Fills and partial fills	All	Recreational users	Provide amenity for access tracks, canoeing, fishing and bird watching
	Heart Morass and Dowd Morass	Shooters	Provide open water for duck hunting season

Component	Wetland	Who?	Shared Benefit
		Campers and other recreational users	Provide amenity for camping
	All	Commercial fishers	May advantage commercial eel and carp fishing.
Acid Sulfate Soil inundation	Heart Morass	Shooters	Maintain open water for duck hunting season, or if water levels have receded and water quality is suitable, the partial fill will be timed to coincide with the duck shooting season opening (mid-March)
		Commercial fishers	May advantage commercial eel and carp fishing
Partial fill	Heart Morass and Dowd Morass	Shooters	If water quality is suitable the partial fill will be timed to coincide with the duck shooting season opening (mid-March)
		Commercial fishers	May advantage commercial eel and carp fishing
Drawdown	All	Recreation users	Provide amenity for access tracks, and bird watching
	Heart Morass and Dowd Morass	Campers and other recreational users	Provide amenity for camping

8. Increasing knowledge and addressing constraints/ impacts

8.1. Latrobe River

There is limited environmental monitoring being undertaken in the Latrobe River currently.

Water quality data from sites that are part of the regional water monitoring network and from Waterwatch volunteers or WGCMA staff will be used to provide insight into water quality conditions throughout the year. The target reach will be the focus.

Empirical data will be supplemented with on-ground observations made by WGCMA staff and where possible, landholders and other interested individuals.

Monitoring of the ecological effects of environmental flow releases in the regulated Latrobe River would be a useful inclusion, especially the effect on in-stream vegetation (natural regeneration or revegetation), physical habitat and fish. Part of this could be to extend previous fish monitoring further up the Latrobe River to locate populations of Australian grayling and undertake larval monitoring to improve knowledge and management of Latrobe River releases for spawning.

The WGCMA will continue to explore opportunities with government and community organisations to collect ecological monitoring data in the Latrobe River.

Key knowledge gaps and limitations that WGCMA are currently aware of, and proposed actions to address these, are summarised below (Table 8-1).

Table 8-1 Key knowledge gaps and limitations for the Latrobe River.

Knowledge gap/limitation	Proposed action
Entire river system	
Location and abundance of preferred Australian grayling habitat	Undertake electrofishing in upper reaches and main tributaries, and larval monitoring in the lower Latrobe.
Lack of understanding of system losses, travel times and flow attenuation limit ability to effectively piggyback on natural events and coordinate flow releases from multiple storages.	Continued investigation of data from recent Thomson and Latrobe environmental water release monitoring
The daily natural time series for the Latrobe River have been derived by disaggregating monthly model output.	Develop a daily water resource model for the Latrobe River system and produce output for natural, current and other relevant scenarios.
Data from a single year was used for the re-definition of flow recommendations and scenario planning.	Make use of a tool such as eFlow Predictor to analyse data from multiple years to characterise scenarios.
The practicalities and accounting issues associated with using the greater release capacity of Lake Narracan to increase daily releases to the Latrobe River.	Investigate these issues in conjunction with SRW and other entitlement holders to Lake Narracan. Document agreement reached in operating arrangements.
Major structural works are required (e.g. fish ladders and meander reinstatements) to realise the full	Develop and implement a large-scale works program (see specific reaches below).

potential of the Latrobe River and to maximise the value of environmental water deliveries.	
Reach 5: Kilmany to Thomson River	
There is only so much that environmental flows alone can do to promote establishment/maintenance of in-stream vegetation.	Undertake complementary works to provide niches for the establishment of in-stream vegetation e.g. installation of large wood and/or meander reinstatements; and to maintain/encourage in-stream vegetation e.g. fencing and revegetation.
The effect of environmental flow releases on in-stream vegetation (natural regeneration and revegetation) and physical habitat.	Undertake a geomorphological study of the Latrobe River system. Use this to inform the design and implementation of a tailored monitoring program.
Implications of meander reinstatements for the hydraulics of reach 5 and the magnitude of freshes needed to trigger ecological conditions where meanders are reinstated.	Technical review of environmental flow recommendations. This would involve use of the reach-scale hydraulic models developed for the meander reinstatement investigation (MIKE11), rather than the HEC-RAS models used for the original FLOWS study.
Reach 8: Tanjil River	
Risks to the stability and ecological function of this reach arising from high flows and a seasonal shift in flows due to its use as a delivery channel.	Technical investigation – could be investigated as part of a broader geomorphological study of the Latrobe River system.
Reach 9: Tyers River	
Passage past Gippsland Water's weir is a limitation to fish migration/habitation in this reach which is in relatively good condition.	Investigate options to provide fish passage over Gippsland Water's weir on the Tyers River.

8.2. Thomson River

8.2.1. Monitoring and knowledge improvement activities

Three targeted monitoring programs are planned in the Thomson system for 2020-2021.

These three programs are outlined below:

Victorian Environmental Flows Monitoring and Assessment Program

As part of VEFMAP Stage 7, native fish surveys will continue to be undertaken in the Thomson River to understand native fish distribution, and the recruitment and dispersal of native migratory fish. These surveys will be useful in assessing the impact of the Horseshoe Bend fishway post construction.

VEFMAP monitoring conducted in other coastal, regulated systems with the same or similar water dependent values may also provide transferrable knowledge that may inform environmental water management for the Thomson River.

Specific information from the VEFMAP program will be used to fill knowledge gaps and increase our understanding of the diversity and condition of vegetation communities and fish

populations in the Thomson system (both identified as system scale environmental objectives for the Thomson River).

Native Fish Report Card Program

This is a four-year monitoring program focused on collecting long term information on the condition of native recreational fisheries across the state. The program commenced in 2017 and is a partnership between DELWP, the Victorian Fisheries Authority and Recreational Fishing Licence Holders. The program will be 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. The Thomson River has been prioritised as a key fishery where monitoring will focus on Australian bass and Australian grayling. Monitoring is continuing in this year and will continue for the next year.

Whilst this program is not directly targeted at environmental watering responses, it has the ability to supplement the native fish surveys collected under VEFMAP. It may also prove useful to understand the status of Australian bass in the river. Australian bass is considered a flow dependent species that is targeted during winter and spring freshes, but there are still large knowledge gaps associated with flows required to trigger spawning and recruitment responses.

Specific information from this monitoring program will be used to fill knowledge gaps and increase our understanding of how to deliver flows to maintain and enhance self-sustaining populations of native fish species in the Thomson system (an identified system scale environmental objective for the Thomson River).

Lower Latrobe Water Quality Monitoring

The WGCMA undertake salinity and water flow monitoring in the lower Latrobe River to measure the movement of the salt wedge as it relates to inflows. Releases from Thomson River influence freshwater conditions in this reach and monitoring will help inform the benefits of environmental flow releases from Thomson Reservoir on estuary conditions.

Specific information from this monitoring program will be used to fill knowledge gaps and increase our understanding of how flow deliveries in the Thomson affect and interact with the lower Latrobe system. Synchronised timing of releases across systems is important for being able to deliver environmental water to restore and maintain lateral connectivity (an identified system scale environmental objective for the Thomson River).

8.2.2. Knowledge Gaps and Limitations

Tailored monitoring to assess the achievement of the environmental objectives that underpin all watering actions for the Thomson River have not been undertaken, as many of these objectives are inherently difficult and expensive to measure. This is because the objective stipulates an ecological outcome that is influenced by multiple factors, other than flow alone (many of which are non-flow related).

Table 8-2 lists objectives that are difficult to measure and the associated knowledge gaps/potential monitoring activities associated with each objective.

Table 8-2 Environmental objectives and associated knowledge gaps and monitoring activities

Environmental objective	Can the objective be measured?	Knowledge gaps and potential monitoring activities
Restore or maintain natural macroinvertebrate community	Difficult to measure. Macro-invertebrate communities are sensitive to multiple factors, flow being only one of these factors	Difficult to measure. Macro-invertebrate communities are sensitive to multiple factors, flow being only one of these factors
Maintain/enhance native fish community structure	This objective has been measured in part through the VEFMAP annual fish surveys and monitoring of Australian grayling spawning behaviour. However, fish communities are also influenced by a number of other factors (e.g. habitat, water quality, food availability)	Monitoring to further understand relationship between streamflow and diadromous fish recruitment (particularly for Australian grayling, tupong and Australian bass) Monitoring to better understand characteristics of flow triggers for female adult tupong (and Australian bass) spawning migration Limited understanding of the habitat requirements, food sources and flow requirements of *all* native fish species present in the system Limited understanding of the influence of flow on non-flow components of habitat (e.g. water quality, in-stream vegetation) Requirement for a statewide data sharing facility that is used by all CMAs and Melbourne Water so that conceptual models are shared freely and easily and new knowledge is distributed to all CMAs
Maintain/restore distinctive riparian vegetation community and structure, with zonation up the bank	Difficult to measure. Vegetation survey data collected under VEFMAP cannot be used to assess this objective as it cannot isolate the influence of flow from other factors	Limited understanding and articulation of the water requirements of in-stream and fringing native vegetation present (that may be influenced by environmental water releases) Limited understanding on the effect of Thomson Reservoir on the distribution of seeds and propagules downstream of the reservoir Requirement for a statewide data sharing facility that is used

Environmental objective	Can the objective be measured?	Knowledge gaps and potential monitoring activities
		by all CMAs and Melbourne Water so that conceptual models are shared freely and easily and new knowledge is distributed to all CMAs
Maintain channel form diversity	Difficult to measure. It is difficult to isolate the influence of flow on channel form given the land uses that predominate the catchment	Limited/inaccurate data on the flows required to scour substrate due to use of outdated 1D hydraulic model No data on flows required to scour biofilms Requirement for an updated hydraulic model
Improve water quality	This is a potentially measurable outcome. It is dependent on how influential environmental watering can be on water quality for the Thomson River, given the surrounding land use	Limited understanding of relationship between flow and water quality variables in pools and riffles in the Thomson River Require water quality measurements in major pools (particularly those downstream of Cowwarr Weir) before during and after the release of an event to identify the impacts of the flow release on water quality Require water quality measurements before, during and after major unregulated flow events to elucidate the magnitude of flows required to significantly impact water quality in pools

8.3. Macalister River

8.3.1. Monitoring and knowledge improvement activities

Two targeted monitoring programs are planned in the Macalister system for 2021-2022.

These programs are outlined below:

Victorian Environmental Flows Monitoring and Assessment Program

VEFMAP fish surveys conducted in March 2021 in the Macalister and other coastal, regulated systems with the same or similar water dependent values (such as native fish surveys in the Thomson River) will provide transferrable knowledge to inform environmental water management for the Macalister River.

Native Fish Report Card Program

This is a multi-year monitoring program focusing on the collection of long-term information on the condition of native recreational fisheries across the state. The program is a partnership between DELWP, the Victorian Fisheries Authority and Recreational Fishing

Licence Holders. The program commenced 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. The Macalister River has been prioritised as a key fishery where monitoring will focus on Australian bass and Australian grayling.

8.3.2. Knowledge gaps and limitations

The knowledge gaps, limitations and the work required to address have been specified in the Draft Macalister River Environment Flow Management Plan (WGCMA, 2017) and are summarised in Table 8-3.

Table 8-3 Summary of Macalister River knowledge gaps

Environmental objective	Description	Knowledge gaps and potential monitoring activities
Increase the abundance of platypus and rakali	Little information on current distribution and abundance on platypus and rakali in the Macalister system. Little quantitative data on the flow requirements of both species, the impacts of regulated flow regimes on their populations and food sources (benthic macroinvertebrates)	Monitoring Population study to delineate distribution and abundance in the system over time (for longevity, it may be useful to harness community knowledge through an established system, extraction of information at engagement events) Research projects Understand the response of platypuses and rakali to variable flow regimes with particular focus on very low and very high flows
Improve spawning and recruitment opportunities for native migratory fish species	Need greater understanding on how flow affects movement (e.g. the hydraulic characteristics of physical habitat that influence swimming ability)	Research projects Use telemetry (tagging) techniques to monitor movement of these species
Improve spawning and recruitment opportunities for native migratory fish species	Need further understanding on how specific mechanisms of flow influence spawning success for this species	Research projects Data on primary productivity and spawning behaviour analysed in conjunction with streamflow may help identify correlations between flow event characteristics and spawning success Monitoring of primary productivity rates, Australian bass spawning behaviour in spawning habitats is required
Re-instate submerged aquatic vegetation	There is a need to understand the limiting factors preventing in-stream vegetation establishment in this system in order to identify management	Monitoring Identify and map current presence of any remnant in-stream vegetation Research project

Environmental objective	Description	Knowledge gaps and potential monitoring activities
	actions that may support its re-instatement	Monitoring to determine whether submerged vegetation establishes in the main river channel
Improve emergent and fringing woody vegetation in the riparian zone	Fringing vegetation in the system has changed considerably over time. For example, abundant and healthy beds of common reed are now rare. There is little understanding on when they have disappeared and what has caused this loss	Desktop analyses Analyse historical documents (e.g. aerial photographs, and supplementary photographs from the local community) to determine where and when riparian vegetation has changed to obtain a visual and guiding template of what the river "should" look like Research project Monitoring of vegetation response (including in-stream vegetation response) from areas that have received complementary works to areas that have not
Increase the abundance and number of functional groups of macroinvertebrates	The current structure of the macro-invertebrate community in the river is unknown. There is no information on the impact of the bushfires and floods over the last decade on the abundance and diversity of functional groups, since last survey in 2005–06	Monitoring Macro-invertebrate surveys to capture what is present in the system and what has changed is required
Improve physical habitat	The relationship between environmental watering in the Macalister River and water quality is not understood. High turbidity events have been observed, however, it is not known if these events are due to a flow release or other channel or land use factors	Monitoring Increase the frequency of turbidity monitoring to daily (or more) to discern spatial-temporal patterns, and the influence of environmental watering Research project Determination of all sources of turbidity and nutrients and the proportional contribution of these sources

8.4. Lower Latrobe Wetlands

8.4.1. Monitoring

WGCMA will undertake environmental monitoring in 2020-21 in order to inform and evaluate implementation of the seasonal watering plan for the lower Latrobe wetlands. This will include:

- Spring, autumn and event-based water quality monitoring (including pH and salinity) at 2 sites in Sale Common and Dowd Morass and 4 sites in Heart Morass, to inform watering decisions and actions
- River flow rates, water level and water quality in the Latrobe River and lower Latrobe wetlands obtained from VEWH funded telemetered monitoring stations installed at Swing Bridge (on the Latrobe River below the confluence with the Thomson River), Heart Morass, Dowd Morass and Bull Bay (on the southern edge of Lake Wellington)
- Incidental observations and photos of biota to track events and gauge the general condition of the wetlands.

The above will be supplemented with ongoing waterfowl monitoring undertaken by Field and Game Australia and observations from other local community members.

8.4.2. Reporting

Reporting will be undertaken in accordance with the Entitlement and the Victorian Environmental Water Holder's Guidelines for reporting on the management of the Water Holdings.

A summary report on environmental watering will be presented to the WGCMA Board at the end of each water year. This will include, but not limited to:

- Overview of conditions throughout the water year
- Compliance of flows against the Seasonal Watering Statements
- Results from monitoring program
- Evaluation of delivery success
- Learnings and emerging issues

8.4.3. Operations and compliance

There is considerable potential to optimise environmental outcomes and improve the efficiency of environmental water delivery to the wetlands by designing and constructing purpose-built watering infrastructure and complementary earthworks. The highest priority – upgrade of the existing structure connecting Sale Common to the Latrobe River – was completed in 2013. Detailed designs have also been prepared for a second regulating structure to service Sale Common as well as new watering infrastructure for Heart and Dowd Morass. Approvals and permits to construct this infrastructure were completed in early 2016/17. Funding is being sought to construct the priority works to realise the benefits of improved environmental outcomes and efficient use of the Lower *Latrobe wetland Environmental Entitlement 2010*.

8.4.4. Environmental effectiveness

Sound wetland water management requires information about the likely and actual response of water-dependent assets (especially plants as they provide the structural habitat and organic carbon required by other wetland biota) to the water regimes provided (whether through natural or 'active' means). This enables a genuine adaptive management framework to be applied to increase knowledge and improve management over time. Useful information is available for some long-lived plant species that occur in the lower Latrobe wetlands, such as Swamp Paperbark, due to focussed research having been undertaken in the local area (Dowd Morass). There is however a dearth of locally relevant information about the hydro-ecological requirements of most other aquatic plant species. Boon (2011) identified the

following limitations to the currently available information on hydrological requirements of wetland plants in his environmental flows study for Macleod Morass near Bairnsdale:

- What information is available is generally based on studies undertaken in arid or semi-arid parts of the Murray-Darling Basin, and there are likely to be difficulties in extrapolating to coastal eastern Victoria;
- Little recognition is given to the possibility that the hydrological requirements of a given species can vary across its geographical range, especially if its range is large e.g. Common Reed *(Phragmites australis)*; and
- Many plant taxa have little or no information available on their hydrological requirements, and there can be a disparity in recommendations for a single species.

Focussed local research and long-term ecological response monitoring are needed to address these limitations and enable refinement of wetland water regime recommendations over time, including the identification of optimum conditions and critical tolerances (as required for Environmental Water Management Plans). Some research/monitoring questions arising from this seasonal watering proposal are:

- Is there an ecological association between Giant Rush and Upright Water Milfoil, and is the aim of controlling the spread of the former and encouraging the persistence of the latter incompatible? These species germinated under the same conditions and based on monitoring to date, are disadvantaged by permanent inundation.
- What are the hydro-ecological requirements for recolonisation and persistence of submerged and emergent aquatic plants (particularly Aquatic Herbland, Aquatic Sedgeland, Brackish Herbland and submerged angiosperms)?
- What are the benefits and risks of summer/autumn versus winter/spring inundation?
- What is the habitat value of widespread introduced species (particularly Parrot's Feather)? Can this habitat be readily replicated or enhanced using indigenous native species, is this achievable, and what role can water regime management play?

A limitation of preparing individual seasonal watering proposals is that the focus is on management of the site, rather than broader but related considerations such as management of highly mobile populations or entire species of waterbirds that occur across or utilise multiple sites. These inter-site issues should be factored into the development of the Victorian seasonal watering plan.

9. Approval and endorsement

I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for the Latrobe River system, Thomson River System, Macalister River system and Lower Latrobe Wetlands in 2021-22.

SIGNED FOR AND ON BEHALF OF

West Gippsland Catchment Management Authority

Signature of authorised representative

Name: *Martin Fuller*

Title: *Chief Executive Officer*

Date:

9.1 Latrobe River System

I, the authorised representatives of the agencies shown below, acknowledge that the potential watering actions being proposed in Section 2 of the proposal are able to be delivered within existing system operations for the Latrobe River system in 2021-22, recognising that there may be additional information to endorse in relevant operating arrangements.

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Irrigation Service Delivery Supervisor*

Date: 3/6/2021

9.2 Macalister River System

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in Section 4 of the proposal are able to be delivered within existing system operations for the Macalister River system in 2021–22, recognising that there may be additional information to endorse in relevant operating arrangements.

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Irrigation Service Delivery Supervisor*

Date: 3/6/2021

9.3 Thomson River System

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in Section 3 of the proposal are able to be delivered within existing system operations for the Thomson River system in 2021-22, recognising that there may be additional information to endorse in relevant operating arrangements.

SIGNED FOR AND ON BEHALF OF

Melbourne Water

Signature of authorised representative

Name: Tommie Conway

Title: *Team Leader, Network Operations*

Date: 3/6/2021

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Irrigation Service Delivery Supervisor*

Date: 3/6/2021

9.4 Lower Latrobe Wetlands

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in Section 5 of the proposal are able to be delivered within existing infrastructure of the Lower Latrobe Wetlands system in 2021-22, recognising that there may be additional information to endorse in relevant operating arrangements

SIGNED FOR AND ON BEHALF OF

Parks Victoria

Letter of endorsement provided

Date:

10. References

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11. Appendices

10.1 Environmental Water Proposal for Heyfield Wetlands

Site Background:

Heyfield Wetlands was a deep, 26-hectare freshwater marsh adjacent to the Thomson River and was reduced post European Settlement (DELWP, 2019). After being used for multiple recreational purposes, the area has been converted back to a functioning wetland. The area reclaimed is similar in size and location to the original marsh. Due to the construction of levees and weirs along the Thomson River, inundation of river waters to the wetland no longer occurs even in the event of a 1 in 100-year flood (Water Tech, 2011a). Stormwater from the town and nearby agricultural lands have been diverted to the wetland supplying much of the wetland's water. The wetlands are deemed an important environmental feature of the area as the surrounding land is used for industrial and agricultural purposes with nearby rivers harvested for irrigation.

Wetland redevelopment commenced in 1994 and is defined by two stages. The first stage wetland development was the construction of a large pond at the eastern end of the wetlands, with permanent inundation supplied through town stormwater and rainfall. Stage 2 of the wetland development created four ponds at the western end of the site. Completion of the second stage has caused the watering area of the wetlands to outgrow the stormwater and rainfall infill capacity. Ongoing dry and drought conditions meant that the four western ponds remained dry throughout 2017-2019. These ponds were planted with semi-aquatic vegetation, with the intention that rainfall would inundate the ponds, but this did not occur. The plantings were sustained by a localized drip system which watered the plants but was not designed to inundate them. Environmental water was first delivered to this site in 2019.

Site Values

Ecological values:

The initial objective of re-establishing Heyfield wetlands was to filter stormwater and agricultural run off before it entered the Thomson River. This initiative assisted in decreasing the levels of turbidity and reducing the nutrient load entering the river and ultimately entering the RAMSAR listed Gippsland Lakes. The importance of Heyfield Wetlands ability to reduce nutrients and turbidity has been recognised through three successful grant applications to the Gippsland Lakes Co-ordinating Committee (GLCC) Grants for rehabilitation works.

Figure 1: Aerial Photograph of Heyfield Wetlands. Stage 2 ponds.

The Heyfield wetlands serve as a refuge for wetland and migratory bird species, a feature which is lacking in the immediate surrounding landscape. Since the construction of the Thomson Dam, natural flood events and high flows have decreased in the downstream reaches of the river, reducing the total water volume that would have naturally reached the Gippsland Lakes. Freshwater wetlands are also diminishing, as salinity levels increase in the Gippsland Lakes, highlighting the importance of the Heyfield Wetlands as a potential refuge. The increased vulnerability of freshwater wetland species was also recognized by the GLCC and provides another reason as to why Heyfield Wetlands was awarded their GLCC community grants. Currently the site boasts 92 different bird species recordings including Great Egret (vulnerable as listed on the FFG Act 1988 (Vic)), Little Black and Little Pied Cormorants and Eastern Spoonbills. Several woodland and grassland species are represented at the site alongside several floodplain and wetland species. Due to the proximity of the Heyfield township as shown in Figure 1, this is considered an impressive feat of the wetlands to host so many different species. The species variety is also a reflection of its importance as a refuge area within the Gippsland Plains landscape.

In late 2018, a Landcare grant was awarded to Heyfield Wetlands to enable frog monitoring. Monitoring is and will be carried out by volunteers with support from Wildlife Unlimited, an environmental research consultancy, and is due to be completed in 2020. Six frog species have been identified around the Heyfield area (Atlas, 2018). The Heyfield Wetlands present an opportunity to serve as habitat for vulnerable species that are already present in the landscape including Growling Grass frog (*Litoria raniformis*) and the Green & Golden Bell frog (*Litoria aurea*).

Acting on advice from West Gippsland Catchment Management Authority, the Heyfield Wetlands have planted appropriate, endemic vegetation species according to the EVC 641 (Riparian Woodland) classification defined for the area. Some of these plants include semi-aquatic species such as *Triglochin procerum, Bolboshoenus medianus, Juncus procerus* and riparian species such as *Allocasuarina verticittala, Callistemon sieberi* and *Eucalyptus*

tereticornis. In 2018 alone, over 4800 semi-aquatic plants and 350 riparian plants were planted in the western ponds increasing the vegetation coverage and quantity within the wetlands.

Shared Benefits/Social Connections:

The Heyfield Wetlands are a popular community recreation, meeting and events site. The site is managed by a volunteer committee that features prominent community members. The town's information centre is located on the edge of the wetlands, and the site regularly hosts family fun days and markets. Information on the local ecology and environment is a key part of the information available in the Heyfield Wetlands Centre. There are 2.9 kms of boardwalk and walking tracks around the wetlands that are open for the public to use and explore the sights and sounds of the wetland. To develop and maintain the wetlands, the Heyfield Wetlands committee actively seeks local volunteers to carry out improvement works. Using local volunteers has also been an opportunity to further educate the community of wetland importance. The previously mentioned 2018 plantings enlisted 310 students from 8 local schools to carry out the plantings. Bug Blitz and Parks Victoria both regularly hold educational holiday programs and events on the Heyfield Wetlands site.

Ecological Threat:

The eastern pond receives stormwater runoff and is permanently inundated with water. The western ponds do not receive regular stormwater and the dry conditions of the past years, and the disconnection from the Thomson River, has meant that these ponds are rarely inundated naturally. The 2018 plantings were completed with the expectation that winter and spring rains would enable strong growth of the plants. The plant growth and inundation of the pond would then provide a basis for the wetland habitat to expand from the eastern pond and throughout the western ponds and include all 27 hectares of the wetland site.

The semi-aquatic vegetation in the western wetlands was solely sustained by a localised drip irrigation system connected to the water mains from 2017-2019. However, the quantity of water supplied does not meet the plants watering requirements for growth. This can be seen in Figure 2. A more extensive inundation is required to promote the expansion of wetland vegetation to a more resilient and successful community. Rainfall cannot be relied upon to inundate the western ponds alone.

In the broader landscape, environmental water will be beneficial for this site long term due to the improvements in irrigation water delivery. The Macalister Irrigation District has been supported by programs that have changed irrigation delivery from surface delivery channels to underground piping. An unintended consequence is the reduction of surface delivery channels, decreasing the amount of available surface water for wildlife and vegetation throughout the district. As such, the Heyfield Wetlands provide a valuable refuge across the broader landscape.

Management Objectives:

- The Heyfield Wetlands Committee has approached the West Gippsland Catchment Management Authority (WGCMA) with a request for environmental water to be delivered on site to assist in supporting the wetlands.
- The primary purpose of the environmental water will be to inundate the wetland ponds at the western end of the wetlands to provide an opportunity for the growth and establishment of the semi-aquatic plants planted in 2018, 2019 and 2020.

Proposed hydrologic regimes:

Proposed environmental watering priorities are aligned with the establishment, growth and reproduction requirements of these planted native aquatic plants. The water delivery times will be reflective of these plant's requirements as described in the Sale Common Hydrological Investigation (Water Technology Pty Ltd, 2011) and Thomson Flows Study (Force, 2003). Delivery will align with the Thomson River Seasonal Watering Proposal 2021-2022 but may not be restricted to known fresh release times. In line with wetland requirements in the Sale Common Hydrological Investigation (Water Tech Pty Ltd, 2011b). Proposed watering actions, expected watering effects, environmental objectives and delivery rationale is outlined in Table 3-5, in the Thomson River seasonal watering proposal section.

The table below outlines the proposed watering volumes based on the climatic conditions for 2021-2022 year.

Watering	Drought	Dry	Average	Wet*
August Winter Wetting Flow – for full inundation	Full wetting 15 ML	Full wetting 15 ML	Full wetting 10-15 ML	Full wetting 5 -15 ML
Winter Watering Objective	This delivery is designed to: • inundate the ponds to capacity, allowing the pond banks to stabilise and support spring growth of semi-aquatic vegetation. • increase surface water availability to fauna and support in improving the ecological value of the wetlands			
Spring October/November wetting flow for partial inundation	Partial Wetting <5 ML	Partial Wetting <5 ML	Partial Wetting <5 ML	Partial Wetting <5 ML
Spring Watering Objective	This release is designed to 'top up' the ponds before summer and allow for a natural drying over the summer months before possible autumn/winter rains. This will assist the aquatic plants and riparian vegetation in their growth and potential seed dispersal by replicating more natural watering conditions, it will also sustain the surface water available to fauna and support in improving the ecological value of the wetlands			
Summer Partial Drawdown	Partial Drawdown	Partial Drawdown	Partial Drawdown	Partial Drawdown
Summer Drawdown Objective	The partial drawdown is designed to promote oxygenation of surface soils, breakdown of accumulated organic matter and nutrient recycling. This will also support birdlife by increasing feed available to them in the wetlands.			

Table 1: Proposed hydrologic regime for the Heyfield Wetlands 2020/2021.

*A full wetting may not be required in wet conditions as rainfall and runoff throughout the winter months may be enough to provide this action.

Knowledge Gaps and further research:

As stated in the introduction, there is no current FLOWS study or EWMP for the Heyfield Wetlands. The WGCMA, Heyfield Wetlands Committee and delivery partners are currently preparing creating a long-term management plan to be incorporated into the 2022-23 seasonal watering proposal.

The passion of the Heyfield Wetlands Committee means that ecological monitoring, rehabilitation works, and maintenance will continue. This will aid in the knowledge sharing and monitoring required to ensure environmental water is used most effectively in this area.

10.2 Recommended ramp up and ramp down rates for Lake Glenmaggie spill releases

Lake Glenmaggie is managed as a “fill and spill” storage. The release of water to maintain a pre-determined fill curve presents an opportunity for WGCMA and SRW to collaborate to deliver on various ecological objectives.

Flow recommendations that may be fulfilled during the storage spilling period (winter to spring) include winter and spring freshes of various peak magnitudes 700 ML/d, 1500 ML/d, 2500 ML/d and 3000 ML/d.

This section provides guidance on the release storage spills such that it may deliver on lower priority watering actions. The main considerations are detailed in Table 11-1 and

Table 11-2, providing recommended release patterns for various event magnitudes recommended from the Macalister River environmental flows study (Alluvium, 2015).

Table 11-1 Considerations for storage operators to incorporate to achieve ecological benefits during Lake Glenmaggie spill releases.

Characteristic of release	Recommendations	Relative priority of recommendation
Peak magnitude (ML/d)	• The target magnitudes of flow events range from 700 – 3000 ML/d • As such, the peak magnitude of the release should be a **minimum of 700 ML/d** in order to fulfil at least one ecological objective (migration trigger flows)	Low
Event ramp up (rising limb)	• The ramping up of spill releases should be incremental, increasing by **2.5 times** the flow of the previous day (e.g. day 1– 60 ML/d, day 2– 150 ML/d, day 3– 375 ML/d, day 4– 937 ML/d etc.)	Medium
Event ramp down (falling limb)	• Ramp down rates are critical to minimise the risk of fish stranding and provide sufficient time for completion of movement • The preferred **24-hour ramp down** rate is **0.7 times** the flow of the previous day (e.g. day 1– 700 ML/d, day 2– 490 ML/d, day 3– 343 ML/d, day 4– 240 ML/d etc.). • Where possible, the preferred **12 hour ramp down** rate is **0.85 times** the flow of the previous 12 hours (e.g. 8am– 700 ML/d, 8pm– 595 ML/d)	High

Table 11-2 . Considerations for storage operators to incorporate to achieve ecological benefits during Lake Glenmaggie spill releases. Note that these patterns assume commencement from the passing flow of 60 ML/d on day 0 and return to this flow.

Day	Required flow (ML/d)			
	Peak magnitude 700 ML/d	Peak magnitude at 1500 ML/d	Peak magnitude 2500 ML/d	Peak magnitude 3000 ML/d
0	60	60	60	60
1	150	150	150	150
2	375	375	375	375
3	700	937	937	937
4	700	1500	2343	2343
5	700	1500	2500	3000
6	700	1500	2500	3000
7	490	1500	2500	3000
8	343	1050	1750	2100
9	240	735	1225	1470
10	168	515	857	1029
11	117	360	600	720
12	82	252	420	504
13	60	176	294	352
14		124	205	247
15		86	144	172
16		60	100	121
17			60	84
18				60