West Gippsland
Catchment Management Authority

Water for rivers

Seasonal watering proposals for the Latrobe, Thomson, and Macalister rivers

2022-23

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.

Traditional Owner input and guidance on river objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team.

We also recognise the contribution of Aboriginal and Torres Strait Islander people and organisations in land and natural resource management.

Cover photo: Macalister River at Lanigans Bridge (WGCMA)

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West Gippsland Seasonal Watering Proposal 2022-23

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 2022-2023 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. The Lower Latrobe Wetland environmental water entitlement (covering Dowd Morass, Heart Morass and Sale Common) will be addressed in a separate proposal.

The objectives, scenarios and associated potential watering actions in this proposal took 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. 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 expected water availability for each system and the associated storage operator and land managers are shown in Table 1.

Table 1 Summary of the expected water availability at the beginning of 2022-23 water year and the waterway, storage and land managers for each environmental water entitlement

System Name	Latrobe River	Thomson River	Macalister River
Expected water availability. (July 1st, 2022)	18 GL*	22.3 GL*	21.8 GL*
Waterway Manager	West Gippsland Catchment Management Authority		
Storage Operator(s)	Southern Rural Water & Melbourne Water		
Land Manager(s)	N/A		

*values are estimates based on a March 2022 assessment.

Environmental Objectives

The broad, system scale objectives identified for the Latrobe River, Thomson River, and Macalister River are summarised in Table 2. With two years of high flows and flooding across the region, the priority flows for all systems are targeted at providing continued support to the native fish communities, from baseflows to freshes allowing for continued migration, dispersal and survival of the 2020 and 2021 new recruits.

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

Value	Latrobe River	Thomson River	Macalister River
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
Platypus and rakali 	Maintain or improve extent of platypus and rakali populations	Increase the abundance of platypus	Increase the abundance of platypus and rakali

Value	Latrobe River	Thomson River	Macalister River
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.
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		

Potential Watering Actions

Table 3 summarises the highest priority watering actions for each of the river systems for the upcoming water year.

Table 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.

Risk Assessment and Management

Potential risks arising from the implementation of the seasonal watering priorities were assessed and risk tables developed during the Gippsland Risk Planning Workshop in February 2022. Risks and mitigation strategies for each system are provided in section 5.

Engagement

Table 4 summarises the engagement that has occurred in the development of the West Gippsland Seasonal Watering Proposal. An example of engagement methods include:

- Formal advisory groups (Macalister, Thomson and Latrobe EWAGs)
- Partnership meetings and direct engagement / one-on-one and specific issue engagement
- Irrigator advisory groups (Macalister Customer Consultative Committee; CMA Irrigator Reference Group)
- E-flows subscriber notifications and newsletters (email, SMS)

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

Category	Stakeholder	IAP2 level
Program partners 	• VEWH • Parks Victoria • Southern Rural Water • Melbourne Water	Collaborate
Traditional Owners 	• Gunaikurnai Land and Waters Aboriginal Corporation	Collaborate
Community and environment groups and non-government organisations 	• Native Fish Australia • Landcare and Friends Of groups • Birdlife Australia • Environment Victoria • Greening Australia • Latrobe Valley Field Naturalists	Involve
	• Cowwarr Landcare Group • Waterwatch volunteers	Inform
Land managers / landholders/ farmers 	• Heyfield Wetlands Committee of Management • Sale Field and Game Australia (Heart Morass)	Collaborate
	• Macalister Irrigation District irrigators/ diverters • Other landholders	Involve / consult
Other government agencies and technical experts 	• Gippsland Water • Department of Environment, Land, Water and Planning - Water and Catchments	Involve
	• Department of Land, Environment, Water and Planning (Latrobe Valley Regional Water Study) • East Gippsland CMA • Parks Victoria	Inform

Category	Stakeholder	IAP2 level
	• Arthur Rylah Institute (Department of Environment, Land, Water and Planning)	Collaborate
Recreational users 	• Field and Game Australia	Collaborate
	• VRFish • Tourism operators • Recreational users (key individuals and event organisers (e.g. Baw Baw Extreme Event)	Involve
	• Recreational paddling (individuals and organisations)	Inform
Local businesses 	• Port of Sale Heritage River Cruises • Frog Gully Cottages	Inform

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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 three of 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, and Macalister River.

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 state-wide Seasonal Watering Plan. 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.

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).

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

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 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 impacting 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). This has caused 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 ranges 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), based on providing the environmental flow recommendations.

Despite extensive modification, the Latrobe River system does retain many significant environmental values: the upper Latrobe River is ecologically healthy and listed (endangered and vulnerable) riparian vegetation communities exists in all but the most modified reach (reach 4) flowing 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.

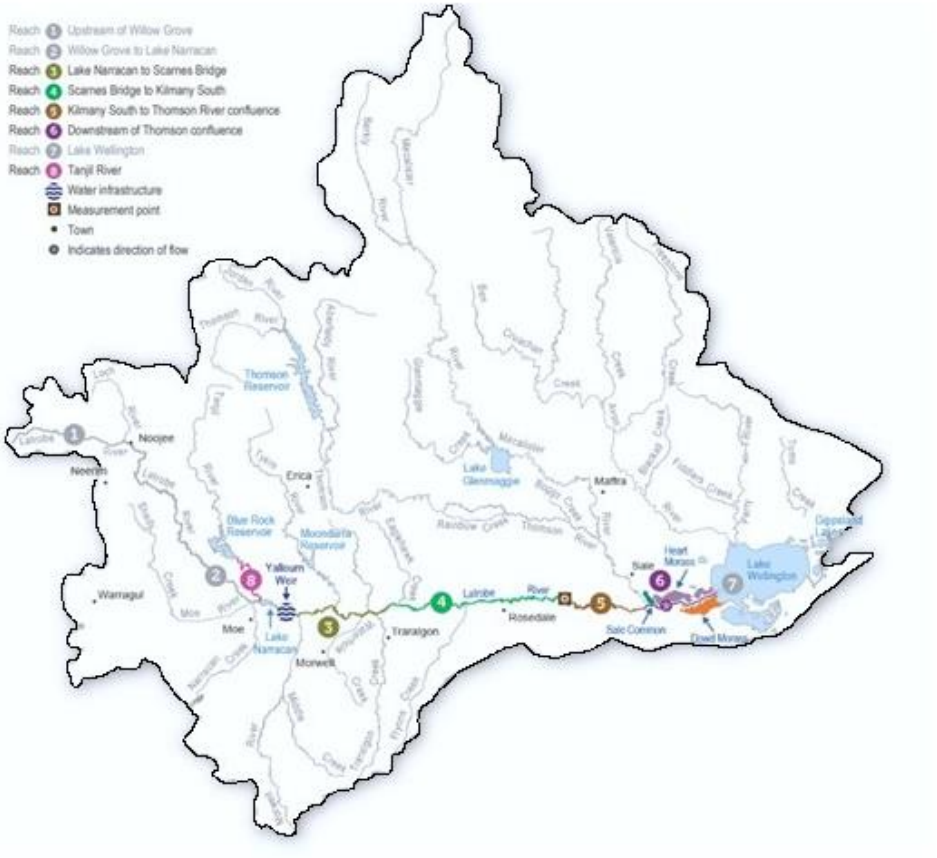


Figure 2 Map of the Latrobe River and tributaries with associated reach numbers

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 management major reaches (see Figure 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 (Reach 5). Reach 6 represents the section of river below the Macalister confluence and upstream of the confluence with the Latrobe River, downstream of Swing bridge.

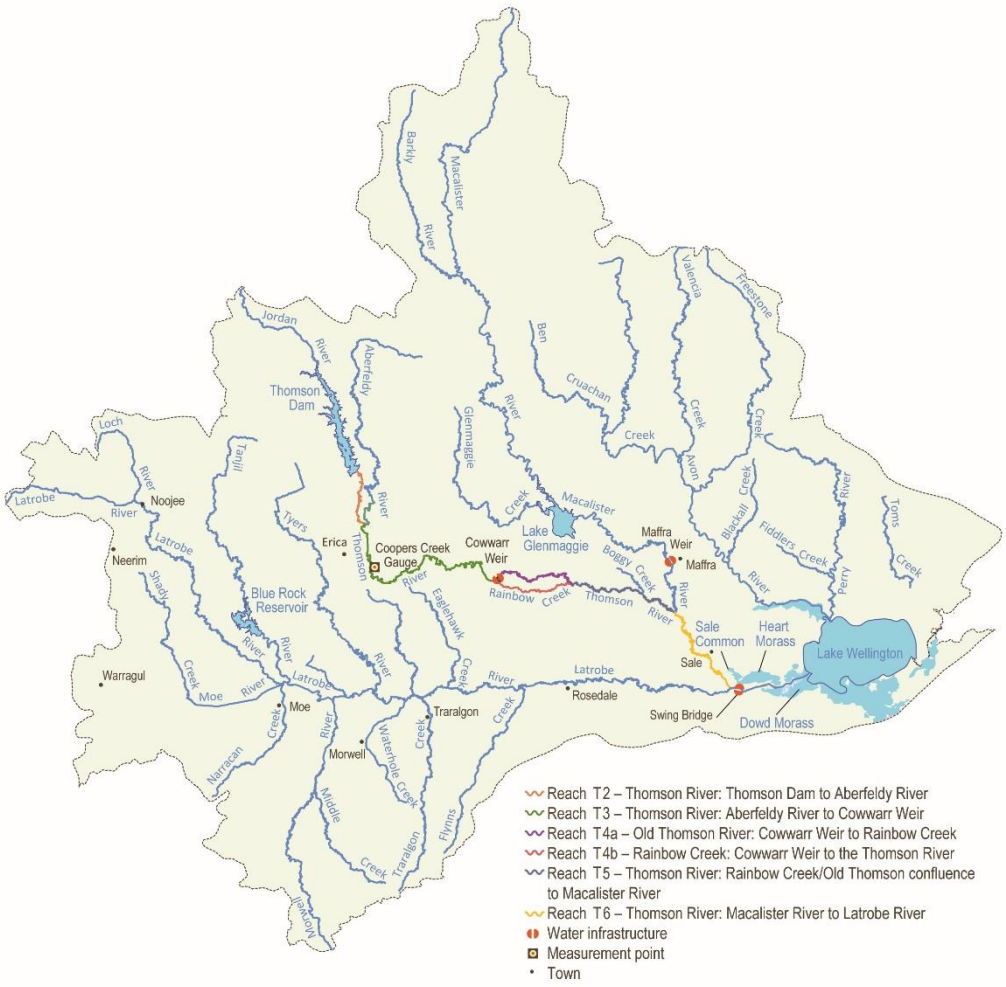


Figure 3 Map of the Thomson River and tributaries with associated reaches

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 4).

Figure 4 Aerial view of the Thomson Fishway at Horseshoe bend

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

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 received environmental water deliveries to support vegetation and habitat objectives.

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 management reaches (see Figure 5); 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 for most of the year. 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 5 Map of the Macalister River and tributaries with associated reaches

Latrobe Estuary and the Lower Latrobe wetlands

The lower Latrobe wetlands are situated along the Latrobe River between its confluence with the Thomson River and Lake Wellington (**Error! Reference source not found.** and **Error! Reference source not found.**) 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.

Culturally, the lower Latrobe wetlands were an important resource for the 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.

Environmental water delivery in all three river systems consider impacts to the estuary and lower Latrobe wetlands in an effort to maximise environmental benefits at a landscape scale.

Climate review and Climate outlook

Gippsland rainfall for 2021 was up to 50% above average, with particularly heavy rain and widespread flooding in June and November. This continued the trend set by 2020-21 which was the coolest and wettest for Australia since 2016, generating above average streamflow across the country.

In West Gippsland the wet winter was reflected in above average rainfall across the eastern catchments of the region (see **Error! Reference source not found.**).

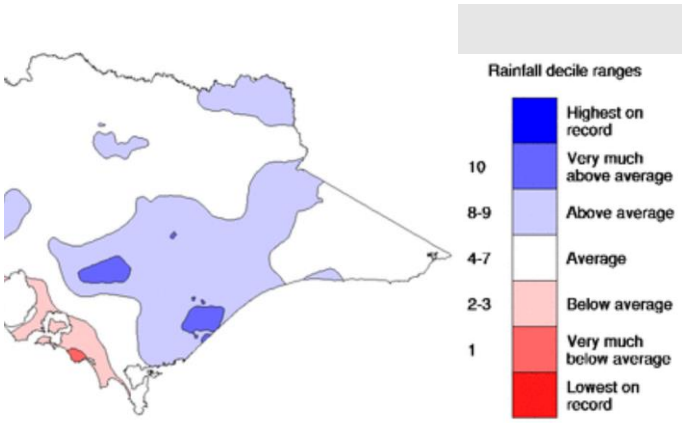


Figure 6 West Gippsland rainfall deciles from 1 June to 31st August 2021, showing above average rainfall across the eastern end of West Gippsland (Source: BoM Victoria in Winter 2021 (bom.gov.au)

During June 2021, an East Coast low developed off the coast of NSW and Victoria and produced heavy rainfall over a 24-hour period from 9th June - 10th June. As the catchments in the rainfall area were already relatively wet, this produced an intense flood event with minor to major flood warnings issued by the BoM across the region, impacting the catchments of the Latrobe, Macalister and Thomson rivers (Table 5). The largest rainfalls occurred at the higher altitudes of the Strzelecki and Baw Baw Ranges, with the Baw Baw weather station recording the highest June daily rainfall on record which is in excess of 100-year ARI. This rainfall varied with the Traralgon EPA gauge and the Sale weather station, lower in the catchment, recording a 2-to-5-year ARI.

Table 5 A sample of water level recordings in the Latrobe, Macalister and Thomson catchments, from June 10th, 2021.

Waterway	Gauge	Height	ML/day	Flood Class Level	ARI
Traralgon Creek	Traralgon	5.76	16,500	Major	50
Morwell River	Boolarra	5.1		Moderate	20-50
Tanjil River	Tanjil Junction	5.72	25,085	Major	17
Latrobe River	Willow Grove	4.7	19,240	Minor	50
	Thoms bridge	6.39	86,134	Moderate	50

Waterway	Gauge	Height	ML/day	Flood Class Level	ARI
Traralgon Creek	Traralgon	5.76	16,500	Major	50
Macalister River	Licola	4.2	42,200	Major	32
Thomson River	Wandocka	6.89	45,009	Major	8
	Upstream of Cowwarr weir	7.6	73,931	Major	30

(Ref: Rainfall and Flood Magnitude Summary, WGCMA 2021)

The West Gippsland region also saw higher than average spring rainfall, with some areas (e.g., Traralgon EPA station) showing the highest rainfall on record (see Figure 7 below). Higher in the catchment, Mount Baw Baw was the wettest place in Victoria across the season. The above-average rainfall was predominantly due to a developing La Niña in the Pacific Ocean. It was the wettest November on record for Australia as a whole.

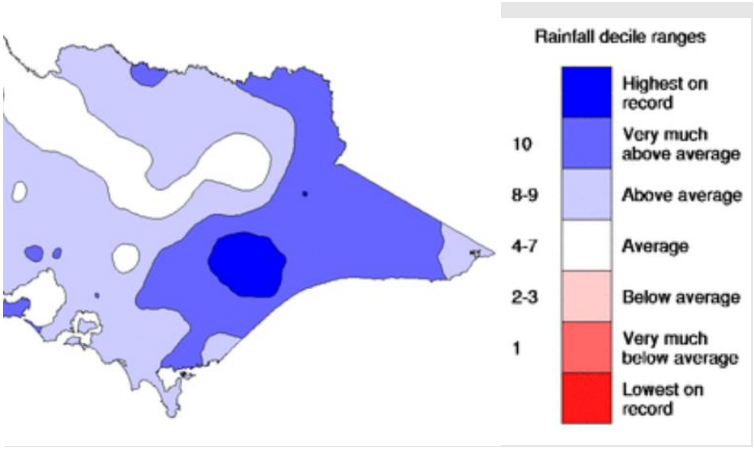


Figure 7 West Gippsland rainfall deciles from 1 September to 30th November 2021 (Source: BoM Victoria in Spring 2021 (bom.gov.au))

These natural rain events, and subsequent storage releases and unregulated river flows, across winter and spring provided flushing flows in the Latrobe, Macalister and Thomson rivers, with flows remaining elevated throughout the year.

Climate Outlook

Available forecast information from the Bureau of Meteorology (BoM) indicates that while La Nina is still active, there are signs that it will return to neutral conditions in mid-Autumn 2022. Predictions indicate that there is an increased chance of the unusually high rainfall continuing into May for southern Victoria (Figure 8) and the streamflow outlook for Feb – April indicates that high flows will continue across South-eastern Australia.

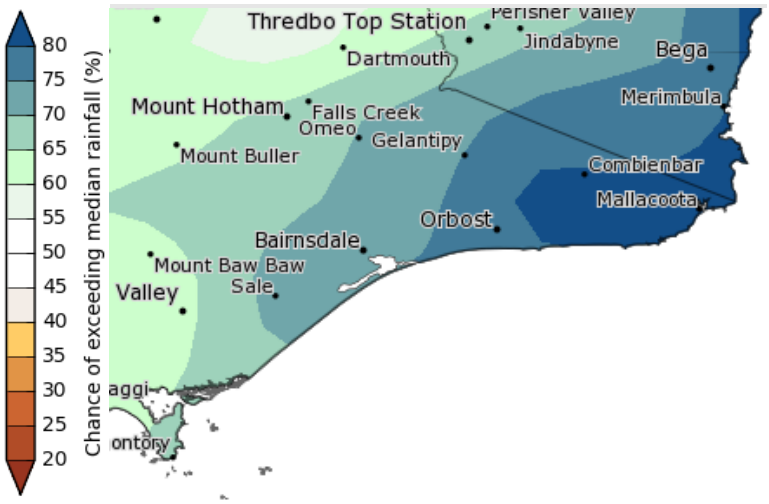


Figure 8 Chance of above median rainfall for March to May 2022. Source: BoM

Long-term objectives

The objectives set reflect the environmental values of the individual river systems considered important by both waterway managers, Traditional Owners 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 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.

2. Latrobe River seasonal watering proposal

The following section provides details for the Latrobe River 2022-23 proposed watering actions.

2.2 Environmental objectives

Objectives for environmental flows in the Latrobe River are derived from the Latrobe Environmental Water Requirements Investigation (LEWRI) (Alluvium, 2020). 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).

Table 6 shows the overarching long-term environmental objectives for environmental water management in the Latrobe River. Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team.

Table 6 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 components and considerations

2.3.1 Delivery

Options to deliver environmental water to the Latrobe via the Tyers River are being considered for 2022-2023 as was for 2021-22. Wet conditions meant environmental watering objectives were met with natural events.

The Tyers River is a highly flow stressed river largely due to 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 riparian and instream 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 or cultural 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.

2.3.2 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 and the Thomson River. 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).

2.3.3 Temporary trade

Temporary trade of environmental water is proposed for consideration in the 2022-23 water year. Historical under use of the environmental entitlement is largely a result of the delivery constraint in reach five (highlighted above in section 2.2.2), and, while this constraint remains, the ability to effectively use the full entitlement and benefit additional reaches of the river (including the estuary) will continue to be compromised.

It is proposed that between 2-5 GL could be made available for temporary trade depending on the prevailing climate conditions. However, this should be reviewed throughout the year to ensure base environmental needs are met. The WGCMA proposes that proceeds from any trade be made available for works aimed at addressing the constraint.

The inherent risk with this proposal is the perception that the VEWH hold to much environmental water in the Latrobe. This is not correct, and a significant deficit exists in the system. If the temporary trade is to proceed, appropriate community engagement should be undertaken.

2.3.4 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 7). Flow frequencies expressed as ‘per season’ denote the number of events in the “Summer-Autumn” or “Winter-Spring” expression (i.e. a six-month period). 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.

2.3.5 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 7 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

2.4 Scenario planning and prioritisation

2.4.1 Observations and provision of flow recommendations

As with all three river systems, the 2020-21 and 2021-22 water years were considered wet years in terms of planning scenarios, with rainfall and river flow being consistently high from July through to September (winter – spring). For most of the water year, increased unregulated flows in the river often achieved and exceeded the priority flow components. Flow peaks throughout the year exceeded bankfull levels providing lateral connectivity between the main channel and some low-lying freshwater wetlands. July 2021 saw a significant flow >30,000 ML in Reach 5, well above bankfull flow levels.

For overall context, Figure 9 illustrates the streamflow in Latrobe River (at the Reach 5) for the 2013 – 2021 water years, with the bankfull level indicated in brown.

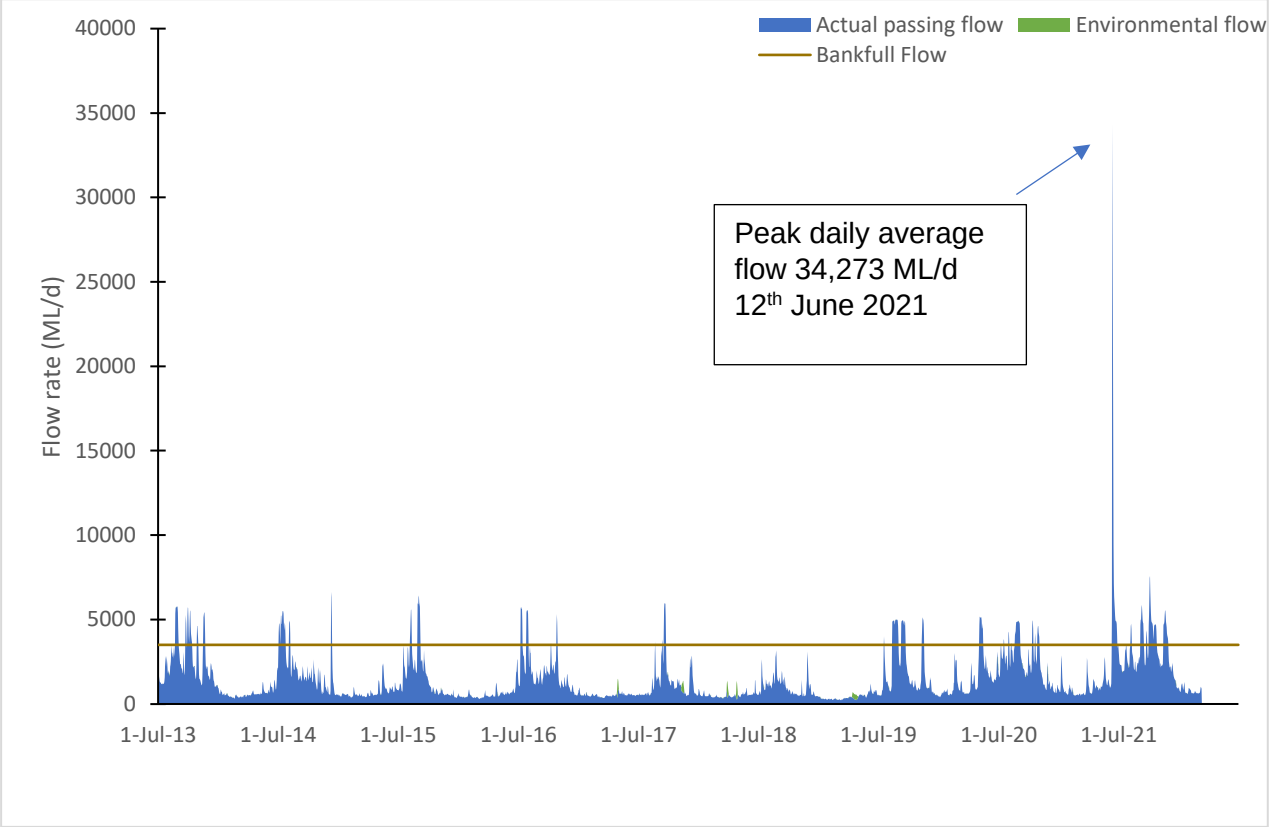


Figure 9 Hydrograph of managed and unmanaged flows occurring in reach five of the Latrobe River between the 2013 and 2021 water years, as well as the estimated low flows and planned freshes for the remainder of 2021-22.

To date no managed freshes or low flows have been delivered in the 2021-22 water year as they have been provided by unmanaged/natural river flows (Table 8). Heavy rainfall from June 2021 to November saw high river levels, providing substantial bankfull and overbank flows throughout the system (Figure 10). This marks the third year in a row that all flow recommendations for reach 5 in the Latrobe River have been met.

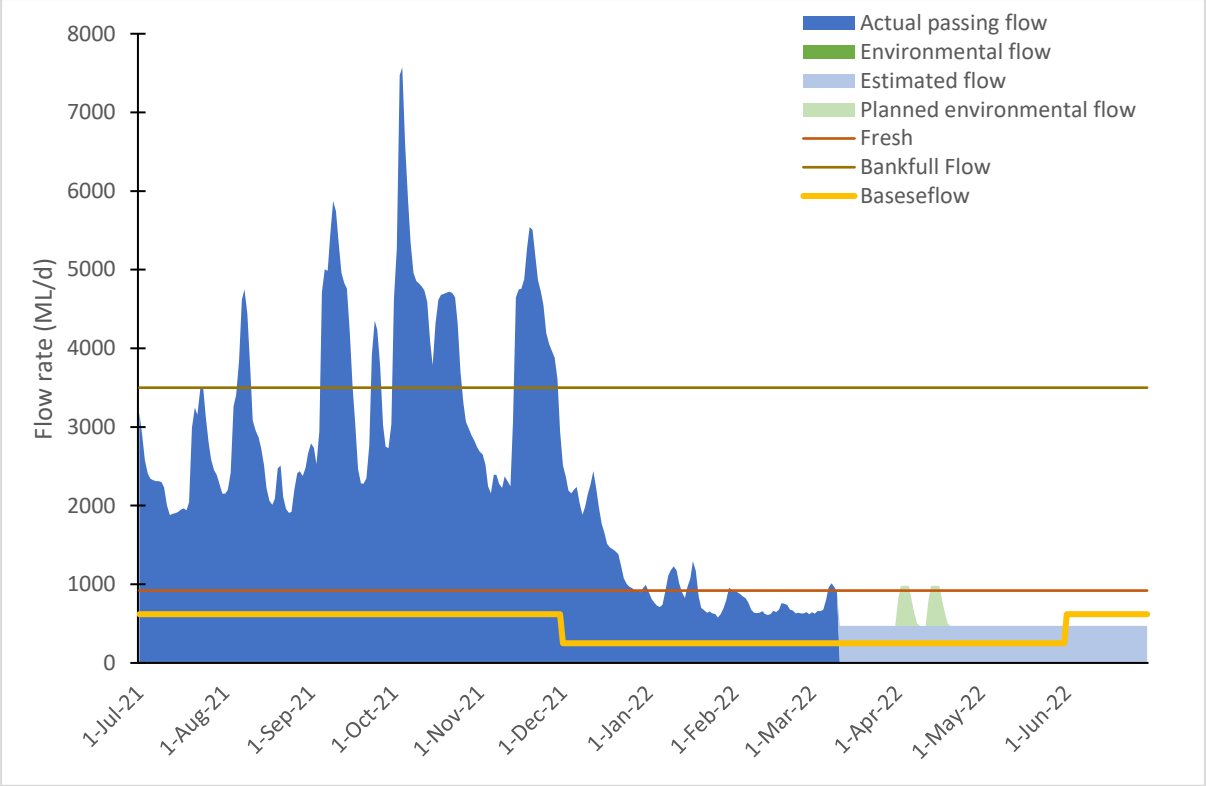


Figure 10 Hydrograph of managed and unmanaged flows occurring in reach five of the Latrobe River in the 2021-22 water year, as well as the estimated low flows and planned freshes for the remainder of 2021-22

Table 8 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	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21-22*
Summer-Autumn Fresh (fish and vegetation)	Dec-May; Up to 920 ML/d; 3-5 days; 1-3/yr	0	1 (E)	3 (1 E)	1 (E)	1 (E)	3 (2 E)	2	4 (2 E)	6	2
Summer-Autumn fresh (water quality)	Dec-May; Up to 920 ML/d; 1 day; 4-6/yr	0	1 (E)	4 (1 E)	1 (E)	3 (1 E)	4 (2 E)	2	3 (2 E)	6	3
Winter-Spring Fresh[b]	Jun-Nov Up to 2,200 ML/d; 2 days; 1-4/yr	1	5	2	3	4	2	3	4	4	1
Summer-Autumn Low flow	Dec-May; Up to 250 ML/d	0	0	0	0	0	0	14	0	0	0
Winter-Spring Low flow	Jun-Nov Up to 620 ML/d	1	0	3	24	27	62	43	0	0	0
Bankfull flow[b]	3,500 ML/d	4	3	2	2	3	1	0	4	5	5
Overbank flow[b]	>5,000 ML/d	4	3	2	2	2	1	0	3	1	4

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%

2.4.2 Potential watering actions

Potential watering actions for 2022-2023 are focused on maintaining the benefits of the wet conditions over the past two years. In line with the Thomson and Macalister rivers, watering action this year will be targeted at providing continued support to the native fish communities, from baseflows to freshes allowing for continued migration, dispersal, and survival of the 2020 and 2021 new recruits. The watering actions are also aimed at preventing catastrophic reduction in water quality resulting in fish kills and algal blooms if drought or dry conditions arise. Prioritised potential watering actions for 2022-23 are shown in Table 9.

Table 9 Prioritised potential watering actions for the Latrobe River (reach 5) and Latrobe estuary in 2022-23. 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>Flow Details</th><th>Rationale</th><th>Priority (H/M/L)</th></tr>
<tr><td rowspan="5">Summer-Autumn low flow – 380 ML/d (December – May)</td><td rowspan="5">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="5">The flow recommendation is to provide low flows on a continuous basis. However, if dry conditions eventuate, shorter pulses may be utilised to meet some 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="5">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="5">M</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 rowspan="2">Summer/Autumn water quality fresh - 920 ML/d for one day (December – May)</td><td rowspan="2">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="2">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="2">The focus of 2022-23 is to enhance the benefits seen in 2020-22 from the high flows and floodplain inundation. 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="2">M</td></tr>
<tr><td>  </td><td>Avoid adverse water quality conditions</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 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"></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>Flow Details</th><th>Rationale</th><th>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="9">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="9">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 arise. Accordingly, these flows are a low priority for 2022-23</td><td rowspan="9">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>

2.4.3 Delivery constraints

Competition for, and total, outlet capacity as well as risk of downstream flooding are the key operating constraints in the Latrobe River (Table 10). Operating constraints have been considered in the development of this proposal, and in the operating arrangements for the Environmental Entitlement. These will be further considered as required in the implementation of the seasonal watering plan. Effective implementation will require coordination by the storage managers (SRW and GW) and cooperation/negotiation with other entitlement and land holders.

Table 10 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. Most likely to impact freshes but may also impact low flows.
Total available outlet capacity	Limits release volume. Most likely to impact freshes.
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).

2.4.4 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 regular 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 11). 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. 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 2022-23 seasonal watering plan.

Table 11 Proposed release triggers for fish and vegetation freshes in. [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.

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]

2.4.5 Scenario planning

Four climatic scenarios were selected for the Latrobe River system: 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.

Operating constraints were 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 2022-23 priority watering actions under each scenario are shown in Table 12 and Table 13. 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 12. 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 13 Scenario planning for watering actions for the Latrobe River at reach five and the Latrobe estuary in 2022-23. [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: 12-18 GL[1]		Starting Volume: 12-18 GL[1]		Starting Volume: 12-18 GL[1]		Starting Volume: 12-18 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 = 13.4 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 2022-23 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, GLaWAC, landholders, urban and rural water suppliers and environmental interest groups through a Project Advisory Group (PAG). Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team.

The overarching environmental objectives for the flow components are summarised in Table 14.

Table 14 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

Figure 11 Thomson River at Bruntons Bridge

As Heyfield wetlands does not currently have an environmental management plan in place (due for completion in 2022), 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.

Figure 12 Aerial view of the Heyfield Wetlands Complex

3.1.1 Flow Requirements

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.

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.

3.2 Flow components & Seasonality

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

3.3.1 Seasonal Review

The 2020-21 and 2021-22 water years were considered wet years in terms of planning scenarios, with rainfall and river flow being consistently high from July through to September (winter – spring). June 2021 saw a flow >35,000 ML at Coopers Creek, which sits mid-way between the moderate and major flood level for that location.

For the majority of the water year, increased unregulated flows in the River often achieved and exceeded the priority flow components. This also includes two significant flows in September (>2900 ML/d) and again in November (>3000 ML), which are volumes considered to achieve bankfull objectives in Reach 3. Bankfull flows provide lateral connectivity between the main channel and some low-lying freshwater wetlands. Geomorphically, these larger flows also create pools, build bars and benches, and inundate flood runners and anabranches

For overall context, Figure 13 illustrates the streamflow in Reach 3 of the Thomson River (at the Coopers Creek gauge) from July 2017 – 30 June 2022, with low flow, fresh and bankfull recommendations overlain in black.

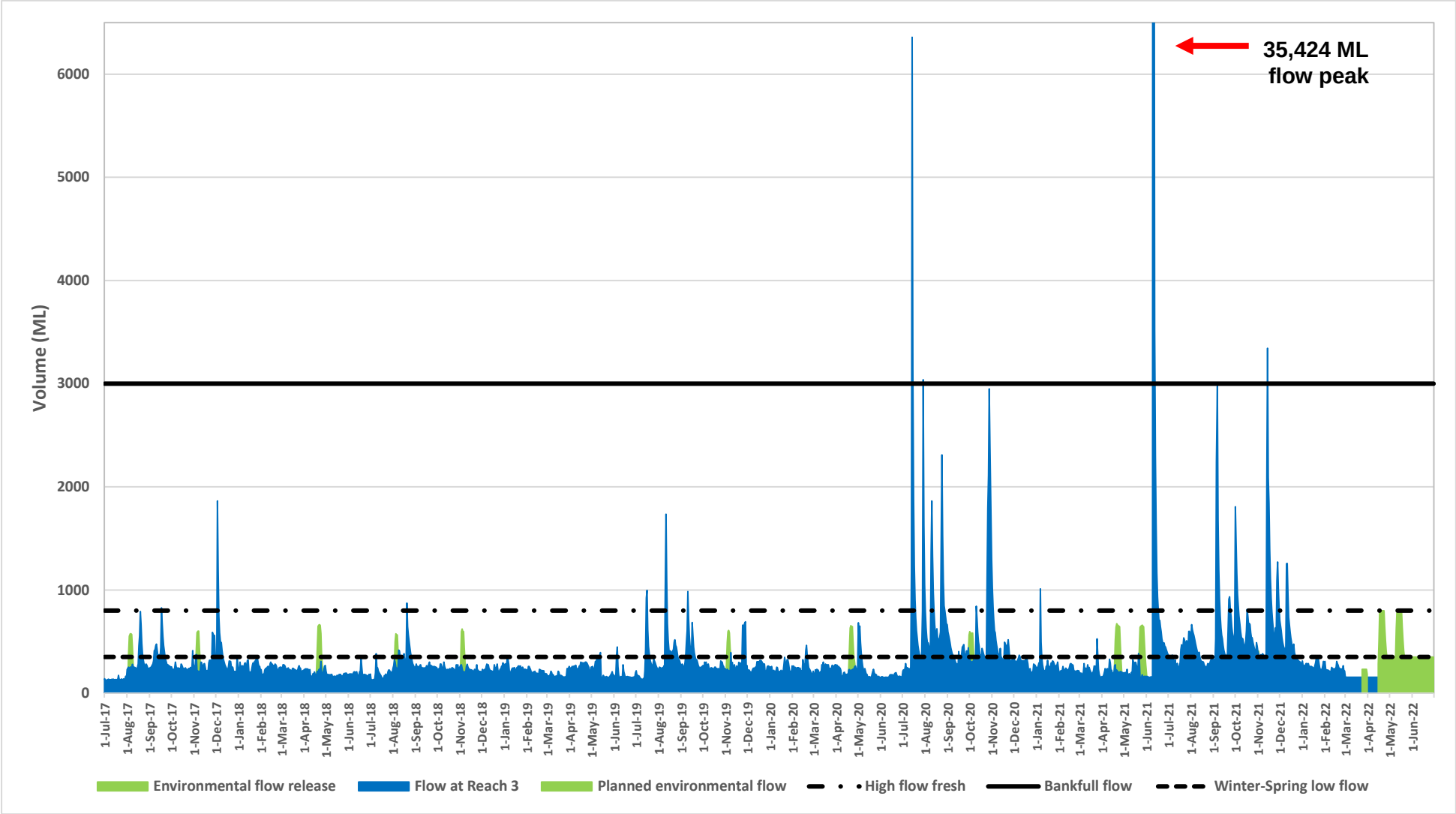


Figure 13 Hydrograph of managed and unmanaged flows occurring in the Thomson River (at Coopers Creek gauge) from July 2017-July 2022

At the writing of this proposal, there have only been two environmental flow deliveries in the Thomson for the 2021-22 water year. A spring fresh of 800 ML/d over 7 days was delivered in Oct-November 2021, and a summer fresh of 350 ML/d for 7 days during January 2022. The spring fresh was delivered in Oct-November 2021 as these flows are timed to provide flow cues for migratory native fish species, particularly triggering the recruitment of juvenile fish from the estuarine/marine environment into the freshwater reaches. Monitoring in February 2021 detected Australian grayling and high numbers of young-of-year tupong in the middle-lower reaches of the Thomson River. This was reflected in the flow priorities for 2021-22, with spring freshes considered a high priority across all climate planning scenarios (i.e. drought-dry-average-wet). No water for the environment was delivered to the Heyfield wetlands in 2021-22 as significant rainfall across the catchment filled the wetlands in winter and water levels were maintained throughout spring

Three planned deliveries remain for the 2021-22 water year, from April through to June 2021 (i.e., a continuous low flow and 2 freshes). 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 2022 (Autumn fresh) and May 2022 (Winter fresh).

Figure 14 illustrates the streamflow in reach 3 of the Thomson River (at the Coopers Creek gauge) from 1 July 2021 – 30 June 2022. Flows post 10th March 2022 reflect the upcoming planned flow deliveries remaining for 2022.

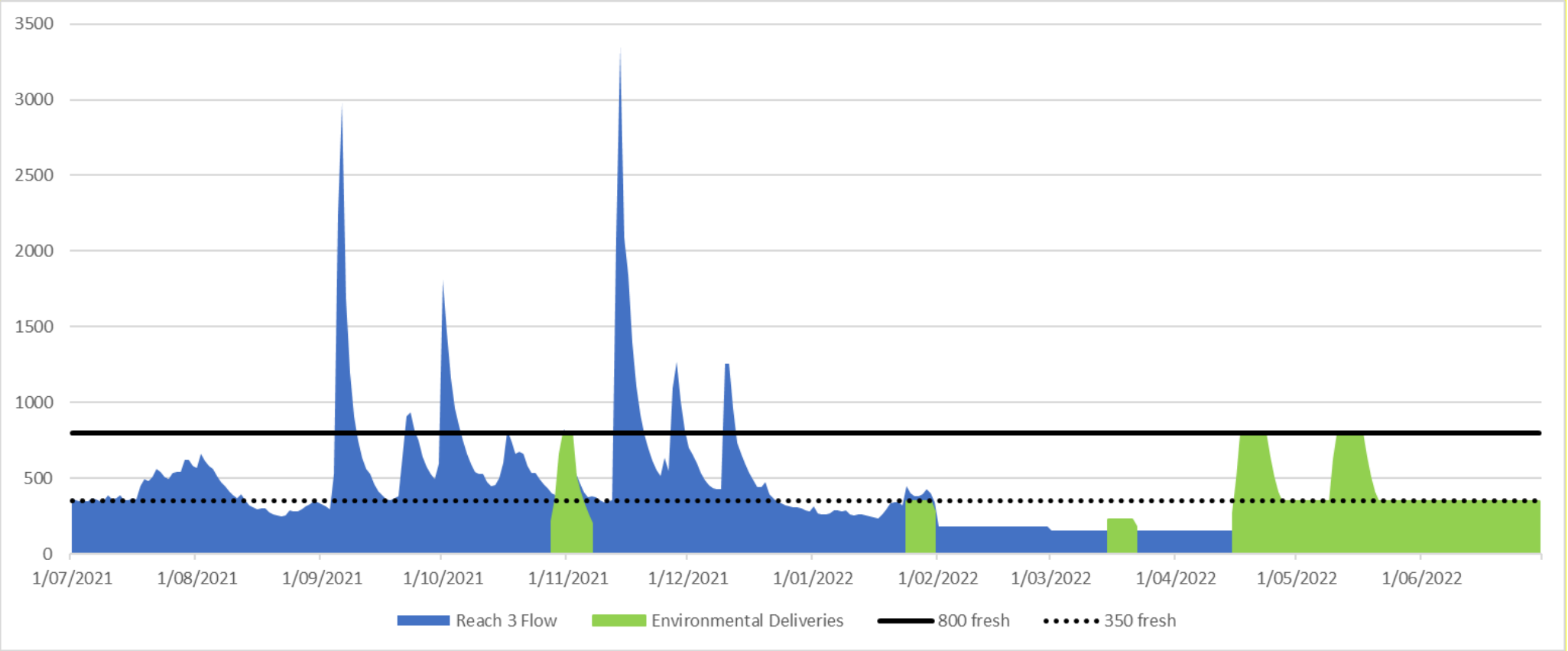


Figure 14 Thomson River Hydrograph (at Coopers Creek gauge) July 2021-30 June 2022.

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

3.3.2 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).

3.3.3 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.

3.3.4 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. Information summarised in Table 20.

3.3.5 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 15 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 16 summarises the delivery results for Heyfield Wetlands.

The Arthur Rylah Institute completed fish surveys on the Thomson River in February 2022, as part of VEFMAP annual population surveys. Preliminary field results indicate good survival of last year's strong young-of-year tupong cohort, with juvenile fish dominating the catches. Six tupong were detected above the Horseshoe Bend fishway, including juvenile fish indicating successful upstream migration in the past 12 months (Figure 15).

Figure 15 ARI Feb 2022 Thomson River annual fish population surveys. Top left Tupong, top right measuring an eel, bottom left 3–4-month-old River Blackfish and bottom right ARI staff electrofishing

Table 15 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	21/22*	Ecological outcomes/observations 2020/21
Autumn high flow fresh	Apr-May; 800 ML/d; 7 days. 2/yr	E	1	E	E	E	These are planned environmental water deliveries, the first in April and the second in May 2022. 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 2022) reported good survival rates of the 2020-21 tupong young-of-year cohort. Tupong were also captured above the horseshoe bend fishway. This year, the April fresh has also been timed to coincide with the Easter break, providing a shared benefit of increased river flows for recreational users.
Winter-Spring low flow	June - Nov;350 ML/d; continuous	E/O/U	E/O/U	E/O/U	E/O/U	U	Met through unregulated flow throughout July – November 2021
Summer-Autumn low flow	Dec – May; 125 ML/d; continuous	O/U	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	E	A spring fresh was provided through a managed release late October early November 2021 to encourage recruitment of juvenile migratory fish species from the estuary into freshwater reaches. The ARI 2022 Thomson fish survey detected good survival rates and upstream migration of the 2020-21 tupong young-of-year cohort.
Summer fresh	Dec-Jan; 350 ML/d; 7 days; 1/yr	O/U	O/U	O/U	O/U	E	Flow delivered in January 2022
Summer-Autumn low flow fresh	Feb-Mar; 230 ML/d; 7 days; 1/yr	O/U	O/U	O/U	E	O/U	Met through unregulated and passing flows throughout Feb-March 2022
Bankfull/sub bankfull	Anytime; 3,000 ML/d; 1 days	2	2	U	U	U	Two high flow events in September and November 2021 at and above 3000 ML/d

Key			Footnotes
	Flow component has been fully provided		*Note: This assessment is as of 11th March 2022 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 16 Heyfield Wetlands Historical environmental delivery compliance

Heyfield Wetlands (Western Ponds)	**17-18**	**18-19**	**19-20**	**20-21**	**21-22**	**Ecological outcomes/observations**
Winter Watering	N/A*	N/A*	E	U	U	With significant rainfall and runoff widespread across the catchment, no environmental deliveries were required to meet the 2021-22 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. Covid-19 restrictions reduced the capacity of both WGCMA staff and volunteers to do more formal water quality and frog response monitoring in 2021-22.
Spring Watering	N/A*	N/A*	E	U	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					

3.3.6 Potential watering actions

Potential watering actions for the Thomson River in 2022-23 have been prioritised in Table 17, 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 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 18.

Table 17 Potential watering actions in the Thomson River for 2022 - 23

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***		***2022-23 Flow Details***	***2022-23 Rationale***	***Priority (H/M/L)***
Autumn fresh 800 ML/d for 7 days (April)	Flow cue for downstream migration for Australian grayling, adult Short-finned eel, adult Long-finned eel, adult Australian bass, and adult Common galaxias.		Maintain/enhance native fish community structure	This flow is considered a high priority in all scenarios (**drought-dry-average-wet**).	Migratory fish species are a feature of the Thomson River and broader Gippsland rivers landscape. The priority objective of this PWA is to provide a flow cue for native fish migration, particularly for Australian grayling. For species such as Australian grayling, which have shown positive signs of recruitment over	**H**
			Maintain or enhance physical form and functioning of the stream bed			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	Flow 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, and non-woody fringing vegetation 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. Flows to provide opportunities for scouring of existing biofilms and generate new colonisation sites Mobilising fine sediments, turnover of sediment, preventing infilling of pools, and depositing sediments on existing bars and benches		Maintain or enhance in-stream, fringing and riparian vegetation species, zonation and structural diversity		the last two years, the timing and provision of these flows provides continued support for this and the broader migratory native fish population. Monitoring in Feb 2022 detected Australian grayling in the middle to 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 2022-23 that support their migration, spawning and recruitment. At a catchment scale, the provision of this flow would also have 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 would be **partially, if not fully achieved** in 2022-23 during the combined Macalister and Thomson rivers Autumn fresh deliveries in Apr-May.	

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Spring fresh 800 ML/d for 5-7 days (Oct – Nov)	Flow 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. Flow cue for downstream migration of 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		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 and Tupong. Monitoring in Feb 2022 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 2022-23, as they continue to provide opportunities for native migratory fish species. This flow also fits with the overall priority to support native fish populations following successive breeding and recruitment events. At a catchment scale, the provision of this flow would have a secondary benefit for the upper Thomson estuary, providing a full flush. This flow would help to improve water quality by displacing the salt wedge and contributing freshwater flows to the lower Latrobe wetlands. This estuary flow requirement would be **partially achieved, if not fully**, in 2022-23 during combined Macalister and Thomson rivers Spring fresh deliveries 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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	propagules (of submerged, woody and non-woody plant species) Turnover of sediment, mobilising fine sediment, prevention of pool infilling, and deposition of sediment on existing bars and benches					

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2022-23 Flow Details*	*2022-23 Rationale*	*Priority (H/M/L)*
Autumn fresh 800 ML/d for 7 days (May)	Flow 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. Flow 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)		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. This flow also fits with the overall priority to support native fish populations following successive breeding and recruitment events. 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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	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					

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Summer-Autumn fresh 230 ML/d for 7 days (Feb – Mar)	Flow cue for downstream migration of adult Short-finned eel, adult Long-finned eel. Flow cue for upstream migration for juvenile Short-finned eel, juvenile long-finned eel, juvenile		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 and refuge 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			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	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, and non-woody fringing vegetation		Maintain and improve in-stream habitat diversity and connectivity			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Autumn – Spring low flow, 125 – 350 ML/d continuous	Provides flows that support diversity of instream habitat for macroinvertebrates and the whole native fish assemblage		Restore or maintain the natural macroinvertebrate and microinvertebrate community	In a **drought and dry scenario**: 125 – 230 ML/d, dropping to this magnitude is still within a range to	Winter-Spring baseflows provide important longitudinal connectivity and enable fish and other fauna to move freely between different habitats. This is particularly important during this time as it is considered the juvenile recruitment	**M**
			Maintain and improve in-stream habitat diversity and connectivity			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
(May – Nov)	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, and non-woody fringing vegetation Higher flows to permit downstream dispersal of		Maintain/enhance native fish community structure	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, particularly across June – July when the passing flow volumes are <220 ML/d	period for native diadromous species, such as Australian grayling and tupong. <u>Additional benefits for Reach 6 (upper Thomson estuary)</u>: This flow would also 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	
			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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	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.					

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	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 Maintain or enhance physical form and functioning of the stream bed	In a drought scenario this flow would be considered a higher priority.	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**

Potential Watering Action	*Expected Watering Effects*	*Environmental Objectives*		*2022-23 Flow Details*	*2022-23 Rationale*	*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,** when not delivered via unregulated flow**, and** where appropriate to do so, this flow can be increased to 900 ML/d to reach higher up the bank. In a wet scenario this flow could be	As there are no direct fish objectives associated with this September fresh, and with volumes greater than this being achieved through unregulated flows over the last two years, it has been given a lower priority. 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 would be **partially achieved, if not fully**, in 2022-23 with the delivery of a Spring fresh in Sept-Nov.	**M-L**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
				delivered in lieu of a bankfull event. Planning and good communication with storage operators could also see this achieved through piggybacking on unregulated flows.		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	Provides diversity of instream habitat to support		Maintain/enhance native fish community structure	This flow is typically provided	The objective of this flow is to provide connectivity and habitat availability for	**L**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Summer-Autumn low flow, 125 ML/d continuous (Dec – April)	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 and improve in-stream habitat diversity and connectivity	through passing flow arrangements and as such is not considered a high priority for delivery in 2022-23.	macroinvertebrates and fish. This flow is typically provided through passing flow arrangements and as such is not considered a high priority for delivery in 2022-23. For the upper Thomson estuary, this flow also provides a partial flush to 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	
			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		2022-23 Flow Details	2022-23 Rationale	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		Maintain or enhance physical form and functioning of the stream bed	Not a proposed delivery for 2022-23	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.	**L**
			Maintain/enhance native fish community structure			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	Creation of pools, building bars and benches, and inundating flood runners and anabranches				Delivery of this event would also elevate the risk of personal injury or damage to property. This flow event was achieved through unregulated flows in 2021-22.	
			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 18 Heyfield Wetlands Potential Watering Actions for 2022-23

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***		***2022-23 Rationale***	***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 2021-22, 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 not connected directly to the Thomson River. 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*		*2022-23 Rationale*	*Priority (H/M/L)*
Spring-summer top-ups to full **Up to 10-15 ML (Sep-Jan)** **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 Improve water quality in ponds (i.e., dissolved oxygen and salinity)		Maintain the existing vegetation and promote the growth and establishment of semi-aquatic species	In 2021-22, 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 2023. If required: Should climate conditions reflect those of 2019-20, or if water quality is considered an issue, with an extremely dry catchment, and little to no rainfall resulting in an 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*		*2022-23 Rationale*	*2022-23 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	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**
			Provide freshwater refuge habitat for migratory wetland		

3.3.7 Delivery constraints

The main constraints and issues associated with delivery of the priority watering actions in the Thomson River are described in Table 19.

Table 19 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 2022-23
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) • The current operating arrangements do not allow for the flexibility required to deliver 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.

3.3.8 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.

3.3.9 Scenario planning

Four scenarios are considered for the Thomson River: drought, dry, average and wet (Table 20). The logic and evaluation process used for the scenarios is outlined in section 0.3.

Table 20 Climate scenario summary for the Thomson River

		Drought	Dry	Average	Wet
Environmental Objectives		**PROTECT**	**MAINTAIN**	**RECOVER**	**ENHANCE**
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 2022-23 watering actions are outlined in Table Table 21.

Table 21 Scenario planning for watering actions in the Thomson River over 2021-2022 based on allocation as of 28th April 2022*

	Drought	Dry	Average	Wet
Expected allocation volume (GL)	10 - 13 GL	13 - 16 GL	16 - 19 GL	19 - >22 GL
Expected Carryover (GL)	15 GL*	15 GL*	15 GL*	15 GL*
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 230 ML/d continuous (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) Autumn-Winter low flow 300 ML/d, continuous (July) 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 300 ML/d continuous (July) Autumn-Winter low flow 230 ML/d, continuous (May-June) 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 300 ML/d, continuous (July) Autumn-Winter low flow 350 ML/d, continuous (May-June) 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 350 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 (July) Autumn-Winter low flow 350 ML/d continuous (April-June) 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)	**21 GL**	**26 GL**	**33.4 GL**	**43.5 GL**
Tier 1b	Spring fresh 800 ML/d (Oct - Nov), 7 days = additional 1.2 GL (i.e., an additional 2 days high flow) Autumn-Winter fresh 800 ML/d (May), 7 days = additional 1.3 GL (i.e., an additional 2 days high flow) 1 x additional Spring fresh 800 ML/d, 7 days (Sep) = additional 5 GL Winter-Spring low flow (350 ML/d) continuous (July – Nov), additional 15 GL	Winter-Spring low flow 350 ML/d, continuous (July - Nov) = additional 15 GL 1 x additional Spring fresh 800 ML/d, 7 days (Sep) = additional 5 GL Winter-Spring low flow 350 ML/d, continuous (May-June) (i.e. increasing the volume from 230 ML/d) = additional 5.7 GL	Winter-Spring low flow 350 ML/d, continuous (July - Nov) = additional 15 GL Summer-autumn fresh 350 ML/d, 7days (Feb-Mar) up from 230 ML/d = additional 1.2 GL 1 x additional Spring fresh 800 ML/d, 7 days (Sep) = additional 5 GL	Winter-Spring low flow (350 ML/d) continuous (Aug - Nov) = additional 13 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)	**22.5 GL**	**25.7 GL**	**21.2 GL**	**14.6 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 2023-24)	**2.6 GL** (300 ML/d July continuous low flow for 2023-24)	**2.6 GL** (300ML/d July continuous low flow for 2023-24)	**2.6 GL** (300ML/d July continuous low flow for 2023-24)

4. Macalister River seasonal watering proposal

The following section provides details for the proposed watering actions for the Macalister River 2022-23.

Figure 16 Macalister River looking downstream to Lanigans Bridge

4.1 Environmental objectives

The ecological objectives and flow recommendations for the lower Macalister River are detailed in the Macalister River Environmental Water Management Plan (Alluvium, 2015). The Macalister River objectives were refined through direct consultation with stakeholders associated with the Macalister River, landholders, urban and rural water suppliers and environmental interest groups through a Project Advisory Group (PAG). Subsequent Traditional Owner guidance on objectives and values was, and is being, received from GLaWAC via the Gunaikurnai Cultural Water Team and will be updated for the 2023-24 proposals.

Objectives and values are summarised in Table 22.

Table 22 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

Symbol	Value	Overarching objective/s
	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

4.1.1 Flow Requirements

4.1.2 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).

4.1.3 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, function and processes.

4.1.4 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

2020-21 and 2021-22 have both been wet years, 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.

Increased flow in the River with these operational releases saw volumes achieving and often exceeding the priority flow actions and recommendations. 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 2021-22 water year. Three planned deliveries remain for the 2021-22 water year from April through to June 2021 (i.e., continuous low flow and 2 freshes). The April fresh has since been cancelled as SRW deliver managed releases over April.

Figure 17 illustrates the streamflow in Reach 2 of the Macalister River, from July 2016 through to remaining planned flows in June 2022. Flow volume recommendations for low flows, low flow freshes and high flow freshes have been included on the hydrograph. Figure 18 illustrates the streamflow in Reach 2 of the Macalister River, from June 2021 through to remaining planned flows in June 2022. 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 2022 (Autumn fresh) and May-June 2022 (Winter fresh). The April fresh was cancelled as operational releases from SRW over April exceeded these flow volumes.

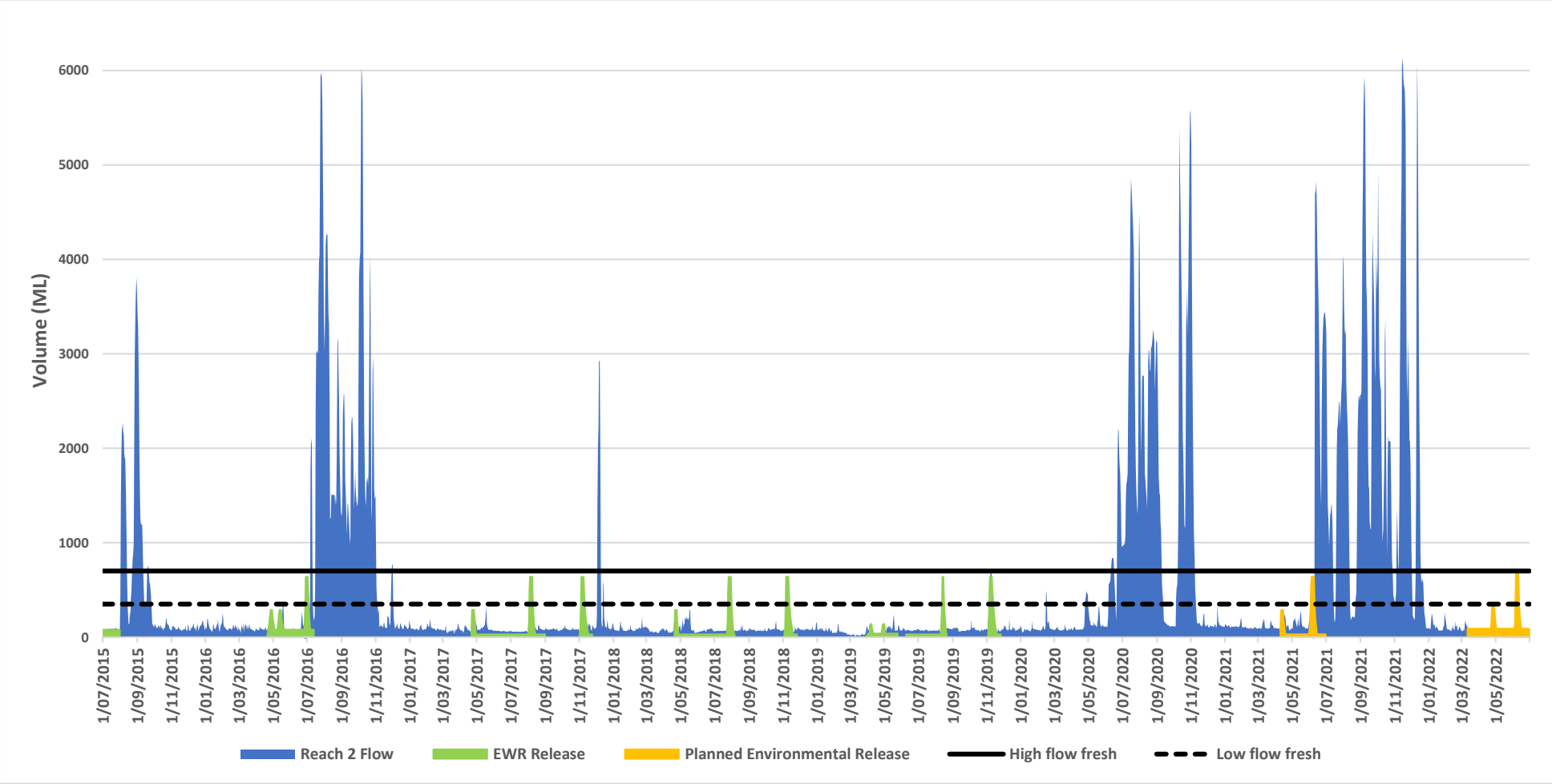


Figure 17 Hydrograph of managed and unmanaged flows occurring in the Macalister River in Reach 2 (Riverslea gauge) from July 2016 – June 2021

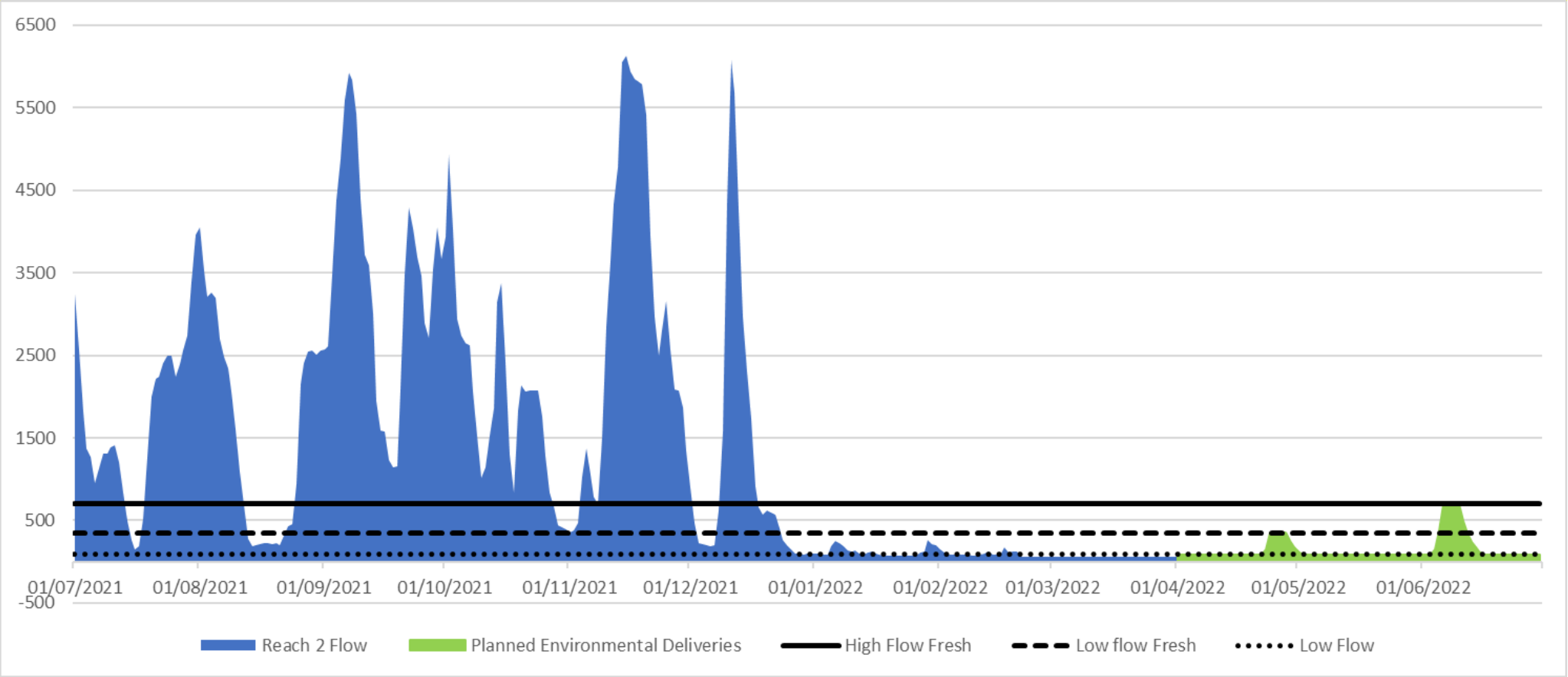


Figure 18 Macalister River streamflow recorded at Riverslea (Reach M2) from July 2021 to June 2022.

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 23 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.

The Arthur Rylah Institute carried out fish surveys in the Thomson River in February 2022 as part of annual population surveys. Preliminary results indicate good survival rates for last year's strong Tupong cohort, with juvenile fish dominating the catch. Tupong were also detected upstream of Horseshoe Bend Tunnel fishway, including juvenile fish, indicating successful upstream migration in the past 12 months. Although a different river, given the connected nature of the Thomson and Macalister, it is highly likely that this trend will be detected in the Macalister into 2022. At the time of writing results from 2022 Native Fish Report Card Macalister River surveys have not been received.

Based on the findings of the Thomson surveys, and previous Macalister surveys, maintenance of baseflows and freshes is important to promote continued migration, dispersal and survival of these recruits.

Table 23 Historical environmental flow compliance in reach M2 of the Macalister River (Riverslea).

Name	Detail	16/17	17/18	18/19	19/20	20/21	21/22*	Ecological outcomes/observations 2021/22
Low flow	All year; 35 ML/d	O	O	O/E	O	O/U	O/U	These flows were provided, and often exceeded throughout 2021-22 thanks to managed spill and passing 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	O/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	O/U	These flows were provided, and often exceeded throughout 2021-22 thanks to managed spill and passing 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	O/U	This flow component was achieved via operational spill releases from Glenmaggie from July 1st through to December.
Summer-Autumn fresh	Dec-May; 140 ML/d; 3 days (or min 20 days in DRT)	U	U	E	U	O/U	O/U	With flows in the Macalister River being >100 ML/d over December – March, the objectives of this fresh were 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	O	SRW operational releases during April resulted in the cancellation of this environmental flow 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	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	O/U	These flow components were fully achieved and exceeded via operational/unregulated spill releases in September, October, and November. In September river flows reached >4000 ML/d for a continuous 7 day duration. Even leading into September, August had increased river flow of >2000 ML/d. In October river flows reached >2000 ML/d for a continuous 5 day duration twice, and in November flows reached >5500 ML/d for a continuous 6 day duration. Recent fish surveys in the Thomson River (undertaken in Feb 2022) reported strong numbers of juvenile Tupong from the 2021 young-of-year. Tupong were again captured above the horseshoe bend fishway, including juveniles. Fish survey results for the Macalister have not been received yet (surveying scheduled in March 2022)
Spring-Summer fresh	Sep-Dec; 700 ML/d; 3 days	U	E	E	E	O/U	O/U	
Spring-Summer fresh	Sep-Dec; 1500 ML/d; 3 days	U	U	[3]	U/E	O/U	O/U	
Fresh	Anytime; 1500 ML/d; 3 days	U	U	[3]	U/E	O/U	O/U	
Bankfull	Anytime; 10,000 ML/d; 1 day	U	[4]	[4]	[4]	O/U	O/U	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 spill release events exceeding 5000 ML/d throughout July – December.

Key	Footnotes
	*Note: This assessment is as of 11th March 2022 [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	

4.2.5 Potential watering actions

The priority flow components for the Macalister River over 2022-23 are listed in Table 24. Priorities were determined based on the hydrologic compliance assessment, 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 24 Priority watering actions in the Macalister River for 2022-23.

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***		***2022-23 Flow Details***	***2022-23 Rationale***	***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 July to mid-August 2022, then from mid-April 2023 through to the end of June 2023, continuous provision of 90 ML/d	At a catchment/connected rivers scale, the 2022 fish surveys in the Thomson River have detected good survival rates of the 2021 young-of-year Tupong. Provision of baseflows allows continued migration, dispersal and survival of these recruits. 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	**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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	food sources and to maintain refuge habitats				conjunction with a fresh, as it provides continuous fish passage for migratory species completing (i.e. Australian grayling) or about to complete (i.e. Tupong, Australian bass) migration in reach **M2**.	

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	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, the 2022 fish surveys in the Thomson River have detected good survival rates of the 2021 young-of-year Tupong. Provision of baseflows allows continued 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		2022-23 Flow Details	2022-23 Rationale	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 is likely to be scheduled for late April-early May 2023, coinciding with an Autumn fresh in the Thomson River – which provides secondary benefits to the upper Thomson estuary.	Monitoring in Feb 2021 and 2022 detected Australian grayling in the middle – lower reaches of the Thomson River and lower Macalister River. Tupong have also had another successful recruitment event 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 2022-23 that support their migration, spawning and recruitment.	**H**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	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 catadromous (e.g. tupong, common galaxias, Australian bass, short and long-finned eels) and amphidromous		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	Flow delivery the same across each scenario (**drought-dry-average-wet**) Proposed flow delivery in late October – early November. Where possible, delivery of this	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 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	**H**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	species (e.g. Australian grayling)			fresh will be timed to coincide with flows in the Latrobe and Thomson which provides secondary benefits to the upper Thomson estuary.	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		2022-23 Flow Details	2022-23 Rationale	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 Improve spawning and recruitment opportunities for native migratory fish species	Flow delivery will be the same across the **Dry-Average-Wet scenario**: In a **drought scenario** this flow would not be considered a	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. At a catchment/connected rivers scale, the 2022 fish surveys in the Thomson River have detected good survival rates of the 2021 young-of-year Tupong.	**H**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	Flush pools to improve water quality Increase wetted area to provide habitat		Increase the abundance and number of functional groups of macroinvertebrates	priority delivery, particularly if providing the flow threatened the ability to carryover water for baseflow top-up provision in July 2023.	Providing flows that encourage spawning of these species is important 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.	
	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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Summer-autumn freshening pulse, 140 ML/d (Dec – Mar)	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		Improve physical habitat	**Average-Wet Scenario:** Provide 3 x 140 ML/d pulses, 3 day duration ***In an average-wet scenario** this is regarded as a "M" priority	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 condition of available refuges (e.g. by flushing stagnant water and improving water quality).	**M**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	flush fine sediment from interstices to improve geomorphic habitat				Maintaining access to in-stream refuge habitat is important for native fish species, particularly some of the small-bodied non-migratory species that only breed on the large-scale flood events.	
	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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Summer-autumn freshening pulse and	Maintain a minimum depth in pools to allow for turnover of water and slow potential water quality degradation		Improve physical habitat	**Dry-Drought Scenario:** Provision of 40 ML/d baseflow	The 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	**M**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
baseflow, 140 ML/d (Dec – Mar) ***trigger-based (when passing flows drop below 60 ML/d)**	Flush pools to improve water quality Provide flows with sufficient shear stress to flush fine sediment from interstices to improve geomorphic habitat			(5-13 days) with a 3-day 140 ML/d pulse ***In a dry-drought scenario this flow would be considered a "H" priority**	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. Maintaining access to in-stream refuge habitat is important for native fish species, particularly some of the small-bodied non-migratory species that only breed on the large-scale flood events.	
	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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Spring fresh	Inundate a greater area of stream channel to limit		Improve native emergent (non-woody) and fringing woody vegetation	**Average-Wet Scenario only**:	As forecasts are pointing towards a above average rainfall in autumn 2022,	**M**

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
1500 ML/d, minimum 3 days (Sep – Oct)	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		(**M1**: wetting intact riparian vegetation, in particular tea tree and paperbark)	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 days), but also	it is highly likely that Lake Glenmaggie will spill in 2022-23. 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).	
	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 adult anadromous species (e.g. short-		Increase the distribution and abundance of Australian grayling			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	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	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		2022-23 Flow Details	2022-23 Rationale	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. As such delivery is not planned. **Drought-Dry:**	In **average and wet scenarios**, passing flows (60 ML/d) would typically provide this flow component in **M2**.	**L**
	Provide flows with low water velocity and appropriate depth and to		Re-instate submerged aquatic vegetation			

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
	improve water clarity and enable establishment of in-stream vegetation			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		
	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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
Spring-Summer Fresh 2500 ML/d, 3 days (Sep – Dec)	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 priority watering actions in an average climate scenario. Spill releases from Lake Glenmaggie over the 2020 and 2021 naturally	**L**
	Inundate higher benches to provide water level variability for fringing woody vegetation		Improve native emergent (non-woody) and fringing woody vegetation			

					provide for the desired objectives in reach **M1**, and as such delivery of this event is not considered a priority.	

Potential Watering Action	***Expected Watering Effects***	***Environmental Objectives***		***2022-23 Flow Details***	***2022-23 Rationale***	***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 flow (3000 ML/d, 1 days), but also to ensure the ramp down rate is conducive to the ecological objective and reduces the risk	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 2020 and 2021 have achieved this magnitude for short durations and naturally provided for the desired objectives of reach **M1**. Glenmaggie is highly likely to spill again this year, and so this flow is not considered a high priority to deliver.	**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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
				of bank slumping issues.		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 Flow Details	2022-23 Rationale	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 winter and spring months If Lake Glenmaggie does spill, and carryover is "lost" from the account, it may mean there is	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		2022-23 Flow Details	2022-23 Rationale	Priority (H/M/L)
				insufficient water to sustain baseflows for extended periods		

Potential Watering Action	Expected Watering Effects	Environmental Objectives		2022-23 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 2022-23 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 25.

Table 25 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. Outside of this instance, all other freshes peak at 700 ML/d

Constraint	Description	Implications for environmental watering
		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 Although the effectiveness of these freshes is compromised, fish ecologists from ARI have

Constraint	Description	Implications for environmental watering
		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.

Given the population dynamics of migratory fish species in the region, the broader fish population will have benefited from recent high flows and flooding across Gippsland. Providing continued opportunities for migration, spawning and recruitment in the Thomson, Macalister and Latrobe rivers will be a priority to support the native fish population and to increase the likelihood of survival for new recruits (i.e., young-of-year) under all climate scenarios.

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 26). The logic and evaluation process used for the scenarios, along with priority watering actions are outlined in section 0 with scenario planning for the 2022-23 water year summarised in Table 27.

Table 26 Climate scenario summary for the Macalister River

		Drought	Dry	Average	Wet
Environmental Objectives		**PROTECT**	**MAINTAIN**	**RECOVER**	**ENHANCE**
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 27 Scenario planning for watering actions in the Macalister River over 2022-2023 based on HRWS allocation of 100% and LRWS allocation of 100% as of 31st April 2022*. Note: M1 = reach 1, M2 = reach 2 (assessed April 2022).

	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
Est. Carryover (GL)	13 GL*	13 GL*	13 GL*	13 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, 14 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 (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, 14 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) • Piggybacking on a spill up to 3000 ML (Sep - Dec) = (used to shape the ramp down from 3000 ML/d)
Tier 1a Water Demand (GL)	**12.2 GL**	**16.5 GL**	**17 GL**	**21.1 GL**

	Drought	Dry	Average	Wet
Tier 1b	Autumn-Winter low flow 90 ML/d continuous (Mar-April) (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-April) (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 (March) (i.e., extending low flow provision) = additional 1 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 (March) (i.e. extending low flow provision) = additional 1 GL Summer low flow 90 ML/d continuous (Dec- Jan) (i.e. extending low flow provision) = additional 2 GL 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**	**8.2 GL**	**31.8 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 1 for further information.

5. Risk management & Engagement

5.1 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 28).

Table 28 Risk assessment for 2022/23 watering proposal – Macalister, Latrobe and Thomson systems (DG Consulting 2022)

Red text indicates items that have been added or updated in this assessment.

		Pre-Mitigation Risk					Residual Risk	
Risk category	**Risk description**	**Likelihood**	**Consequence**	**Risk Rating**	**Mitigation actions**	**Lead organisation**	**Likelihood**	**Consequence**
Environment	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		
Environment	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 (note that learnings have been extrapolated to Latrobe, as specific Latrobe monitoring data is not available) • Share updated information on Australian grayling behaviour with other relevant waterway managers.	WGCMA		
Reputational	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		
Environment	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		
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 actions. • Ensure pre-order communications process in Operating Arrangements document are implemented	WGCMA		
Environment	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	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. *Note: developing alternate release options to address constraints in the Latrobe, possibly using Moondarra & Narracan reservoirs*	WGCMA		
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		
Environment	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		
Environment	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		
Reputational	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.*	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		
Environment	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		

Reputational	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 (& Storage operator) WGCMA VEWH		
Environment	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 22-23, further analysis planned for 22-23*	WGCMA VEWH/ WGCMA WGCMA		
Environment	Debris from bushfires, including ash, or erosion from drought affected areas may enter reservoirs or waterways, leading to adverse environmental impacts	Unlikely	Moderate	Low	• Monitor ash related water quality issues and adjust environmental water releases as required to mitigate impacts	WGCMA		
Reputational	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		
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		
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		
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		
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		
Environment	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		
Environment	Constraints to environmental releases such as limited river channel capacity (and risk of flooding private land) constrain environmental releases, leading to a failure to achieve environmental objectives Reach 5 - Killmany constraint and tidal influence results in varying constraint (500 ML/d to 2,000 ML/d)	Possible	Moderate	Medium	• Develop strategy and negotiate 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: This risk is still rated as medium after mitigation actions.)*	WGCMA		
Environment	Timing of environmental flow diversions into wetlands adversely impacts on Australian grayling breeding *Note: need to have regard for grayling impacts in other catchments and the role this system plays in their recovery*	Unlikely	Moderate	Low	• Plan regulator operations to minimise potential impacts on Australian grayling eggs and modify wetland filling procedures as required. - Further analysis through WETMAP & VEFMAP to understand risk issues *Note: further advice from ARI suggests that this may not be a risk - review in 2023 to consider deletion*	WGCMA WGCMA		
Environment	High tides coinciding with low water levels in wetlands could result in saline water intrusions into the wetlands, which may cause negative environmental impacts on long term vegetation conditions. *- Based on Sale Common risk, which is the highest risk. Others are Heart - Possible & Moderate Dowds - Likely + Moderate*	Possible	Moderate	Medium	• Implement findings from saline inflow risk assessment study. • Apply findings from the Latrobe River environmental watering recommendations. - Consider the medium to longer term objectives and values to be protected *(Note: This risk is still rated as medium after mitigation actions.)*	WGCMA		

Environment	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		
Environment	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		
Environment	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		
Environment	Inlet capacity is insufficient to enable Dowd Morass to be watered at low river levels, leading to salt water intrusion from Lake Wellington which results in environmental damage	Possible	Minor	Low	• Provide additional upstream inlet structure to enable access to low river flows for watering the site. - Consider temporary pumping alternatives	WGCMA WGCMA		
Environment	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	Unlikely	Moderate	Low	• Provide additional upstream inlet structure to enable access to low river flows for watering the site. - Consider temporary pumping alternatives	WGCMA WGCMA		
Environment	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.	Unlikely	Moderate	Low	• 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		
Safety	Negative community sentiment in relation to government decisions/actions creates a safety risk for staff involved in environmental watering actions **This is state wide risk, but may not apply in all systems - the risk rating will reflect local risk levels*	Possible	Moderate	Medium	- ensure staff are alerted to warnings about violent members of public - Strategic Communication of benefits of e-water and concern over safety to wider public (with co-ordination between partners) - ensure safe operational procedures for staff are followed	All		
Reputational	Trade of environmental allocations (available in Blue Rock) which is unable to be delivered in average - wet conditions due to delivery constraints in the Latrobe R creates a perception that additional environmental water is not required, potentially impacting the ability to secure additional e-water entitlements. **Note: rated unlikely as trades may not occur in 22-23*	Unlikely	Major	Low	- In VEWH Trade Strategy, communicate details of the delivery constraints hampering environmental deliveries which lead to decision to sell allocation in this system. - Communicate reasons for trade of water to local interest groups and community	VEWH WGCMA		
Service delivery	Wet seasonal conditions cause damage to or build up of debris on infrastructure, impacting the ability to deliver environmental water. *NEW RISK: SRW/WGCMA - this could be service delivery or environment risk category - please advise and also review consequence rating*	Unlikely	Moderate	Low	- Undertake debris clearing or conduct repairs as soon as possible and advise waterway manager of outcomes	SRW		

5.2 Engagement

This section outlines the engagement that has occurred in the development of the West Gippsland Seasonal Watering Proposal for 2022-23.

Significant engagement has been made through the established Macalister Environmental Water Advisory Group (Macalister EWAG), and the newly formed Thomson and Latrobe river EWAGs, and their predecessor Project Advisory Groups (PAGs).

As part of the SWP engagement, members were informed about the process of translating the environmental objectives, flow recommendations, allocations and climate scenarios into priority watering actions for the 2022-23 seasonal watering proposals. The group where then able to discuss and provide feedback on the proposed flows and their specific priorities for the upcoming water year. The establishment of new EWAG's lifts the level of engagement for most groups from "inform" to "involve" (Table 29).

Table 29 Summary of engagement undertaken in development of the 2022-23 Seasonal Watering Proposal

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
Program partners 	• VEWH • Parks Victoria • Southern Rural Water • Melbourne Water	Collaborate	• Formal advisory groups (Macalister, Thomson and Latrobe EWAGs) • Partnership meetings and direct engagement	• Seek input on development of SWP • 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.

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
Traditional Owners 	• Gunaikurnai Land and Waters Aboriginal Corporation	Collaborate	• Direct engagement (one-on-one) • Formal advisory groups (EWAGs) and Project Steering Committees • On-ground assessment and monitoring contributing to e-water planning and management (AWA's, eDNA)	• Share information and develop cultural and environmental water knowledge for future engagement • Incorporate TO knowledge, values and objectives into planning • Supporting on-country work • Opportunity to relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders
Community and environment groups and non-government organisations 	• Native Fish Australia • Landcare and Friends Of groups • Birdlife Australia • Environment Victoria • Greening Australia • Latrobe Valley Field Naturalists	Involve	• Formal advisory groups (Macalister, Thomson and Latrobe EWAGs, and prior to that, Project Advisory Groups) • Community environmental monitoring • E-flows subscriber notifications and newsletters (email, SMS)	• Opportunity to both learn more about environmental water and relay community concerns, ideas and comments directly to environmental water officers and other interested stakeholders • Review previous environmental watering actions and seek feedback on any outcomes or observations • Assist in increasing

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
	• Cowwarr Landcare Group • Waterwatch volunteers	Inform	•	awareness and understanding of the purpose and objectives of the environmental watering program in West Gippsland • Provide opportunities to contribute to the proposed watering actions and intended outcomes • Identify opportunities to achieve shared benefits
Land managers / landholders/ farmers 	• Heyfield Wetlands Committee of Management • Sale Field and Game Australia (Heart Morass)	Collaborate	• Formal advisory groups (EWAGs) • Direct engagement (one-on-one)	As above plus: • Identify watering objectives relevant to the group/individual
	• Macalister Irrigation District irrigators/ diverters • Other landholders	Involve / consult	• Formal advisory groups (EWAGs) • Irrigator advisory groups (Macalister Customer Consultative Committee; CMA Irrigator Reference Group) • Specific Newry Creek issue engagement	As above

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
			• E-flows subscriber notifications	
Other government agencies and technical experts	• Gippsland Water • Department of Environment, Land, Water and Planning - Water and Catchments	Involve	• Formal advisory groups (EWAGs)	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 • Share information and develop environmental water knowledge for future engagement • Identify watering objectives relevant to the group/individual
	• Department of Land, Environment, Water and Planning (Latrobe Valley Regional Water Study) • East Gippsland CMA • Parks Victoria	Inform	• Latrobe Environmental Water Requirements Investigation project advisory group	
	• Arthur Rylah Institute (Department of Environment, Land, Water and Planning)	Collaborate	• Collaborate with on fieldwork ; share monitoring findings • Direct engagement (one-on-one) • Direct engagement – sharing of river and aquatic knowledge	As above plus • Sharing of river and aquatic knowledge; e.g. emerging evidence emerging of connection between tupong movement and winter freshes

Category	Stakeholder	IAP2 level	Engagement method	Engagement purpose
Recreational users 	• Field and Game Australia	Collaborate	• Formal advisory groups (EWAGs) • Direct engagement (one-on-one)	As above plus • Coordinate around specific recreational events, e.g. Baw Baw Extreme Event
	• VRFish • Tourism operators • Recreational users (key individuals and event organisers (e.g. Baw Baw Extreme Event)	Involve	• Formal advisory groups (EWAGs) • Direct engagement (one-on-one)	
	• Recreational paddling (individuals and organisations) •	Inform	• E-flows subscriber notifications and newsletters (email, SMS) •	
Local businesses 	• Port of Sale Heritage River Cruises • Frog Gully Cottages	Inform	As above	As above

6. 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.

6.1 Latrobe River

Traditional Owner Values

The Latrobe River is an important resource for the 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 regarding the cultural significance of the Latrobe River, further shared benefits will be identified for the use of the Latrobe environmental water entitlement. This engagement is planned to continue through the 2022-23 water year. Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team.

GLaWAC have representation on all three river system EWAGs, and are directly engaged with on the lower Latrobe Wetlands watering proposal.

Shared Benefits

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 2021-22 are summarised in Table 30.

Table 30 Summary of the shared benefits of the potential watering actions in the Latrobe River, 2022-23.

Who?	Shared benefit
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.
Recreational fishers	Freshes linked with recreational fish movements and behaviour (e.g. black bream and estuary perch become active during high flows providing fishing opportunities).
Shooters / field and game hunters	Delivering flows for wetland watering improves waterbird diversity and abundance providing game hunting opportunities.
Commercial fishers	Low flows create continuous instream habitat, providing for fish distributions and increasing commercial fishing abundance.
Gippsland water	Base flows improve water quality for stock watering and irrigation, while also reducing water treatment required by urban water suppliers.
Irrigators/farmers	Base flows improve water quality for stock watering and irrigation, while also reducing water treatment required by urban water suppliers.
Regional economy and tourism	Overall benefit of flows and river health for the regional economy and tourism values

6.2 Thomson River

Traditional Owner Values

GLaWAC view Country as connected, with the Latrobe, Thomson and Macalister rivers being integral to the lower Latrobe wetlands and the Gippsland Lakes. 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.

The Thomson River is an important feeder into the lower Latrobe wetlands, which are very important - traditionally and today.

Water-dependent species and values were identified through the Thomson flows study process, with GLaWAC represented on the Project Advisory Group. Traditional Owner guidance on objectives and values was received from GLaWAC via the Gunaikurnai Cultural Water Team, who completed Aboriginal Waterways Assessments for the Thomson, and took part in workshops as part of the Thomson flow study review in 2020.

GLaWAC have representation on the Thomson EWAG, and WGCMA Environmental Water staff have engaged with individual Cultural Water Staff on the flow priorities for 2022-23.

Shared Benefits

In West Gippsland, there are several known shared benefits provided by environmental watering. Table 31 summarises the Thomson River shared benefits identified in 2022-23.

Table 31 Thomson River Shared benefits review for 2022-23.

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 was timed to coincide with the Baw Baw Extreme multisport event, to maximise the opportunity for this event to take advantage of the river level conditions. The 2022 watering event is coinciding with the Easter holidays Over 2021-22, 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

Who?	Shared benefit
	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 of riparian vegetation and maintenance of in-channel vegetation

Figure 19 Kayaker competing in the 2021 Baw Baw Extreme event during an environmental delivery (Photo: Serge Kurov)

6.3 Macalister River

Traditional Owner Values

GLaWAC view Country as connected, with the Latrobe, Thomson and Macalister rivers being integral to the lower Latrobe wetlands and the Gippsland Lakes. 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.

The Macalister flows study preceded the creation of the GLaWAC Cultural Water Team, and as such culturally significant water-dependent values and objectives are not well defined for the Macalister. Through reviewing the Macalister EWMP in 2022, the WGCMA is looking to correct this and plan to work with GLaWAC's Cultural Water Team to meaningfully include these in the updated study.

GLaWAC have representation on the Macalister EWAG, and WGCMA Environmental Water staff have engaged with individual Cultural Water Staff on the flow priorities for 2022-23.

Shared Benefits

Table 32 summarises the Macalister River shared benefits identified in 2022-23.

Table 32 Macalister River Shared benefits review for 2022-23.

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

7. Increasing knowledge and addressing constraints/ impacts

7.1 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 33).

Table 33 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.

7.2 Thomson River

7.2.1 Monitoring and knowledge improvement activities

Targeted monitoring programs are planned in the Thomson system for 2022-2023.

These three programs are outlined below:

Victorian Environmental Flows Monitoring and Assessment Program

As part of VEFMAP, annual 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.

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 an annual 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 is likely to continue 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).

Heyfield Wetlands

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 2023-24 seasonal watering proposal. This will outline a site-specific watering regime and objectives.

The passion of the Heyfield Wetlands Committee means that ecological monitoring (i.e., bird surveys and frog 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.

The WGCMA is also looking to implement more routine water quality monitoring at Heyfield in 2022.

7.2.2. 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 34 lists objectives that are difficult to measure and the associated knowledge gaps/potential monitoring activities associated with each objective.

Table 34 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)

Environmental objective	Can the objective be measured?	Knowledge gaps and potential monitoring activities
		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 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

7.3 Macalister River

7.3.1. Monitoring and knowledge improvement activities

Targeted monitoring programs are planned, or relevant to, the Macalister system for 2022-2023 are outlined below:

Victorian Environmental Flows Monitoring and Assessment Program

VEFMAP fish surveys conducted in March 2022 in the Thomson River and other coastal, regulated systems with the same or similar water dependent values 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.

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.

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 35.

Table 35 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

Environmental objective	Description	Knowledge gaps and potential monitoring activities
		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 actions that may support its re-instatement	Monitoring Identify and map current presence of any remnant in-stream vegetation 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

Environmental objective	Description	Knowledge gaps and potential monitoring activities
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 Determination of all sources of turbidity and nutrients and the proportional contribution of these sources

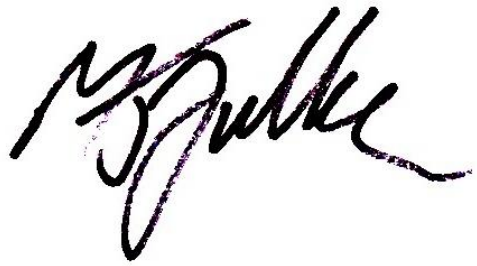
8. Approval and endorsement

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:2/5/2022

Latrobe River System

I, the authorised representatives of the agencies shown below, acknowledge that the potential watering actions being proposed in the Latrobe section of the proposal are able to be delivered within existing system operations for the Latrobe River system in 2022-23, 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:

Date: 24/06/2022

Macalister River System

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in Macalister section of the proposal are able to be delivered within existing system operations for the Macalister River system in 2022–23, 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: 24/06/2022

Thomson River System

I, the authorised representatives of the agencies shown below, acknowledge that the priority watering actions being proposed in the Thomson section of the proposal are able to be delivered within existing system operations for the Thomson River system in 2022-23, 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: 10/05/2022

SIGNED FOR AND ON BEHALF OF

Southern Rural Water

Signature of authorised representative

Name: Matt Cook

Title: *Irrigation Service Delivery Supervisor*

Date: 24/06/2022

9. References

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10. Appendices

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 36 and Table 37, providing recommended release patterns for various event magnitudes recommended from the Macalister River environmental flows study (Alluvium, 2015).

Table 36 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 37 . 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