



Lower Barwon Wetlands Seasonal Watering Proposal 2023-24

FINAL April 2023



*healthy and productive lands and waters
cared for by thriving communities*

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Acknowledgment of Country

Corangamite Catchment Management Authority (Corangamite CMA) wishes to acknowledge the Wadawurrung People of the Kulin Nation, Traditional Owners of the land and waters of the lower Barwon River *Barre Warre Yulluk*. We pay our respects to their Elders past, present and emerging. We commit to continuing to work with all Traditional Owners to ensure their knowledge and culture is included and valued in Corangamite CMA planning and delivery.

Executive Summary

This Seasonal Watering Proposal (SWP) outlines Corangamite Catchment Management Authority's proposed priorities for the use of environmental water in the Lower Barwon River system in 2023-24, as required under section 192A of the *Water Act 1989*. The Victorian Environmental Water Holder (VEWH) will use this SWP to inform the development of the Seasonal Watering Plan 2023-24.

The Barwon River begins in the Otway Ranges and flows through Geelong, joining the ocean at Barwon Heads. Prior to entering the sea, the Barwon River drains through a large estuarine zone comprising a lake and wetland complex. The wetlands form part of the internationally significant Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. They consist of a diverse range of aquatic vegetation communities that provide important feeding and breeding habitat for native fish and wetland-dependent bird species, including rare and endangered flora and fauna. The Wadawurrung Traditional Owners of the Lower Barwon have a strong living cultural connection and long history with the area and place a high cultural value on the wetlands.

Reedy Lake and Hospital Swamps are part of this complex and are managed under the Barwon River Environmental Entitlement 2011 as separate water bodies subject to different watering regimes. In 2013, the Lower Barwon Community Advisory Committee set the overarching watering objective for the Lower Barwon Wetlands including Reedy Lake and Hospital Swamps. It is to:

“Maintain the ecological character of the wetlands”. Ecological character is defined as the combination of ecosystem components, processes, benefits and services that characterised the wetlands in 1983 when the wetlands were Ramsar listed.

Environmental watering at Reedy Lake and Hospital Swamps has been based on an adapted version of the long-term watering recommendations in the Flow Ecology Report 2012 (Lloyd et al., 2012) which was commissioned to set watering objectives and recommendations for the wetlands. At Reedy Lake, a set four-year watering cycle was trialled through 2016-17 to 2019-20 (three years partial drying, one year full). This watering regime was largely endorsed by the recent Lower Barwon Review (Sherwood et al., 2020), with some minor modifications. Following completion of the four year trial and the Lower Barwon Review, and until FLOWS recommendations are updated, the approach for the water years into the future is to implement the long term Lloyd recommendations with a seasonally adaptive approach, but avoiding complete dry out years. Draw-downs are also to be informed by water bird monitoring for breeding and will take a later and more gradual approach. At Reedy Lake this means having the wetland full 25% of years and doing a partial draw-down for 75% of years. At Hospital Swamps this means doing a partial draw-down most years.

Like the previous two years, 2022-23 has been a wet year, with birds breeding at both wetlands, and full wetlands were maintained through winter and spring and into summer. Levels were monitored and regulators adjusted where possible to maintain water levels or allow a gentle drop at the wetlands while water bird breeding was underway. Active draw-down commenced towards the end of February, following receipt of bird advice. It is anticipated that target low water levels will be achieved at both wetlands as La Niña dissipates.

Once again for 2023-24 a seasonally adaptive approach will be taken, in line with the long-term recommendations from the Flow Ecology Report 2012 (Lloyd et al., 2012), and the recommendations of the Lower Barwon Review (Sherwood et al., 2020). Watering actions for 2023-24 are presented below (Table 1). Note that levels will be adjusted through gate manipulation where required, with gates

left open whenever possible to maximise connectivity. This is more likely to be possible in wet conditions and it may just be the relative settings of inlet and outlet gates that create the change. In dry conditions, evaporation and/or gentle assisted draw-down is more likely.

Table 1. Potential watering actions 2023-24: Reedy Lake and Hospital Swamps

Reedy Lake	
Potential Watering Actions	Timing
Autumn refill to winter full of approximately 0.8m AHD, topping as required and allowing for some natural variation.	April to March (wetland can be refilled and topped up any time from April 2024 through to the following March)
Draw-down to summer low – gradually reduce water levels to approximately 0.3m AHD. Topping or drawing down as required to maintain approximately 0.3m AHD. Specific timing and rates dictated by bird advice.	December to May (wetland can be drawn down any time from December 2023, but is likely to occur later than this to ensure minimal impact on waterbird breeding)
Hospital Swamps	
Potential Watering Actions	Timing
Autumn refill to winter full of approximately 0.5m AHD, topping as required and allowing for some natural variation.	April to March (wetland can be refilled and topped up any time from April 2024 through to the following March)
Drawdown to summer low – gradually reduce water levels to approximately 0.1-0.3 m AHD. Topping up or drawing down as required to maintain 0.1-0.3m AHD. Specific timing and rates dictated by bird advice.	December to May (wetland can be drawn down any time from December 2023, but is likely to occur later than this to ensure minimal impact on waterbird breeding)

A risk assessment was undertaken for the 2023-24 season, and the results are presented in section 10. No high risks were identified following mitigation for the 2023-24 water year.

1. Introduction

This SWP outlines Corangamite CMA's proposed priorities for the use of environmental water in the Lower Barwon Wetland system in 2023-24, as required under section 192A of the *Water Act 1989*. It has been developed with reference to the Victorian Environmental water Holder (VEWH), *Seasonal watering proposal 2023-24 guidelines (Standard format)*.

The VEWH will use the SWP to inform the development of the Seasonal Watering Plan 2023-24. The SWP also meets objectives identified in the *Corangamite Waterway Strategy 2014-2022* (Corangamite CMA, 2014), which is currently under review, by realising shared benefits for the community where ecological outcomes of the watering are not compromised.

1.1 System overview

The climate of the Barwon basin is temperate. Average annual rainfall varies from up to 1,500mm per year in the Otways to as low as 400-500mm per year in the central and eastern parts of the basin. (DELWP (2015). *Climate ready Victoria– Barwon South West*. [Factsheet]). Flows in the rivers of the basin are strongly seasonal, and the Barwon, Moorabool and Yarrowee-Leigh rivers typically have long periods of very low flow in the summer and autumn. Maximum flows usually occur in August or September, and minimum flows in the January to April period.

Prior to entering the sea, the Barwon River drains through a large estuarine zone comprising a lake and wetland complex including Lake Connewarre, Reedy Lake, Hospital and Salt Swamps, Murtnaghurt Lagoon and the Barwon River estuary at the river mouth (Figures 1 and 2). The wetlands are connected by various degrees to the Barwon River and/or Lake Connewarre, which lies centrally in the complex.

These wetlands form part of the internationally significant Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. They consist of a diverse range of aquatic vegetation communities that provide important feeding and breeding habitat for native fish and several wetland-dependent bird species, including the vulnerable Australian painted snipe and critically endangered Orange-bellied parrot. The endangered Australasian bittern has also been recorded at the wetlands, including in 2020, 2021, 2022 and 2023.

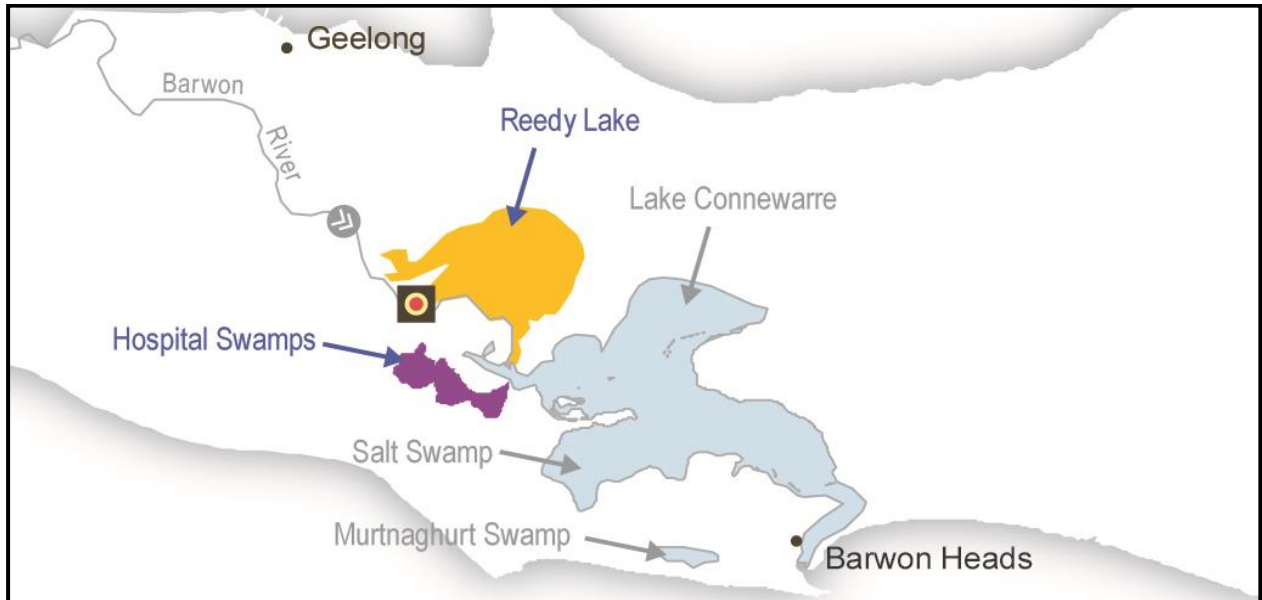


Figure 1. Lower Barwon Wetlands

The Lower Barwon Wetlands are a culturally significant area for Wadawurrung people. The wetlands have long been a place for sourcing food, medicine and resources. The area is recognised under the Aboriginal Heritage Act (2006) and the Aboriginal Heritage Regulations (2007) as an area of cultural heritage sensitivity. The wetlands have high recreational value to the communities surrounding Geelong, providing open space for birdwatching, fishing and duck hunting. The wetlands are also the site of commercial eel fishing licences. Within the Lower Barwon wetland complex, environmental water can be actively delivered to and from Reedy Lake and Hospital Swamps which lie within the Connearre State Game Reserve managed by Parks Victoria.

Key threats to the Lower Barwon Wetlands include urban growth that, if not managed appropriately, could result in increased stormwater run-off, degraded water quality, soil disturbance, bank erosion and degradation of native riparian and estuarine vegetation as well as impacts from domestic animals. Climate change and associated sea level rise and potential increase in the groundwater table are emerging threats that have the potential to significantly impact the Barwon's low-lying estuarine vegetation communities, including saltmarsh and mangroves.



Figure 2. Aerial view of Lake Connewarre and the Lower Barwon wetland system

1.2 Seasonal watering

The environmental entitlement for the Lower Barwon Wetlands does not provide access to water held in storage. Instead, it allows water to be diverted from the Barwon River into Reedy Lake and Hospital Swamps when river levels are above 0.7m AHD (Australian Height Datum). The Lower Barwon Wetlands Seasonal Watering Proposal is prepared annually by Corangamite CMA and submitted to the Victorian Environmental Water Holder (VEWH) to inform delivery of the Barwon River Environmental Entitlement 2011. The VEWH achieves this through its annual Seasonal Watering Plan.

In developing the SWP, consideration was given to the agreed watering objective for the wetlands, developed by the Lower Barwon Community Advisory Committee in 2013. The legal, policy and practical constraints to the delivery of the environmental entitlement have also been considered.

Water will be delivered and removed from Reedy Lake and Hospital Swamps using the infrastructure in place to control the movement of water in these systems, and by allowing natural processes such

as evaporation to reduce water levels at times. Water monitoring stations are located near the inlet to Hospital Swamps, at 'Big Hole' in Reedy Lake and on the lower Barwon River upstream of the lower barrage. These gauges inform watering actions by measuring water level, electrical conductivity (salinity), temperature, and dissolved oxygen.

Watering decisions are based on scientific recommendations and are influenced by the associated water levels in the lower Barwon River. It is important to note that in average to wet conditions, localised storm water run-off and flows in the Barwon River are expected to overtop riverbanks and flow into the wetlands, regardless of structure operation.

In the decades before the creation of the Barwon River Environmental Entitlement in 2011, the water movement at Reedy Lake and Hospital Swamps was managed by Geelong Field and Game, in conjunction with government agencies and other environmental groups, who maintained a wet and dry regime for Hospital Swamps and maintained Reedy Lake to a largely full level year-round for many years. The Flow Ecology study (Lloyd et al., 2012) recommended altering the watering regime at Reedy Lake to a wetting and partial drying cycle and maintaining the existing regime at Hospital Swamps. The Flow Ecology study was subsequently endorsed by a Technical Assessment Panel in the same year. In 2020 the Lower Barwon Review (Sherwood et al., 2020) combined expert advice that underpins current seasonal watering at the Lower Barwon Wetlands in support of the agreed watering objective (Section 5).

Reedy Lake

Reedy Lake is a shallow estuarine wetland located at the bottom of the Barwon River system upstream of the township of Barwon Heads. Changes to the hydraulics of Reedy Lake from 1970 until 2016 resulted in annual summer flooding in most years, which changed the natural wetting and partial drying cycle of the wetland. At the time of the Flow Ecology study (Lloyd et al., 2012) there was concern that prolonged periods of full water levels (>0.8m AHD) had reduced vegetation diversity, flooded out threatened communities such as coastal saltmarsh and reduced bird diversity by restricting the formation of shallow wading habitat and sandbars.

The largely full water level regime historically implemented by community had been to enable recreational opportunities for bird watching and duck hunting, rather than holistic ecological outcomes. Figure 3 below outlines the extent of wetland areas that are exposed at various water levels. It should be noted that allowing the wetland to draw down to 0.3m or 0.4m AHD still provides for a large surface area of water, shown by the line separating the orange and yellow zones in Figure 3. Figure 4 illustrates exposed mudflats during 2016-17 partial draw-down.

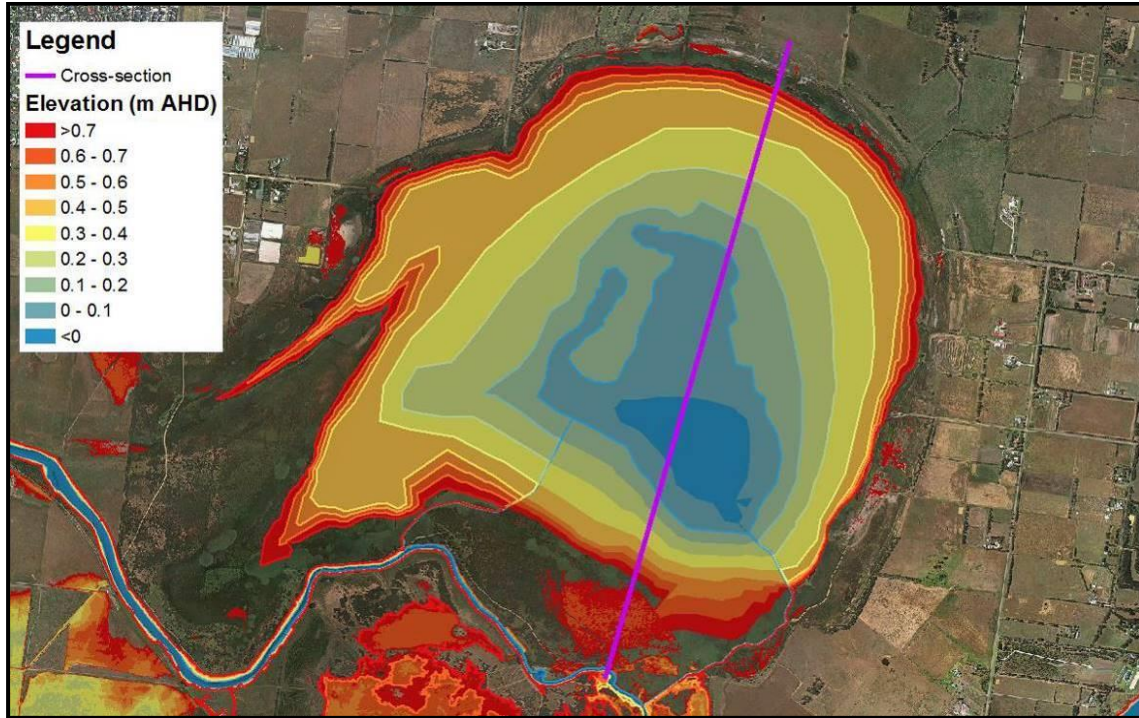


Figure 3. Bathymetry mapping of Reedy Lake, showing water extent at various levels



Figure 4. Reedy Lake mudflats during the implementation of the partial drying regime (S. Vermeeren, 2017)

The currently recommended wetting and partial drying regime for Reedy Lake is intended to support a wider range of habitats and species than in the past. In 2016, Corangamite CMA incorporated a change in management practice by lowering water levels and implementing a partial drying regime at Reedy Lake over the summer-autumn period to start a long-term process to rebalance the diversity of habitats and restore the site's threatened ecological values.

“The implementation of a wetting and drying regime through the use of environmental water is the most important management activity to protect the ecology of the Lower Barwon Wetlands” (Lloyd et al., 2012).

The recommendations from the Flow Ecology study (Lloyd et al., 2012) included an initial ten years of wetting and drying to 'reset' the Reedy Lake wetland, followed by a four-year cycle that involved a full wet year every one in four years. Because of community opposition at the time, the ten-year 'reset' was not implemented and instead the 'longer term' four-year cycle was implemented in 2016 as a trial. The 2019-20 watering year was the final year of the four-year cycle with the wetland maintained at the recommended fill level all year. Some adaptations to timing were also made to accommodate shared benefits.

The recently completed Lower Barwon Review (Sherwood et al., 2020) recommended adoption of Lloyd's original, longer-term four-year cycle regime in Reedy Lake, with its original timing, until FLOWS recommendations are updated. However, it also recommended avoiding a complete drying year and that when drawing down, a later and more gentle approach be taken.

Hospital Swamps

The Hospital Swamps ecosystem (Figure 5) has retained its ecological character and biodiversity values predominantly due to the regulated management (by graziers and others) of the natural wetting and drying regime since the 1970s (Lloyd et al., 2012). Since the entitlement was established, Corangamite CMA has continued to implement the historical wetting and drying regime. Variable climatic conditions over the past seven years have also provided a level of seasonal fluctuation in conditions, which provides additional environmental benefits to existing watering activities (i.e. floods, fresh events and extended drying events).

As an outcome of the watering regime, the wetland's internationally significant waterbird population and diversity have been maintained and the diverse ecological vegetation communities have remained largely unchanged since the 1980s. The water regime of Hospital Swamps is seen as currently beneficial to the ecosystem values of the site (Lloyd et al., 2012). This has been confirmed by the Lower Barwon Review (Sherwood et al., 2020). The environmental values of the wetland are in good condition, supporting large areas of threatened subtropical and temperate coastal saltmarsh and a diversity of fish and waterbird populations.



Figure 5. Hospital Swamps June 2019

Corangamite CMA is working with City of Greater Geelong (CoGG) to ensure the ecological character of Hospital Swamps is maintained into the future. Increased stormwater run-off from new housing developments near Hospital Swamps poses a threat to the existing ecological character of the wetlands due to increased volume of water surges with lower salinity and water quality. CoGG is currently developing operating rules in consultation with Corangamite CMA to guide diversion of existing and future increased stormwater flow into the Sparrovale - Nubjitj yoorree Wetlands Reserve, as pictured below in Figure 6.



Figure 6. Sparrovale - Nubjitj yoorree Wetlands Reserve, south-east of Geelong

The diverse natural and constructed wetlands will occupy about 200 hectares, which adjoins the Barwon River, Lake Connewarre and Hospital Swamps. The wetland will provide additional habitat to migratory shorebirds and waterbirds, including sharp-tailed sandpipers, whiskered terns, a variety of ducks, herons, stilts and brolga. Controlled discharge to either Lake Connewarre or Hospital Swamps will be subject to water quality and the requirements of the SWP. In 2022 Sparrovale - Nubjitj yoorree Wetlands Reserve was connected to the developments through a diversion channel that can be adjusted to allow Armstrong Creek, including its captured stormwater, to flow through to Sparrovale - Nubjitj yoorree Wetlands Reserve or through to Baenches Wetland and Hospital Swamps. Diversion rates and timing will be guided by the operating rules.

Corangamite CMA and CoGG will continue to work together on managing stormwater in this wetland complex.

2. Engagement

Corangamite CMA has led the engagement for developing this SWP. Even though this proposal is strongly underpinned by technical expertise and advice, local knowledge and input adds significant value to the proposal.

Corangamite CMA consults widely with stakeholders to ensure that consideration is given to social, cultural and economic matters relevant to water management in the Lower Barwon Wetlands. This SWP has been developed in consultation with Wadawurrung Traditional Owners Aboriginal Corporation who are the Registered Aboriginal Party under the Aboriginal Heritage Act 2006, to ensure their knowledge and culture is incorporated and that watering requirements for culturally significant species are maintained.

Corangamite CMA established the Lower Barwon Community Advisory Committee (LBCAC) in 2013 to provide local knowledge and insights that combine with the technical studies and monitoring results to help Corangamite CMA develop the SWP. The LBCAC is an enthusiastic and dedicated group of individuals, clubs, businesses and government representatives with a broad combination of skills including technical, historical and on-ground knowledge, and an understanding of government policy and community values. It is the primary vehicle for engaging the public, agency partners and other qualified individuals in the development of the SWP. LBCAC is also engaged on key projects that relate to SWP development, such as the recently completed Lower Barwon Review (Sherwood et al., 2020), the Water Salt Balance for the Lower Barwon Wetlands (Alluvium 2022) and the anticipated review of FLOWS recommendations in 2025 (funding dependent). The operation of the Committee is underpinned by a Terms of Reference and any individual can apply to join LBCAC via the Corangamite CMA website.

In line with the Victorian Government best practice for public participation guidelines, Table 2 below defines the level of participation, method and purpose of engagement with stakeholders during the development of the SWP. The International Association for Public Participation (IAP2) spectrum of public participation has been used to assist with the selection of the appropriate level of participation that defines the public's role in any community engagement program and can be found in Appendix 3 (figure 15).

Table 2. Stakeholder engagement for the Lower Barwon SWP 2023-24

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
Government agencies	Department of Energy & Climate Action (DEECA) Parks Victoria- Western Basalt District Barwon Water Southern Rural Water VEWH Victorian Fisheries Authority (VFA)	Collaborate	Representation on LBCAC <ul style="list-style-type: none"> Meeting to discuss and seek input on draft proposal Review of draft proposal and opportunity to provide formal feedback. Response to stakeholder on how their feedback influenced the SWP and why. Partnership meetings with links or relevance to seasonal water proposal development. Attendance at Community forums. Direct engagement (one on one)	All stakeholders <ul style="list-style-type: none"> Seek input to the development of the proposal. Review previous environmental watering actions and seek feedback on any outcomes and capture observations. Assist in increasing awareness and understanding of the purpose and objectives of the environmental watering program in the Lower Barwon Wetlands. Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. Identify opportunities to achieve shared benefits. VEWH – to provide direct guidance and advice on draft proposal. Parks Victoria, as the land manager – to review and endorse SWP.
Community groups and environment groups	Geelong Environment Council	Involve	Representation on LBCAC Meeting <ul style="list-style-type: none"> Meeting to discuss and seek input on draft proposal 	All stakeholders <ul style="list-style-type: none"> Seek user input to the development of the proposal.

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
	<p>Geelong Field Naturalists Club</p> <p>EstuaryWatch</p> <p>Friends of the Barwon</p>		<ul style="list-style-type: none"> • Review of draft proposal and opportunity to provide formal feedback. • Response to stakeholder on how their feedback influenced the SWP and why. <p>Attendance at Community forums.</p> <p>Direct engagement (one on one)</p>	<ul style="list-style-type: none"> • Review previous environmental watering actions and seek feedback on any outcomes and capture observations. • Assist in increasing awareness and understanding of the purpose and objectives of the environmental watering program in the Lower Barwon Wetlands. • Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. • Identify opportunities to achieve shared benefits. <p>Specific focus on specific group conservation interests through the SWP.</p>
<p>Traditional Owners</p>	<p>Wadawurrung Traditional Owners Aboriginal Corporation (Wadawurrung)</p>	<p>Collaborate</p>	<p>Face-to-face meeting during SWP drafting process.</p> <p>Representation on LBCAC</p> <ul style="list-style-type: none"> • Meeting to discuss and seek input on draft proposal • Review of draft proposal and opportunity to provide formal feedback. • Response to stakeholder on how their feedback influenced the SWP and why. 	<p>All stakeholders</p> <ul style="list-style-type: none"> • Seek user input to the development of the proposal. • Review previous environmental watering actions and seek feedback on any outcomes and capture observations. • Assist in increasing awareness and understanding of the purpose and objectives of the environmental watering program in the Lower Barwon Wetlands.

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
				<ul style="list-style-type: none"> • Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. • Identify opportunities to achieve shared benefits. <p>Specific focus on supporting Traditional Owner values through SWP.</p>
Recreational users	Field and Game Australia (Geelong branch) Geelong Gun and Rod Association Inc. Victorian Recreational Fishing	Involve	<ul style="list-style-type: none"> • Representation on LBCAC Meeting to discuss and seek input on draft proposal • Review of draft proposal and opportunity to provide formal feedback. • Response to stakeholder on how their feedback influenced the SWP and why. <p>Attendance at Community forums.</p> <p>Direct engagement (one on one)</p>	All stakeholders <ul style="list-style-type: none"> • Seek user input to the development of the proposal. • Review previous environmental watering actions and seek feedback on any outcomes and capture observations. • Assist in increasing awareness and understanding of the purpose and objectives of the environmental watering program in the Lower Barwon Wetlands. • Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. • Identify opportunities to achieve shared benefits. <p>Specific focus on recreational interests</p>
Landholders/Farmers	Individual landholders	Involve	Membership of LBCAC	All stakeholders

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
	Commercial eel fishers		<ul style="list-style-type: none"> • Meeting to discuss and seek input on draft proposal • Review of draft proposal and opportunity to provide formal feedback. • Response to stakeholder on how their feedback influenced the SWP and why. <p>Attendance at Community forums.</p> <p>Direct engagement (one on one)</p>	<ul style="list-style-type: none"> • Seek user input to the development of the proposal. • Review previous environmental watering actions and seek feedback on any outcomes and capture observations. • Assist in increasing awareness and understanding of the purpose and objectives of the environmental watering program in the Lower Barwon Wetlands. • Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. • Identify opportunities to achieve shared benefits. <p>Specific focus on commercial interests.</p>
Councils	City of Greater Geelong	Collaborate	<p>Representation on LBCAC</p> <ul style="list-style-type: none"> • Meeting to discuss and seek input on draft proposal • Review of draft proposal and opportunity to provide formal feedback. • Response to stakeholder on how their feedback influenced the SWP and why. <p>Attendance at Community forums.</p>	<p>All stakeholders</p> <ul style="list-style-type: none"> • Seek user input to the development of the proposal. • Review previous environmental watering actions and seek feedback on any outcomes and capture observations. • Assist in increasing awareness and understanding of the purpose and objectives of the environmental watering program in the Lower Barwon Wetlands.

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
			Direct engagement (one on one) Corangamite CMA involvement on linked or related CoGG projects	<ul style="list-style-type: none"> • Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. • Identify opportunities to achieve shared benefits. <p>Specific focus on managing impact of urban development stormwater on environmental watering and reflecting that in the SWP.</p>

2.1 Notable feedback

Support for the Lower Barwon Wetlands Seasonal Watering Proposal was received from Wadawurrung Traditional Owners Aboriginal Corporation, Geelong Field Naturalists and the Geelong Environment Council. Friends of the Barwon had nothing to add to the proposal.

Osseels expressed concern around the level of draw-down and the freshwater status of the wetlands. They also questioned the interpretation of the environmental watering objective. Geelong Gun and Rod do not support the Lower Barwon Wetlands Seasonal Watering Proposal and had a number of concerns. Those relevant to the seasonal watering proposal related to the complexity of the document, use of the IAP2 spectrum and perceived non-use of the entitlement for Reedy Lake. Several LBCAC members raised issues outside of the scope of the annual watering proposal and appropriate comment has been made to those matters, as well as those within scope, in the Lower Barwon Wetlands Seasonal Watering Proposal 2023-24 Comments Register.

Individuals or organisations can contact Corangamite CMA at info@ccma.vic.gov.au to request a copy of the Lower Barwon Wetlands SWP 2023-24 Comments Register.

A letter of endorsement for the seasonal watering proposal was received from Wadawurrung Traditional Owners Aboriginal Corporation. This can be found in Appendix 5.

A letter of support for the seasonal watering proposal was received from Parks Victoria. This can be found in Appendix 6.

3. Values and uses of waterways

The primary purpose of environmental water entitlements is to achieve environmental outcomes. However, the delivery of environmental water is likely to provide other benefits that depend on the condition of our waterways, such as supporting social and cultural values. Shared benefits are the many recreational, social, economic and Aboriginal cultural benefits that occur because of environmental watering such as fishing, boating, bird watching, community events and Traditional Owner events. Opportunities for shared benefits are incorporated into planning and watering decisions if they do not compromise environmental outcomes.

Corangamite CMA is flexible in its delivery approach and aspires to achieve shared benefits from the delivery and use of the water, where possible.

Through the management of the *Barwon River Environmental Entitlement 2011* (the Entitlement) Corangamite CMA consults with diverse stakeholders within LBCAC to ensure that consideration is given to social, cultural and economic matters relevant to water management in the Lower Barwon Wetlands.

3.1 Aboriginal cultural values and uses of waterways

The Barwon River has important social, cultural and economic values. Wadawurrung people place a high cultural value on the Barwon River *Barra Warre Yulluk*. Many Wadawurrung people in the region have a connection and a long history with the river.

Under the Aboriginal Heritage Act (2006) and Aboriginal Heritage Regulations (2007) any waterway or Ramsar listed sites are recognised as sensitive.

In 2018, Corangamite CMA engaged representatives from the Wadawurrung Traditional Owner Aboriginal Corporation (WTOAC) to inform part of the Upper Barwon, Yarrowee and Leigh rivers FLOWS study update (Alluvium, 2019) and to assist in capturing Aboriginal values within each of the waterway reaches that are relevant to Wadawurrung Country. Many of these values, notably culturally significant species, are also common to wetlands of the Barwon River system.

The Wadawurrung Traditional Owners released their *Paleert Tjaara Dja* - let's make Country good together 2020-2030 - Wadawurrung Country Plan in 2020. *Yulluk* – waterways, rivers, estuaries and wetlands, is a key value identified in the plan. Consultation is ongoing, and meetings have been held with the Wadawurrung to help progress future projects and work together to expand on the opportunities for shared benefits.

Important Wadawurrung cultural values and recommendations identified within the Lower Barwon Wetlands include:

- Culturally significant wetland species: *Porronggitj* Brolga, *Toolim* Black Ducks, *Kunuwarra* Black Swan, *Buniya* Eel, *Tark* Common Reed, and *Bal-yan* Bull Rush.
- Recognition of wetlands as meeting/ceremony/trade places
- Maintaining waterholes and refuge pools

- Maintaining access to culturally important story places and ceremonial places
- Protection of artefact sites
- Use of appropriate Wadawurrung language for places of cultural importance
- Increased opportunities for Wadawurrung to be involved in monitoring and evaluation activities
- Including the Wadawurrung in all communication around environmental water releases and other wetland related activities.

The Wadawurrung Country Plan acknowledges the special place Reedy Lake and Hospital Swamps have in their Dreaming.

“The chain of ponds from the Barwon River to Reedy Lake, Hospital Lake, Lake Connewarre and Estuary Bay is connected through water and our Connewarre (Black Swan) Dreaming”.

The plants and animals of the Lower Barwon Wetlands evolved under the influence of varying water levels. There were dry years and wet years creating a diversity of habitats to support a diversity of species, including culturally significant ones. The wetlands were a place of food gathering, meeting and ceremony. The current watering regime is seen to support those natural cycles, the identified cultural values as well as the Ramsar related watering objective.

Corangamite CMA is continuing to work with Wadawurrung Traditional Owners to support their values and uses of the wetlands, and to refine our understanding of how the water regimes in the Lower Barwon Wetlands can support their aspirations. Corangamite CMA meet with Wadawurrung Traditional Owners first, at the beginning of the planning process before engaging the broader community. WTOAC have reviewed, edited and approved relevant section content in this SWP, and are also part of the broader LBCAC. They have provided a letter of endorsement to this document which can be found in Appendix 5.

3.2 Social, recreational and economic values and uses of waterways

Environmental watering at Reedy Lake and Hospital Swamps takes a ‘whole of wetland’ approach. Expert advice in the past (Flow Ecology study (Lloyd et al., 2012) and Lower Barwon Review (Sherwood et al., 2020)) has emphasised that the entire recommended watering regime must be implemented to achieve improvements in biodiversity. In essence, a variety of water levels within a year and seasonality between years creates the healthiest ecosystem. This in turn supports a variety of social, recreational and economic values, such as those listed in Table 3.

Table 3. Social, recreational and economic shared benefits for Reedy Lake and Hospital Swamps for 2023-24

Waterway	Beneficiary	Connection to the wetlands	Values / uses / objectives / opportunities	How have these benefits been considered?
Reedy Lake and Hospital Swamps	Bird watchers and members of the community with an interest in the conservation of birds and their habitats	Reedy Lake and Hospital Swamps are important sites for spending time in the field watching and recording birds.	Birdwatchers value the opportunity to see rare species, threatened species, breeding birds, the spectacle of large numbers of birds, and to contribute to scientific monitoring and photography. Reedy Lake is a site of national importance for species such as Australasian Bittern and migratory shorebirds.	The wetting and drying watering regime at the wetlands supports a diversity of habitats and therefore conservation goals and observation opportunities.
Reedy Lake and Hospital Swamps	Recreational duck hunters	Reedy Lake and Hospital Swamps are part of the Lake Connewarre State Wildlife Reserve and have a long history of game hunting. Ducks are the primary target, and generations of duck hunters have enjoyed duck hunting	Reedy Lake and Hospital Swamps provide habitat for duck species that are permitted to be hunted by law. They are designated locations for that activity as managed by the Victorian Game Management Authority.	The overall watering regime supports a healthy ecosystem, including ducks. It is expected that more breeding will occur during ‘summer full’ years.

Waterway	Beneficiary	Connection to the wetlands	Values / uses / objectives / opportunities	How have these benefits been considered?
		<p>season at the Lower Barwon Wetlands, particularly Reedy Lake, returning to the same hide locations over many years.</p>		
<p>Reedy Lake and Hospital Swamps</p>	<p>Commercial eel fishers and recreational fishers</p>	<p>Reedy Lake and Hospital Swamps are the site of a commercial eel fishing licence. (There is a second licence in the adjacent Barwon River and Lake Connewarre). Recreational fishers also have a history of fishing at the wetlands.</p>	<p>A healthy eel and fish population is important to the viability of the eel business and provides opportunities for recreational fishing.</p>	<p>The overall watering regime supports a healthy ecosystem, including eels. The eel fishery would prefer permanently full wetlands, however the wetland cannot be maintained in a permanently full state, as this has a negative impact on other species and the productivity of the wetlands as a whole.</p> <p>Corangamite CMA has undertaken complementary measures in recent years to improve fish and eel connectivity in the wetlands in order to support the short-finned eel species. These have included two fishways on the lower Barwon breakwater which incorporate eel ropes and matting and a first time fishway on Reedy outlet with an integrated eel ramp.</p> <p>Other Corangamite CMA management activities (funded by the VEWH) support access to the wetland sites through track and channel maintenance/upgrades for efficient and effective water delivery which can be utilised by other recreational and commercial stakeholders for their desired purposes.</p>

4. Seasonal review 2022-23

4.1 Climate

The year 2022 was the 22nd warmest year on record for Australia. Nationally averaged rainfall was 26% above the 1961-1990 average, which makes 2022 the ninth-wettest year on record for Australia. The main climate influences active during 2022 were La Niña, which persisted through summer 2021-22, dissipated during autumn then re-developed in early September and continued through the end of 2022; a negative Indian Ocean Dipole in winter and spring; and a persistently positive phase of the Southern Annular Mode from mid-autumn onwards. (Bureau of Meteorology 2023). Parts of Victoria saw flooding multiple times during the year. (Bureau of Meteorology (2023a) Annual Climate Statement 2022).

Overall, it was a wet year, with higher than average rainfall through many months and very noticeably in October and November 2022 (see Figure 7). The wet conditions and spilling reservoirs through late winter and spring on both the Upper Barwon and Moorabool systems have maintained very high water levels in the lower Barwon, creating flood conditions throughout the lower Barwon wetlands through spring. Water levels in the Barwon River did not drop below 0.7m AHD above the lower barrage. This meant there were no restrictions to watering the wetlands from the entitlement, due to river level. The Barwon River near the wetlands peaked at over 2.1m in mid-October due to natural flow, so water was overtopping the river banks onto surrounding land and the wetlands. How these conditions played out in terms of watering both wetlands can be seen below in Figures 8 and 9.

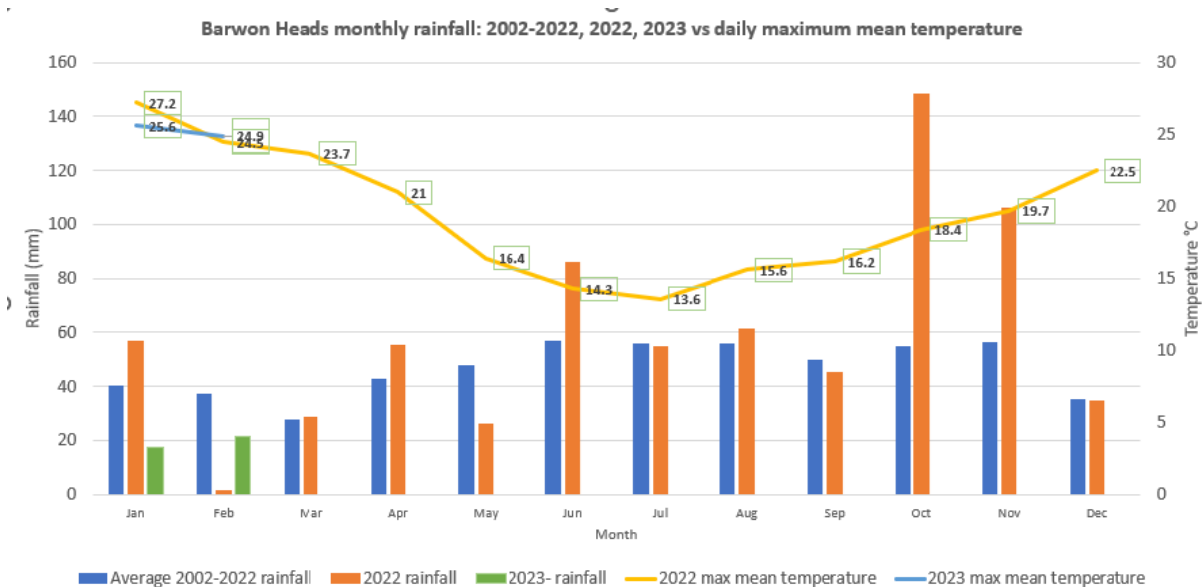


Figure 7. Average monthly temperature and rainfall at Barwon Heads: 2002-2022, 2023

4.2 Hydrological achievement

Reedy Lake

In the first days of March 2022, two of three gates were closed down at Reedy Lake inlet to initiate a gentle draw-down. After a week of monitoring the response of the wetland, and not seeing water levels drop, the third gate was shut on March 16, 2022. Water levels then began to drop, but only reached a minimum of 0.69m before rising again. The inlet was then formally opened on June 24 to fill the wetland and move water around the lower Barwon barrage in high flow conditions. A flow through setting was then maintained throughout winter, spring and early summer. High flows kept the wetlands full, over-topping the banks at times, while maximising connectivity and movement of flooding waters past the lower Barwon barrage. During the flood events, it is likely the low dissolved oxygen levels were a result of higher loads of organic material washing into the system and consuming the oxygen during breakdown

Water levels were maintained either steady or at a slow naturally dropping rate through summer until advice was received with regards to the finalisation of water bird breeding activity and the safety of assisted draw-down. Assisted draw-down was commenced on 15 and 22 February 2023.

Figure 8 below shows how water level, dissolved oxygen and salinity trended over the last year. Unreliable data has been omitted from the graph below.

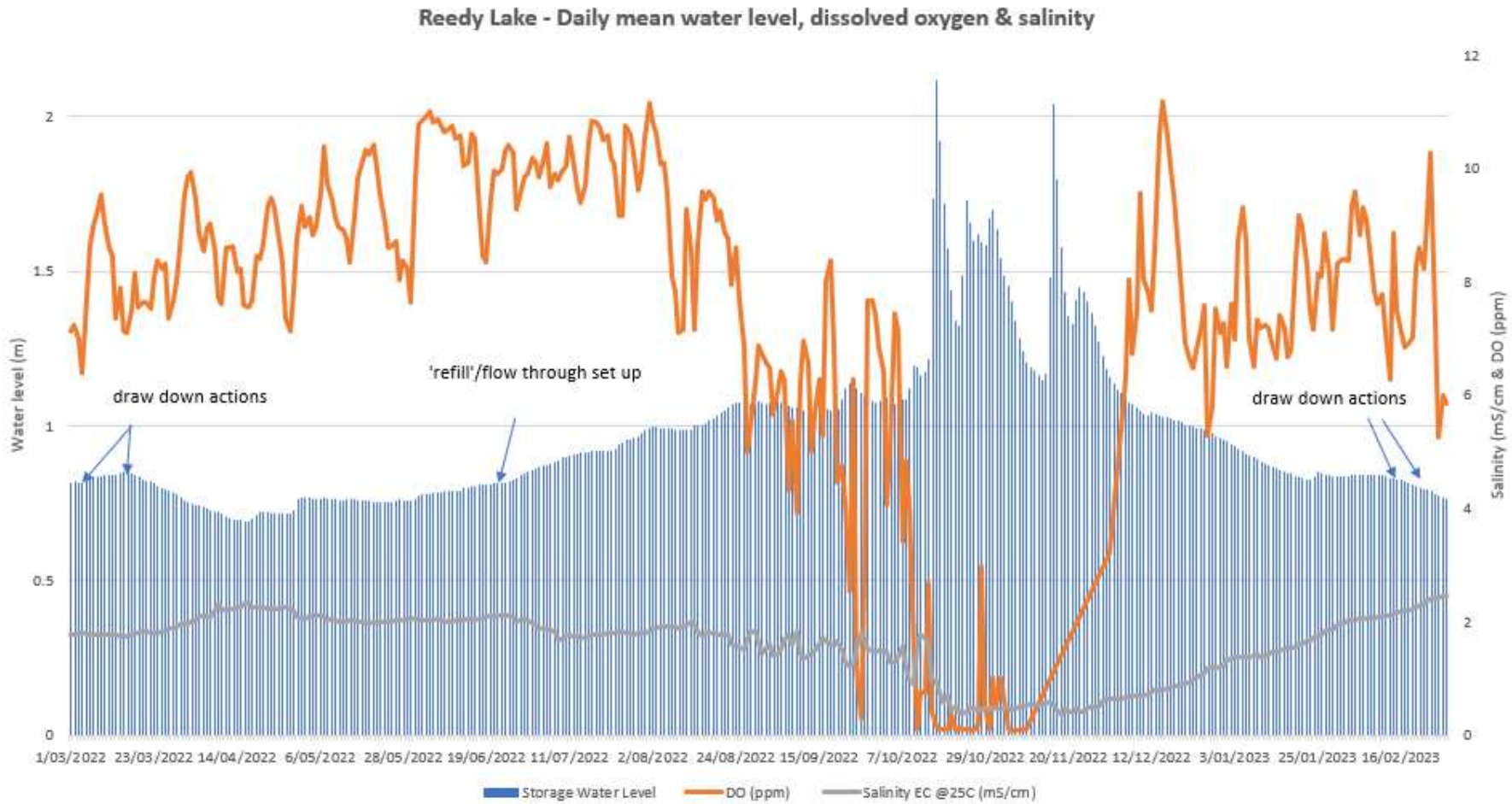


Figure 8. Water levels and key parameters at Reedy Lake 2022-23 (data from WMIS)

(note: unreliable or absent data appears as a gap in the line plot)

Hospital Swamps

In March 2022 Hospital Swamps was sitting at a naturally drawn down level of 0.3m, with an open tidal outlet. In May in line with the Seasonal Watering Plan, a single gate was open at the Sparrovale – Nubjitj yoorree intersection area. This allowed water already flowing in from the Barwon River through to the Blind Channel connector to Lake Connewarre, to enter Hospital Swamps. In early June the single open gate was partially shut down to slow down inflows. The river gates were also adjusted down to slow flow. With a full wetland, on the 8th of June, the inlet was completely shut to stop the wetlands over filling and allow the first half of the inlet channel to be used to mover water around the lower Barwon barrage in very wet river conditions. Sparrovale - Nubjitj yoorree was also allowed to discharge to the Blind Channel by City of Greater Geelong. Water levels remained high in Hospital Swamps throughout winter and spring due to local rainfall and flooding conditions.

With water levels in Hospital Swamps dropping over December, one of the inlet gates at the Sparrovale – Nubjitj yoorree was opened by approximately 30cm on 3rd of January 2023 to slow the rate of drop and support breeding water birds. However with rising wetland levels the same gate was shut down to just a 10cm opening to steady levels. Water levels were aimed to be maintained either steady or at a slow naturally dropping rate though summer until advice was received with regards to the finalisation of water bird breeding activity and the safety of assisted draw-down. On February 10th with water levels still rising, the inlet was completely shut down. This in effect initiated draw-down, as a lack of rainfall allowed the wetland to start dropping.

Figure 9 below shows how water level, dissolved oxygen and salinity tracked over the year. Please note that unreliable data has been omitted from the graph.

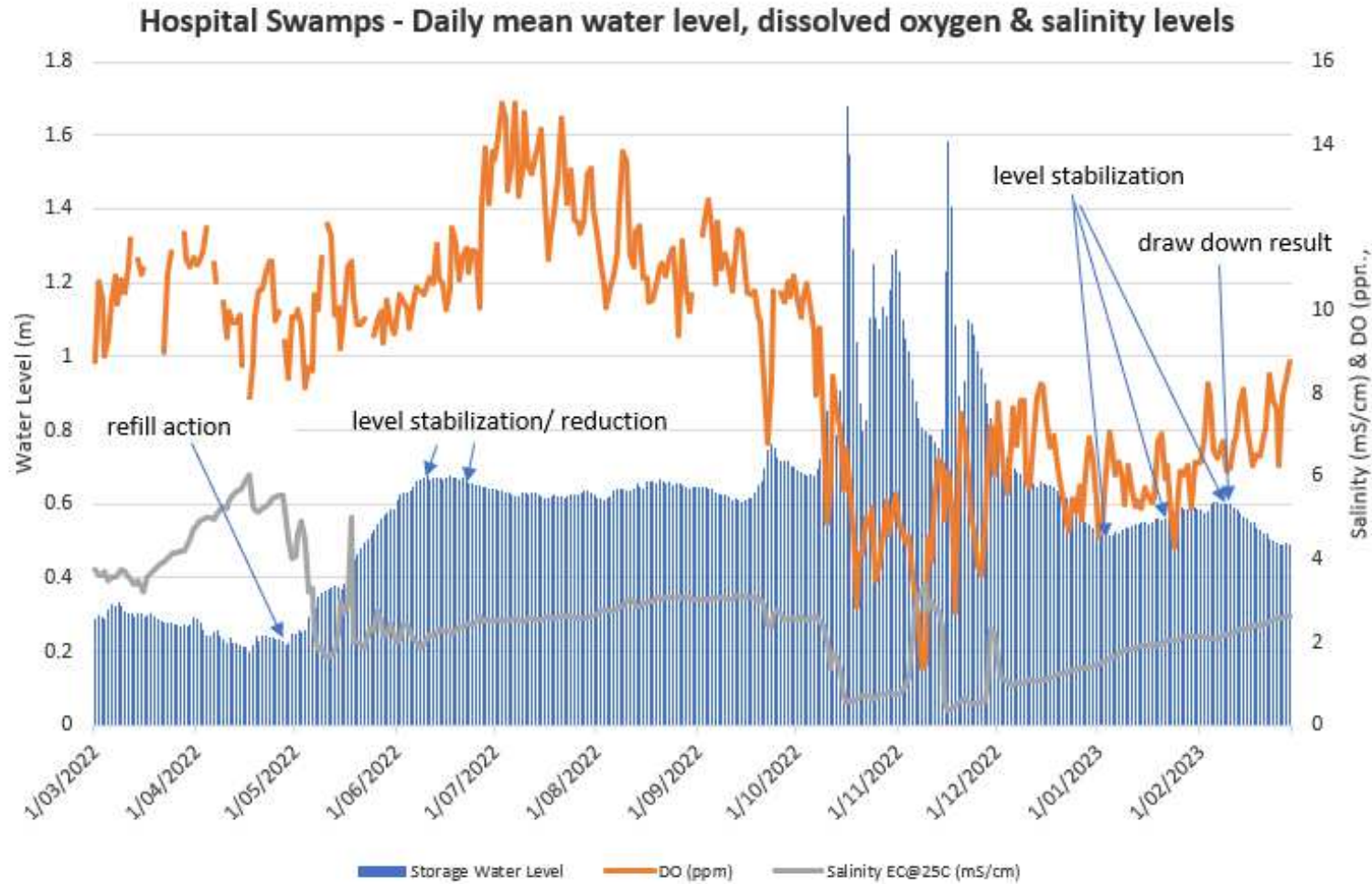


Figure 9. Water levels and key parameters at Hospital Swamps 2022-23 (data from WMIS)
 (note: unreliable or absent data appears as a gap in the line plot)

A summary of the Lower Barwon Wetlands watering regime for the years 2012/13 to 2022-23 has been completed.

Table 4. Hydrological achievement of flow regime in the Lower Barwon Wetlands: 2012/13 – 2022/23

Site	Flow component achievement by year											Ecological outcomes / observations 2022-2023	
	2012 -13	2013 -14	2014 -15	2015 -16	2016 -17	2017 -18	2018 -19	2019 -20	2020 -21	2021 -22	2022 -23		
Reedy Lake	E	E	E	E	E	E	E	E	E	E	E/U	E/U (tbc)*	<p>Wet conditions triggered good breeding activity at Reedy Lake, however natural flooding immersed large areas of the nesting colonies. Not all were affected and ibis and spoonbills completed a successful breeding event post floods.</p> <p>Booming bitterns were recorded.</p> <p>Large choruses of Growling grass frogs were also observed during listening surveys for breeding water birds.</p> <p>*Draw-down underway at time of writing. Target low-level of 0.3m unlikely to be achieved due to a combination of wet conditions, late draw-down start and silted channels (to be desilted in 2023), however a partial draw-down to <0.57 will be achieved.</p>
Hospital Swamps	E	E	E	E	E	E	E	E	E	E	E	E	<p>Booming bitterns were recorded.</p> <p>Large choruses of Growling grass frogs were also observed during listening surveys for breeding water birds.</p>

Key

	Dry wetland
	Wetting and drying regime
	Water present

E	Managed environmental water release
O	Consumptive water en route/other managed flow
U	Unregulated flows (or water not managed by Corangamite CMA)

4.3 Ecological observations

Reedy Lake has previously been part of the Arthur Rylah Institute (ARI) WetMAP program for vegetation assessment in response to environmental watering. However, there was no WetMAP activity this water year. It is anticipated that Reedy Lake will be included in WetMAP Stage 4 in future years.

Corangamite CMA once again engaged consultants SMEC to conduct surveys of Australasian bitterns and colonial nesting water bird species in spring and summer 2022-23. This monitoring was a recommendation of the Lower Barwon Review (2020) and informs the timing of planned draw-down watering actions at Reedy Lake and Hospital Swamps. The SMEC surveys also included some incidental observations of other bird species, and frogs. The primary purpose of the surveys was to detect and monitor any breeding activity, in order to support that breeding by providing stable or slowly dropping water levels. When advice was received that breeding was likely to be finished, a faster rate of assisted draw-down was initiated to achieve planned watering actions.

Field observations have also been provided by both Geelong Field and Game and the Geelong Field Naturalist Club, both of which are members of the Lower Barwon Community Advisory Committee (LBCAC). Members of the general public have also made and recorded bird observations through e-bird at both wetlands. Records can be accessed at www.ebird.org/australia. These contributions from the community are extremely valuable in building the picture of bird activity in the wetlands.

In summary, following early detection of both bitterns and colonial nesters in October, flooding interrupted breeding activity. With water levels rising by over 1m during October and November, it is thought that a significant number of nests were submerged, although some were observed to survive. Breeding re-established post flooding and a breeding event of approximately 100 pairs of Australian White Ibis and approximately 10-20 pairs of Royal Spoonbill took place at Reedy Lake in late October 2022 to January 2023 after the flooding events. There was booming from Australasian bitterns at both wetlands post flooding, and probable breeding.

A summary of the SMEC surveys, and highlights from the observations made by LBCAC members is provided below.

SMEC**Table 5. Waterbird monitoring result summary from SMEC for the 2022-23 season**

Date	Deployment, acoustic recording unit (song meters) relocation, battery replacement, SD card download		Songmeter analyses (bitterns)	Additional observations
	Location	New Location		
30-Sep-22		Hospital Swamps, Baenchs Lane		Growling Grass Frogs calling actively. Brolga pair seen flying eastwards over Hospital Swamps. Great Egrets x4, Musk Duck x1, Black Swans with cygnets common.
		Moolap Station Road		Australian White Ibis and Straw-necked Ibis flying overhead carrying nesting material.
		O'Hallaron Road		Pair of Brolgas foraging, Australian White Ibis and Straw-necked Ibis flying overhead carrying nesting material. Approximately >300 Ibis observed during deployment.
4-Oct-22	Hospital Swamps, Baenchs Lane	Hospital Swamps, Hospital Swamps Road	Australasian bittern detected calling 10/10/2022	
	Moolap Station Road	Moolap Station Road		
	O'Hallaron Road	Fitzgerald Road		
16-Oct-22	Flooding	All songmeters submerged	Songmeters still operating, no bitterns calling	Reedy Lake 2.12m, Hospital Swamps 1.68m
24-Oct-22		All songmeters retrieved for health check		
16-Nov-22	Flooding			Reedy lake 2.03m, Hospital Swamps 1.58m

Date	Deployment, acoustic recording unit (song meters) relocation, battery replacement, SD card download		Songmeter analyses (bitterns)	Additional observations
1-Dec-22 Redeployment	Hospital Swamps, Hospital Swamps Road	N/A	Australasian bittern detected calling 3/12/2022	Water levels stabilising to levels pre flooding. Growling grass frog calling actively, 30+ individuals.
	Moolap Station Road	N/A		Water levels stabilising to levels pre flooding. Growling Grass Frog calling actively, 50+ individuals. Ibis colony checks (on foot, waders), saw an array of nest stage development. Some nests were quite new, with eggs, others had well developed chicks, some of which had fledged. It was obvious that many nests had been reconstructed above the flooding levels experienced in October and November. Initial sub colony observed was only 20 birds, several other small colonies could be seen from this location, with Straw-necked Ibis outnumbering Australian White Ibis 2-1.
	Fitzgerald Road	N/A	Australasian bittern detected calling 2/12/2022	Water levels stabilising to levels pre flooding. Growling Grass Frog calling actively, 50+ individuals. Musk Duck pair observed, as well as a pair of Magpie Geese.
21-Dec-22	Hospital Swamps, Hospital Swamps Road	N/A		Water levels naturally dropping. Growling Grass Frog calling actively. 50+ individuals at least. Australian Spotted Crakes seen and heard.

Date	Deployment, acoustic recording unit (song meters) relocation, battery replacement, SD card download		Songmeter analyses (bitterns)	Additional observations
	Moolap Station Road	N/A		<p>Water levels naturally dropping. Growling Grass Frog calling actively. 100+ individuals. Colony of 100-120 Australian White Ibis with juveniles (25+ days old) and some still sitting on nests located on a patch of Tangled Lignum approximately 1m off water line. This patch was approximately 100m north of where the colony was located last year. Also of note were 5-10 Royal spoonbills (likely breeding) amongst the Australian white ibis.</p> <p>The area where the nests were previously located seems to have been flooded (you could feel all the stacked organic debris below the waterline making it difficult to walk through) however there were still a few Australian White Ibis sitting on nests in another close-by patch of Lignum (approx. 1m from waterline) and some new nests with eggs in the fringing Typha.</p> <p>Australian White Ibis were observed flying overhead carrying nesting material.</p>
	Fitzgerald Road	N/A		<p>Water levels naturally dropping. Growling Grass Frog calling actively, 100+ individuals. Brolga pair present. Eastern Great Egret x3 and Musk Duck x1</p>
29-Dec-22	Fitzgerald Road		Last recording of Australasian bittern detected on Song meter recordings	
9-Jan-23	Hospital Swamps, Hospital Swamps Road		Last recording of Australasian bittern detected on Song meter recordings	

Date	Deployment, acoustic recording unit (song meters) relocation, battery replacement, SD card download		Songmeter analyses (bitterns)	Additional observations
11-Jan-23	Hospital Swamps, Hospital Swamps Road			Growling Grass Frog no longer calling
	Moolap Station Road			Growling Grass Frog still calling, 15+ individuals.
	Fitzgerald Road			Growling Grass Frog no longer calling. 4 Brolga flew in while checking songmeter, and landed to forage south of Fitzgerald Road.
2-Feb-23	Hospital Swamps, Hospital Swamps Road			Growling Grass Frog no longer calling, mud flats exposed due to natural reduction in water levels. 9 Latham's Snipe recorded during visit, plus another 14 at Armstrong Creek wetlands - nationally significant numbers between them.
	Moolap Station Road			Growling Grass Frog no longer calling, notable reduction in ibis activity
	Fitzgerald Road			Growling Grass Frog no longer calling. Pair of Brolga foraging south of Fitzgerald Road. Ibis numbers have declined significantly with only 41 Australian White Ibis seen during the visit, although there are still colonies of what appear to be roosting birds towards the centre of the lake, or a combination of fledged by dependent chicks still being creched.
5-March-23			Suggested Hospital Swamps expedited draw-down commencement	
22-Feb-23			Suggested Reedy Lake expedited draw-down commencement	

Community observations

Geelong Field and Game (GF&G)

Observations were made at Reedy Lake by Trent Leen of Geelong Field and Game. On the 12th October 2022, prior to the flooding events, large numbers of breeding Straw necked ibis were observed (Figures 10 and 11).

Following flooding, further observations were made on the 16th January 2023 of nine single ibis nest sites, and another that had 12-14 nests. The flight path can be seen in Figure 12.

It was noted on the 19th January 2023, that most of the ibis appeared to have finished breeding.

Geelong Field Naturalists Club (GFNC)

As part of the Geelong Field Naturalists Club RPA program, funded by a Corangamite CMA grant (Ramsar team) – to better appreciate and understand waterbird breeding events at Reedy Lake, Craig Morley visited on the 22nd December 2022 (from Fitzgerald Rd access point) with Richard Shelton, HICAM RPA operator. Numerous videos and images were taken during several RPA flights.

Observations from the Fitzgeralds Road vantage point on the 22nd December included:

Several small colonies of Australian white ibis tending nests.

Small colony of about 15 Royal spoonbills nesting, including some flapping runners being fed. Figures 13 and 14 (drone flight 2-01 at -38.206298, 144.429711).

Australian white ibis (~50) tending nests, including some flapping runners being fed, together with total of ~10 Royal spoonbills. Figures 15 and 16 (drone flight 3-01 at -38.204160, 144.432960).



Figure 10. Straw-necked ibis, Reedy Lake 12th October (GF&G)



Figure 11. Eggs in ibis nesting sites, Reedy Lake 12th October (GF&G)

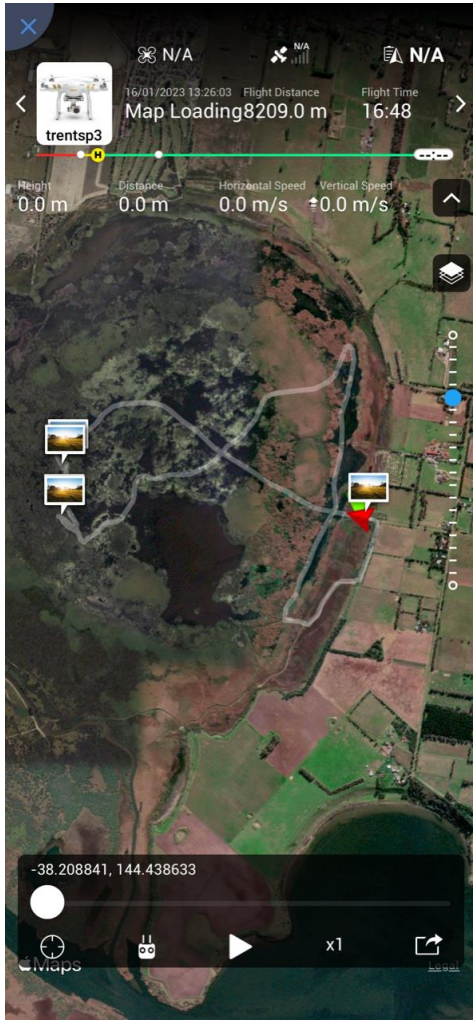


Figure 12. Ibis nest locations observed at Reedy Lake on 16th January 2023 (GF&G)



Figure 13. Royal spoonbill nests, Reedy Lake – flight 2-01 (GFNC)

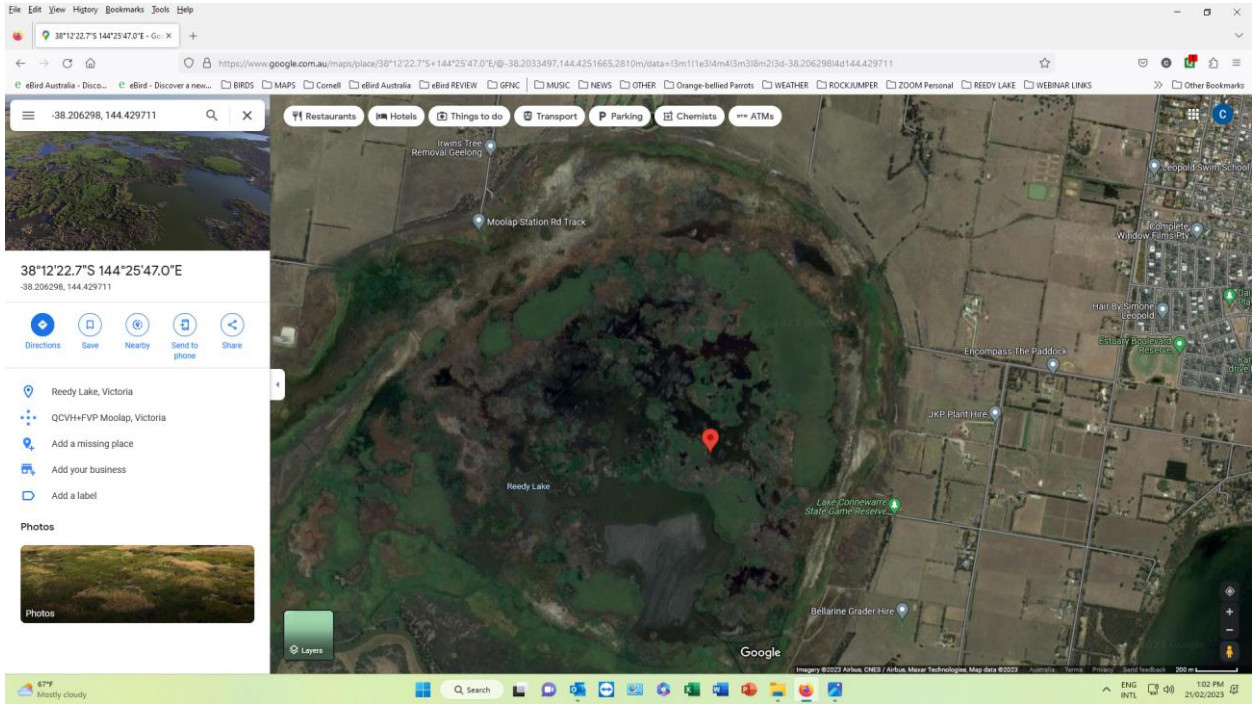


Figure 14. Royal spoonbill nests location at Reedy Lake – flight 2-01 (GFNC)



Figure 15. Australian white ibis and Royal spoonbill nests at Reedy Lake – flight 3-01 (GFNC)

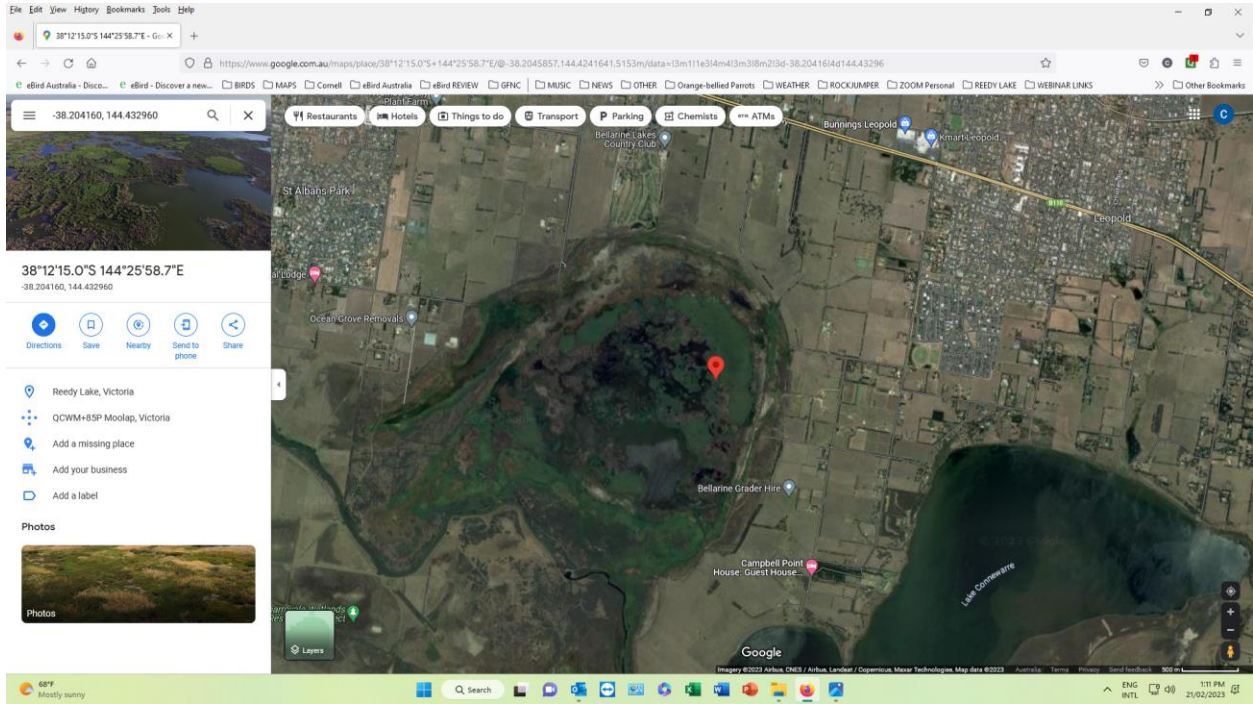


Figure 16. Australian white ibis and Royal spoonbill nests at Reedy Lake – flight 3-01 (GFNC)

4.4 Shared benefit review

This section should be read in conjunction with section 3.1 where it is outlined how stakeholders' values are considered wherever possible through the environmental delivery of water. This table provides some more detail where benefits are general in nature and linked to the overall watering regimes, and of specific outcomes achieved in the 2022-23 water year, where they exist.

Table 6. Shared benefit review for the Lower Barwon Wetlands: 2022-2023

Beneficiary	Review of benefits / outcomes
Traditional owners	As outlined in section 3.1, the current watering regimes (as a whole) support the natural cycles and the original balance of the wetlands prior to European contact in the region. They have been recommended as the best way to support healthy ecosystems. Traditional Owner wellbeing is closely tied to healthy Country. Appropriate environmental water regimes that support and improve the ecosystem health of the Lower Barwon Wetlands therefore benefit Wadawurrung people. Traditional Owner participation in planning for environmental water management in wetlands also forms part of their obligation to look after Country.
Recreational users/environment groups/local businesses	In addition to the way the watering regimes at Reedy Lake and Hospital Swamps support a diversity of bird types, as outlined in section 3.1, because of the presence and probable breeding of the EPBC listed endangered Australasian bittern, draw-down was timed at Reedy Lake to specifically support the breeding of this species during the 2022-23 water year.
	Corangamite CMA strives to provide as much as water as possible in the wetlands prior to the opening of duck season, where this does not compromise environmental outcomes. This is done to support preferred conditions of recreational duck hunters. It is anticipated that water levels will be relatively high at the start of the 2023 season due to the wet year, and the gentler approach to draw-down following the Lower Barwon Review (2020).
	The draw-down of the water at the wetlands drives its productivity in numerous ways. For example, the draw-down itself triggers macroinvertebrates (water bugs) to lay eggs, which on reflooding hatch and provide a food source to ducks and small fish. Vegetation which dries out during draw-down decomposes on reflooding, adding carbon back into the system, driving the food chain. This supports the recreational fish population, and recreational fishing. Construction of a fish way and eel passage at both Reedy Lake and the lower Barwon barrage in 2020 improved the ability of fish to migrate and spawn and the amount of habitat available to them. Corangamite CMA also maintains gate structures for maximum connectivity wherever possible. Both these initiatives provide shared benefits for commercial and recreational fishers.

5. Environmental objectives and scope of environmental watering.

The overarching watering objective for the Lower Barwon Wetlands was developed by the Lower Barwon Community Advisory Committee in 2013. It is to:

“Maintain or improve the ecological character of the wetlands”. Ecological character is defined as the combination of ecosystem components, processes, benefits and services that characterised the wetland in 1983 when the wetlands were Ramsar listed. A change in ecological character is a human-induced adverse alteration of any ecosystem component, process and/or ecosystem benefit/service. This objective is consistent with Ramsar obligations.

Further to the agreed watering objective, the Lower Barwon Review (Sherwood et al., 2020) advised that

“It is important to note that the Expert Review Panel supports a wetting and drying regime for Reedy Lake. Both the (Lloyd et al. 2012) study and other research undertaken in coastal wetlands in Victoria (e.g. Raulings et. al. 2010, 2011; Boon 2011) show that a permanently full lake will lead to a decrease in biodiversity. Wetting and drying regimes produce a mosaic of different habitat types as the water availability fluctuates providing specialist habitat for a wide variety of different flora and fauna species to utilise. Productivity at wetlands adapted to a wetting and drying regime, such as Reedy Lake, is driven by the disturbances caused by fluctuating water levels, occasional periods of high water and occasional periods of very low water. Occasional wet years would occur intermittently during unusually high flow years but should not be seen as “normal” or “desirable”.

The Lower Barwon Flow Ecology study (Lloyd et al., 2012) advised that the whole water regime is required to meet the overall ecological outcomes and it is not possible to separate out which objective has priority. Therefore, the potential watering actions cannot be tiered nor prioritised, as they are part of a multi-year whole regime.

Reedy Lake

The diversity and abundance of fauna in Reedy Lake, particularly waterbirds is supported by variation in water levels. Wetting and partial drying cycles support a diversity of vegetation types, habitats and species.

The Reedy Lake ecosystem includes sixteen ecological vegetation communities (EVCs), such as coastal saltmarsh, herbfields, sedgeland, open water (semi emergent/macrophyte communities) and reed beds, which all play an important role in providing diverse habitat for a variety of flora and fauna species.

Due to the consistently high water levels that were in place for many years until 2016-17, several vegetation communities that rely on low water levels or only periodic inundation – including the nationally vulnerable coastal saltmarsh – will have been negatively impacted. If the system is continually full, at some point these threatened vegetation communities may be lost from the system

forever and will not be able to recover, regardless of watering activities. It is important to note that while wetland ecosystems are always in a state of change, it is critical to maintain a diversity of vegetation communities similar to those historically represented at the site (Yugovic, 1985). Periods of both higher and lower water levels will ensure the variety of species dependent on the seasonally fluctuating range of water levels within the wetlands can be protected for future generations.

Anecdotal observations collected in 2012 when the Flow Ecology study (Lloyd et al., 2012) was written suggested that tall reeds were taking over the wetland and outcompeting other species. This resulted in recommended watering actions that were partially targeted to control tall reeds, particularly the 10 year reset which was never implemented. The reset was unacceptable to community, and the long-term Lloyd recommendations were implemented straight away as a four year trial. The expert panel engaged to conduct the Lower Barwon Review (Sherwood et.al., 2020) examined previously unavailable satellite imagery and concluded that there was no evidence to suggest tall reeds were taking over Reedy Lake, and recommended further assessment to confirm this. Importantly, a wetting and partial drying regime was still recommended to drive wetland fertility and to support a diversity of vegetation communities and habitats, regardless of tall reed status. However, the timing and extent of draw-down actions could be relaxed if tall reed encroachment is not to be targeted going forward.

The Lower Barwon Review (Sherwood et.al., 2020) recommends that the Flow Ecology study (Lloyd et al., 2012) be updated, and this has now been captured under Action 8.5 in the Central and Gippsland Region Sustainable Water Strategy 2022. Until then, the advice is to implement the long-term Lloyd recommendations with a seasonally adaptive approach, avoiding complete dry out years. At Reedy Lake this means having the wetland full 25% of years and doing a partial draw-down for 75% of years. This can be represented by a nominal four-year cycle (Figure 17).

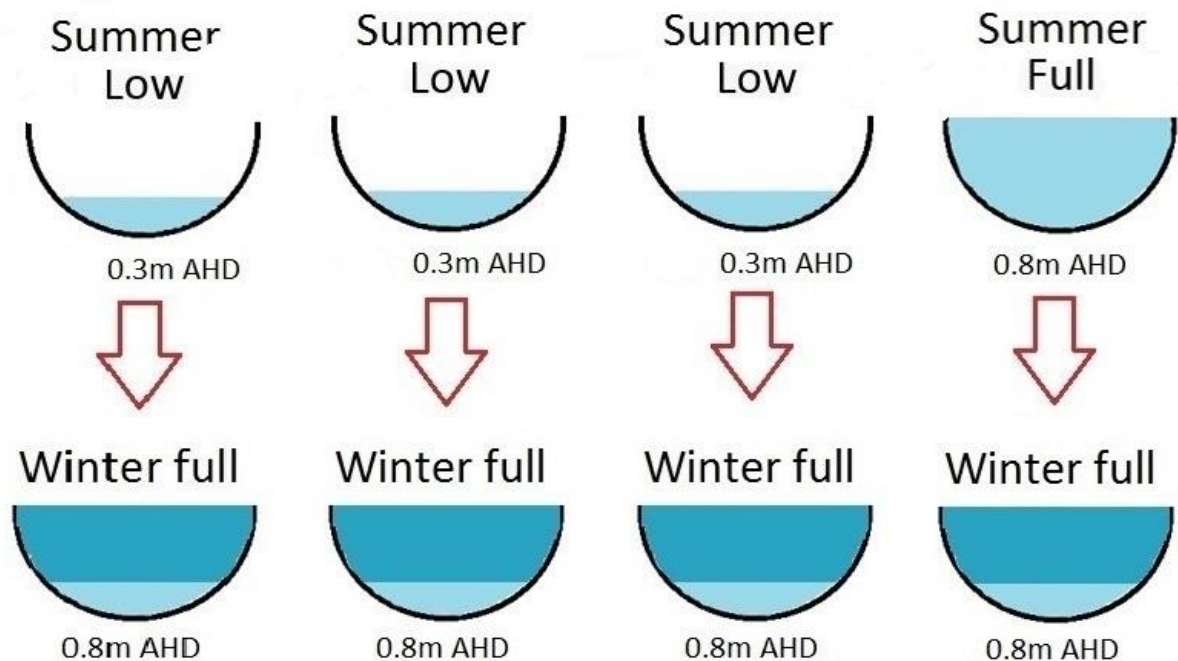


Figure 17. Reedy Lake's nominal four-year watering regime (2023-24 a draw-down year)

Individual watering actions are then presented in more detail in Tables 7 and 8.

Table 7. Potential watering action 1 at Reedy Lake 2023-24.

<i>Potential watering action 1</i>	Autumn refill to winter full of approximately 0.8m AHD from April to March, topping as required and allowing for some natural variation. Wetland can be refilled and topped up any time from April 2024 through to the following March.
<i>Expected watering effects</i>	<p>Initiate decomposition of organic matter on wetland bed</p> <p>Initiate growth of submerged aquatic macrophytes</p> <p>Initiate macroinvertebrate productivity</p> <p>Dilute accumulated soil and surface water salts</p> <p>Stimulate fish and waterbird breeding</p> <p>Allow fish to colonise wetland from the river</p> <p>Growth of submerged aquatic macrophytes</p> <p>Growth of <i>Schoenoplectus validus</i> and other emergent aquatic macrophytes</p> <p>Persistent waterlogging and intermittent inundation of <i>Muehlenbeckia</i>, <i>Sarcocornia</i> and <i>Distichlis</i> vegetation communities</p> <p>Stimulate fish and waterbird breeding</p> <p>Stimulate increase in invertebrate populations and biomass</p> <p>Create nesting habitat for colonial and other waterbirds</p> <p>Trigger fish spawning and sustain juvenile fish</p> <ul style="list-style-type: none"> • Provide connecting flows to the river
<i>Environmental objectives</i>	<p>Moderate waterbird breeding events</p> <p>Spring feeding by waterbirds in flooded vegetation and wetland fringe</p> <p>Moderate fish breeding and recruitment events</p>
<i>Rationale for proposed application in 2023-24</i>	<p>The current recommended water regime for Reedy Lake involves a full wetland every winter and spring, and a partial draw-down over summer in 75% of years. This watering action is in line with that advice, and is not influenced by watering in previous years.</p>
<i>Operational arrangements</i>	<p>As required to fill up and maintain a full wetland over winter and spring.</p> <p>The gates will be left open as much possible to maximise connectivity.</p> <p>When the Barwon River is running high, e.g. >0.9-1m AHD the system can be run as a flow through system, maintaining full water levels and connectivity.</p> <p>When the Barwon River is lower, e.g. between 0.7m AHD and 1m AHD, the outlet gate may need to be closed or partially closed to maintain a full level.</p> <p>When the Barwon River is below 0.7m AHD, both inlet and outlet gates would be closed to comply with the environmental entitlement and to hold water in Reedy Lake.</p>

Table 8. Potential watering action 2 at Reedy Lake 2023-24.

<p><i>Potential watering action 2</i></p>	<p>Draw-down to summer low – gradually reduce water levels to approximately 0.3 m AHD by natural evaporation or flow through adjustment and assisted draw-down (if required). Topping or drawing down as required to maintain approximately 0.3m AHD from December to May (as informed by bird monitoring). The wetland can be drawn down any time from December 2023, but is likely to occur later than this to ensure minimal impact on waterbird breeding.</p>
<p><i>Expected watering effects</i></p>	<p>Some reed beds exposed to retard growth Aquatic habitat retained in big hole and deep channels <i>Bolboschoenus</i> and herbland plants grow on exposed mudflats Submerged aquatic macrophytes set seed and retreat to resting stages Saline groundwater discharge to wetland bed Restart wetland processes Allow egg banks to be produced and laid Provide waterbird food supply from access to tubers, seeds and invertebrates in shallow water Reduce carp habitat</p>
<p><i>Environmental objectives</i></p>	<p>Recruitment of aquatic macrophytes at wetland fringes Retard reed colonisation of low-lying areas Control carp Wading bird habitat over summer Decay of organic matter on exposed wetland beds, which will increase lake productivity when reflooded</p>
<p><i>Rationale for proposed application in 2023-24</i></p>	<p>A partial summer draw-down is recommended in 75% of years. In 2020-2021 draw-down was delayed and full draw-down not achieved, due to probable breeding of Australasian bitterns. In the 2021-22 water year Reedy Lake did not achieve a significant draw-down again. This makes three full years in a row including the planned full year in 2019-20. At the time of writing, partial draw-down has been initiated for summer for 2022-2023 as a wet year starts to dry out. in line with drawing down 75% of years. A draw-down no earlier than December will support waterbird and frog breeding and will also provide muddy margins for migratory shore birds when it is most needed between January and March. A slow draw-down rate will reduce the risk of disruption to any breeding marsh birds or colonial nesting birds. Exact timing of draw-down commencement will be informed by bird monitoring. A faster draw-down will be employed if water levels are not dropping sufficiently to provide muddy margins through January-March or later, depending on breeding activity.</p>

<p><i>Potential watering action 2</i></p>	<p>Draw-down to summer low – gradually reduce water levels to approximately 0.3 m AHD by natural evaporation or flow through adjustment and assisted draw-down (if required). Topping or drawing down as required to maintain approximately 0.3m AHD from December to May (as informed by bird monitoring). The wetland can be drawn down any time from December 2023, but is likely to occur later than this to ensure minimal impact on waterbird breeding.</p>
<p><i>Operational arrangements</i></p>	<p><u>As required to achieve the draw-down slowly.</u></p> <p>In average or dry conditions this may involve closing the inlet and outlet gates and allowing natural evaporation, only assisting draw-down by opening the outlet gate if required.</p> <p>In wet conditions this may involve adjusting the previous winter setting with inlet and outlet gates both open (see Potential Watering Action 1) to a partially closed inlet and an open outlet to achieve a gradual draw-down, but with the benefit of maintaining some connectivity for fish, particularly through the inlet which does not yet have a fish way.</p> <p><u>Top ups (via river upstream of barrage)</u> Inlet gate:- open or opening increased if Barwon River >0.7m AHD Outlet gate:- closed or opening reduced</p> <p><u>Top ups (via tidal Barwon River downstream of barrage)</u> Inlet gate:- closed Outlet gate:- open</p>

Hospital Swamps

Hospital Swamps is subject to a strongly seasonal water regime, filling quickly in winter and spring and drying in summer and autumn when inflows from the Barwon River decline. Shallow water levels prevent significant recharge to the wetland bed and maintain saline soils that are hostile to the establishment of emergent macrophytes. On the northern banks of the main basin there is a cycling of water into the area, with winter inundation to establish a fresh groundwater lens and a subsequent discharge from the banks in summer, which limits the accumulation of salt and promotes the growth of reeds.

The diversity of vegetation types and associated fauna habitat is maintained by a complex interaction between freshwater inflows, water table depth cycles and salinity, movement patterns in freshening groundwater, the extent of overbank flooding, and surface water flows from other sources (Lloyd et al., 2012). The historical water regime of wetting and drying at Hospital Swamps (Figure 13) is seen as currently beneficial to the ecosystem values of the site (Lloyd, et al., 2012) and available data indicates that the environmental watering recommendations are appropriate and ecological values are in good condition (Alluvium, 2020).

The Lower Barwon Review (Sherwood et.al., 2020) recommends that the Flow Ecology study (Lloyd et al., 2012) be updated by 2022, however this is now slated for 2025 in the Central and Gippsland Sustainable Water Strategy 2022. Until then, the advice is to implement the long-term Lloyd recommendations with a seasonally adaptive approach. At Hospital Swamps this means a partial draw-down most years (Figure 18). Lloyd also provided additional advice in 2013 around

the operation of regulatory structures at Hospital Swamps primarily to increase connectivity. This advice is incorporated into operational arrangements, where practical.

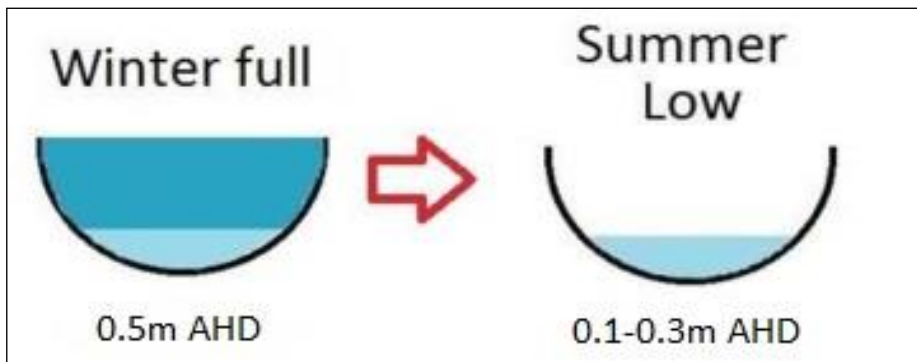


Figure 18. Hospital Swamps watering regime 2023-24

Individual watering actions are then presented in more detail in Tables 9 and 10.

Table 9. Potential watering action 1 – Hospital Swamps 2023-24

<i>Potential watering action 1</i>	Autumn refill to winter full of approximately 0.5m AHD from April to March, topping as required and allowing for some natural variation. Wetland can be refilled and topped up any time from April 2024 through to the following March.
<i>Expected watering effects</i>	<p>Initiate <i>Stuckenia</i> and Chara growth</p> <p>Initiate decomposition of organic matter on wetland bed</p> <p>Dilute accumulated soil and surface water salts</p> <p>Create habitat and invertebrate populations</p> <p>Stimulate fish and waterbird breeding</p> <p>Allow fish to colonise wetland from the river</p> <p>Continuous flushing of salt from deep wetland basins</p> <p>Inundation of reedbeds and <i>Bolboschoenus</i> beds fringing the main basin</p> <p>Sustain growth of <i>Stuckenia</i> and Chara</p> <p>Promote growth of <i>Myriophyllum</i> in southern part of main basin</p> <p>Waterlog <i>Gahnia filum</i> sedgeland</p> <p>Stimulate increase in invertebrate populations and biomass</p> <p>Create nesting habitat for colonial and other waterbirds</p> <p>Continuous flushing of salt from deep wetland basins</p> <p>Inundate shallow wetland basins and promote growth of <i>Ruppia</i></p> <p>Inundate <i>Gahnia filum</i> sedgeland</p> <p>Create additional fish and waterbird habitat and invertebrate populations</p> <p>Trigger fish spawning</p> <p>Provide connecting flows to the river and between wetlands</p>
<i>Environmental objectives</i>	<p>Moderate waterbird breeding events</p> <p>Spring feeding by waterbirds in flooded vegetation and wetland fringe</p> <p>Moderate fish breeding and recruitment events</p>
<i>Rationale for proposed application in 2023-24</i>	<p>The current watering regime recommended for Hospital Swamps involves drawing down the wetland over summer and refilling in autumn to provide a full wetland through winter and spring, most years. This watering action is in line with that advice and is not influenced by watering in previous years.</p>
<i>Operational arrangements</i>	<p><u>As required to achieve refill and maintain a full wetland over winter/spring.</u></p> <p>In average to dry conditions the inlet regulator may need to be opened to fill the wetland, with the outlet gate closed.</p> <p>In wet conditions, local stormwater run-off can be more than sufficient to fill and maintain full wetland basins even with the outlet gate open.</p> <p>Connectivity via open gates will be maintained wherever possible.</p>

Table 10. Potential watering action 2 – Hospital Swamps 2023-24

<p><i>Potential watering action 2</i></p>	<p>Draw-down to summer low – gradually reduce water levels to approximately 0.1 - 0.3 m AHD by natural evaporation or flow through adjustment and assisted draw-down (if required). Topping or drawing down as required to maintain approximately 0.1 - 0.3m AHD. From December to May (as informed by bird monitoring). The wetland can be drawn down any time from December 2023, but is likely to occur later than this to ensure minimal impact on waterbird breeding.</p>
<p><i>Expected watering effects</i></p>	<p>Increase wetland salinity as groundwater discharge increases in proportion to surface water Shallow wetland basins exposed (creates open water habitat upon refilling) Restart wetland processes Allow egg banks to be produced and laid Provide waterbird food supply from access to tubers, seeds and invertebrates in shallow water Soil salinity increases in shallow wetland basins and deep wetland basin Chara and <i>Stuckenia</i> die back Limited colonisation of wetland bed by annual herbland plants Exposed reeds and other emergent macrophytes become dormant High soil salinity excludes reeds Expose mudflats for waterbird feeding Allow nutrient re-cycling Control carp populations</p>
<p><i>Environmental objectives</i></p>	<p>Wading bird habitat over summer Recruitment of aquatic macrophytes at wetland fringes Retard reed colonisation of low-lying areas Control carp Increase lake productivity</p>
<p><i>Rationale for proposed application in 2023-24</i></p>	<p>The system is recommended to have a wetting and drying cycle most years, meaning a summer draw-down in 2023-24. A draw-down no earlier than December, and guided by bird breeding monitoring, will support waterbird and frog breeding (where present) and will also provide muddy margins for migratory shore birds when they are most needed between January and March.</p> <p>Specific timing of draw-down will be informed by water bird monitoring for breeding (if possible). It will be slow in early summer to mimic natural dry out as flows in the Barwon decrease. However, if draw-down at Hospital Swamps is delayed due to bird breeding, a faster draw-down may be carried out to make sure some muddy margins are provided to migratory waders through January-March.</p> <p>Where draw-down at Hospital Swamps is delayed, offset habitat may be available at other nearby wetlands such as the CoGG-managed Sparrovale wetlands.</p>

<p><i>Potential watering action 2</i></p>	<p>Draw-down to summer low – gradually reduce water levels to approximately 0.1 - 0.3 m AHD by natural evaporation or flow through adjustment and assisted draw-down (if required). Topping or drawing down as required to maintain approximately 0.1 - 0.3m AHD. From December to May (as informed by bird monitoring). The wetland can be drawn down any time from December 2023, but is likely to occur later than this to ensure minimal impact on waterbird breeding.</p>
<p><i>Operational arrangements</i></p>	<p><u>As required to achieve the draw-down slowly.</u></p> <p>In average or dry conditions this may involve closing the inlet and outlet gates and allowing natural evaporation, only assisting draw-down by opening the outlet gate if required.</p> <p>In wet conditions this may involve adjusting the previous winter setting with inlet and outlet gates both open (see Potential watering action 1) to a partially closed inlet and an open outlet to achieve a gradual draw-down, but with the benefit of maintaining some connectivity for fish.</p> <p><u>Top ups (via river upstream of barrage)</u> Inlet gate:- open if Barwon River >0.7m AHD Outlet gate:- closed</p> <p><u>Top ups (via tidal Barwon River downstream of barrage)</u> Inlet gate:- closed Outlet gate:- open</p>

6. Scenario planning

6.1 Outlook for 2023-24

The Barwon Southwest region has a temperate climate, with mild to warm summers and cold winters. Summer average maximum temperatures are around 22-24°C near the coast and in elevated areas, and 25-27°C inland. Winter average maximum temperatures are around 12-14°C. Rainfall occurs mostly in winter and spring and is generally the result of rain-bearing weather systems coming from the west (DELWP, 2015).

Climate change continues to influence Australian and global climates. Australia's climate has warmed by around 1.47 °C over the period 1910–2021. There has also been a trend towards a greater proportion of rainfall from high intensity short duration rainfall events, especially across northern Australia. (Climate Driver Update Archive BOM (2023b, February)). Regarding long term climate projection (DELWP & CSIRO, 2019), based on a medium (RCP4.5) emissions scenario, annual rainfall totals are likely to decline by 25% by the end of the decade, with the greatest drying to occur in spring. As warming continues, more heat extremes will occur.

For March to May 2023, below median rainfall is likely (60 to 80% chance) for much of Australia including Victoria, except Gippsland. March to May maximum temperatures are likely to very likely (60% to greater than 80% chance) to be warmer than median for most of Australia except inland areas of the northern tropics and central parts of the New South Wales coast. March to May minimum temperatures are likely to very likely (60% to greater than 80% chance) to be warmer than median for the east and the west of the country. This forecast reflects the status and outlook for several climate drivers, including a declining La Niña (BOM (2023c)).

On balance it is thought that average rainfall is likely for the upcoming water year.

6.2 Scenario planning

Table 11 (below) outlines a range of climatic scenarios that assists with scenario planning. This year's potential watering actions will be based on an average climatic condition and will include partial drying, as advised in Lloyd et al. (2012) and the Lower Barwon Review (Sherwood et.al., 2020). However, given potential unknowns regarding rainfall and water availability linked to flows in the Barwon River, an adaptive management approach will be taken. Regular monitoring of water levels through DEECA's Water Measurement Information System (WMIS) and field observations will be important to determine the best time to adjust water levels in the wetlands.

Factors driving any change in the Lower Barwon Wetlands watering actions are mostly related to flow peaks or reductions to flow in the Barwon River; however, it has also been recommended by the Lower Barwon Review (Sherwood et.al., 2020) that late spring-early summer monitoring for breeding birds also informs draw-down timing.

Table 11. Potential impact of environmental watering under different climate scenarios

Climatic Conditions	Possible impact on Reedy Lake	Possible impact on Hospital Swamps
Dry/Drought	<p>Low water levels in the Barwon River in, prior to autumn fill, could delay or prevent the filling of Reedy Lake for the wetting. (Levels must be sustained above 0.7m AHD, usually by rainfall, to commence the fill.)</p> <p>Once full, increased evaporation would reduce water levels more quickly in the wetland.</p> <p>The Barwon River may fall below 0.7m AHD (trigger to close the inlet to avoid bank slumping of the lower Barwon River) resulting in Reedy Lake being disconnected from the Barwon River for a greater period than ideal.</p> <p>It is possible Reedy Lake may not reach 'full' levels during the winter months.</p>	<p>Low water levels in the Barwon River in the summer, prior to autumn fill, could delay or prevent the filling of Hospital Swamps for the winter.</p> <p>Levels must be sustained above 0.7m AHD, usually by rainfall, to commence the fill.</p> <p>Hospital Swamps may experience less connectivity with the Barwon River if river levels drop to <0.7m AHD during the Spring period.</p> <p>Increased evaporation and decreased flows in the Barwon River may result in water levels decreasing in Hospital Swamps earlier during November, before the planned draw-down.</p>
Average	<p>More gradual lowering of water levels during wetland drying (consistent with flow recommendations) and adaptive management for shared benefits.</p> <p>Unlikely that the Barwon River would fall below 0.7m AHD (trigger to close the inlet to avoid bank slumping of the lower Barwon River) resulting in Reedy Lake being connected to the Barwon River over the winter spring period.</p> <p>Reedy Lake is likely to reach 'full' levels during the winter months and have that sustained until drying commences.</p>	<p>Medium to high chance that Barwon River water levels would allow Hospital Swamps to be full at the end of December.</p> <p>Hospital Swamps would likely be low or dry in autumn when flows increase in the Barwon River and the wetland is reconnected to the river at the inlet.</p> <p>Hospital Swamps is likely to reach 'full' levels during the winter months.</p>
Wet	<p>Overbank flows and local runoff could result in water levels above 0.3m AHD during lowering of wetland water</p>	<p>Stormwater run-off from nearby developments would slow the draw-down of Hospital Swamps over</p>

Climatic Conditions	Possible impact on Reedy Lake	Possible impact on Hospital Swamps
	<p>levels. It is expected that this additional water would drain through the outlet.</p> <p>Very low chance that the Barwon River would fall below 0.7m AHD (trigger to close the inlet to avoid bank slumping of the lower Barwon River) resulting in Reedy Lake being connected to the Barwon River over the winter spring period.</p> <p>Reedy Lake is likely to rise above full levels during the winter months because of overbank flows, stormwater inflows, and local rainfall/runoff. This should not have a significant impact as a temporary event but may result in a fuller wetland over summer than originally planned. Not significant in the long term.</p>	<p>summer, when it exceeds the diversion level to Sparrovale – Nubjij Reserve.</p> <p>Hospital Swamps would be unlikely to dry out over the summer and autumn period. Not significant in the long term.</p> <p>Hospital Swamps is likely to rise above 'full' level during the winter months because of overbank flows, stormwater inflows, local rainfall runoff, and the limited capacity of the outlet structure.</p>

7. Delivery constraints

7.1 Temporary constraints

Endangered Australasian bitterns have been observed at the wetlands. Colonial nesting birds such as straw-necked ibis have also been observed in recent years. The Lower Barwon Review (Sherwood et.al., 2020) has recommended that the timing and rate of draw-down be informed by monitoring of breeding birds. This is an operational issue and potentially a constraint on the delivery of watering actions. Watering actions will be adaptively managed in terms of timing and rate to avoid disturbance of breeding birds and juveniles.

To enable the watering actions in this plan to be implemented, it is essential that annual cutting of reeds in the inlet and outlet channels (see Table 12 below) occurs using an amphibious vegetation cutter. The channels are also shaped and cleared in various spots every few years as required to mitigate sedimentation. This was scheduled for 2022, however a number of issues including permitting related to disposal of spoil delayed works. Desilting is now re-scheduled to begin in 2023. Yearly track maintenance is also essential to maintain access to the control structures by staff.

Inlet and outlet gate structures, particularly the oldest ones, such as those servicing Hospital Swamps (see Figure 19) require regular preventative maintenance to keep them operational, and safe to operate.



Figure 19. A section of the Hospital Swamps' watering infrastructure at the bottom of the barge hole in the inlet channel. Flow controlled by placement of wooden boards in concrete grooves (S.Blum-Caon, 2019)

All these maintenance works are critical in enabling the manipulation of water levels in the wetlands and are currently funded through the VEWH.

Table 12. Temporary delivery constraints for the Lower Barwon Wetlands

Site	Potential constraint	Impact on watering actions	Works and measures to address?
Reedy Lake and Hospital Swamps	Breeding of colonial nesting birds or Australasian bitterns	Cannot draw-down wetland at optimum time to support migratory waders and their supporting habitat in late summer-autumn	n/a
	Vegetation growth in inlet/outlet channels	Reduce the ability to deliver flow efficiently	Annual vegetation trimming to be scheduled.
	Siltation in the inlet/outlet channels	Reduce the ability to deliver flow efficiently	Channels to be dredged every 3-5 years. Next scheduled dredging 2023.
	Access to inlet/outlet impassable due to flooding, disrepair of tracks, and/or overgrown vegetation.	Cannot water wetland due to inaccessibility	Annual grading and vegetation slashing and spraying to ensure tracks are passable.
	Avoidance of delivery changes during duck hunting season.	No watering actions can be made unless an emergency.	Continue to pursue installation of regulator gate automation.

7.2 Systemic constraints

Resources

Implementation of the watering actions requires Corangamite CMA to operate the inlet and outlet structures associated with Reedy Lake and Hospital Swamps. Operating the inlet and outlet structures and managing maintenance of existing structures and channels takes considerable staff time, although this is expected to be offset to a degree with installation of automated regular control at Reedy Lake. Installation was commenced in 2022 and is expected to be completed in early 2023.

At certain times, particularly during summer, the Barwon River can fluctuate around an approximate level of 0.7m AHD due to a combination of weir pool hydraulics and very low catchment inflows. Under this scenario it is impractical for staff to manipulate the inlet gates as it presents little to no benefit to the river or wetland. If levels vary at less than 0.2m above 0.7m AHD, Corangamite CMA will not open the inlet unless there is sustained flow in the Barwon River. This small-scale fluctuation does not represent natural seasonal flow changes and is often the result of weir pool hydraulics as opposed to catchment inflows in the lower to mid catchment.

Flood Mitigation Measures

2021-2022 and the first half of 2022-23 have been very wet. This has resulted in overbank flooding from the Barwon River into properties adjacent to the river above the tidal barrage. Measures to relieve such flooding have utilised sections of the inlet and outlet channels associated with Reedy Lake and Hospital Swamps. The use of the channels in this way to divert river water around the tidal barrage has constrained operational adjustments to optimise environmental watering.

The consequences are minor over the winter and spring periods and include Reedy Lake having a higher winter fill level than the nominal 0.8m AHD. At Hospital Swamps, the impact has been a reduction in connectivity through a closed inlet gate at the Sparrovale intersection.

This issue will be ongoing in wet years.

Table 13. Systemic delivery constraints for the Lower Barwon Wetlands

Site	Potential constraint	Impact on watering action	Works and measures to address?
Reedy Lake and Hospital Swamps	Water level in the lower Barwon River dips below 0.7m AHD	Cannot deliver water to wetland	n/a
	Summer flooding in Barwon River	Cannot deliver summer draw-down action.	n/a
	Use of Reedy Lake and its watering channels, and a section of the Hospital Swamps inlet channel as 'flood runners' in wet years	Reduced ability to optimise water levels (Reedy Lake and Hospital Swamps) and poor connectivity (Hospital Swamps).	Corangamite CMA has commissioned a review of recent catchment changes to determine if river hydrology has been affected. This work will inform future management.
Hospital Swamps	Inflows from new developments in Armstrong Creek area overwhelm the capacity of the outlet structure to drain wetland.	Cannot deliver summer draw-down action.	City of Greater Geelong have completed construction of the Southern Diversion Channel to divert flows from the new developments to the Sparrovale o Nubjitj yoorree wetland. Operating rules are currently being considered by City of Greater Geelong in consultation with CCMA to guide diversion.

8. Confounding factors

Other factors affecting or potentially affecting the environmental health of the Lower Barwon Wetlands include fish barriers, water quality impacts due to urban and peri-urban development and feral species. A summary of confounding factors is provided below in Table 14.

Table 14. Confounding factors at the Lower Barwon Wetlands

Confounding factor	Impact	Mitigation actions
Fish barrier at Reedy Lake inlet	Lack of fish habitat connectivity when closed.	Corangamite CMA's infrastructure team has applied for funding to provide fish passage in the next four years. Awaiting budget approval.
Fish barriers at Hospital Swamps inlets at three locations: 1. on the Barwon River 2. at the bottom of the barge hole 3. at the Sparrovale channel intersection	Lack of fish connectivity when inlets closed.	Gates are kept open as much as possible to enhance connectivity in line with this SWP. No funding is currently available to create fish passage at any location. Sparrovale intersection (CoGG owned): CoGG is planning to raise the Blind Channel weir and gate structure in Feb 2021, which will allow the Barwon River to connect through to Hospital Swamps more often.
Fish barrier at Hospital Swamps outlet (all the time)	Lack of fish habitat connectivity year-round. Even when the outlet is open, fish do not like to swim through dark pipes and the adjacent weir presents a further barrier.	Corangamite CMA's infrastructure team has applied for funding to provide fish passage in the next four years. Awaiting budget approval.
Feral species, notably carp and deer.	Carp create turbidity and undermine wetland banks through their feeding technique. They also outcompete native fish for habitat and resources. Feral deer can destroy native vegetation, cause erosion and turbidity and potentially spread weeds.	Wetting drying regime aims to control carp numbers Parks Victoria as the land manager in partnership with Corangamite CMA's Ramsar team conducts feral animal control measures.
Water quality (possible)	Deteriorating water quality may have an adverse impact on the wetland's ecosystems, but this	Corangamite CMA currently has a project underway to assess the potential impact of acid sulphate soils. Results to date indicate a low risk.

Confounding factor	Impact	Mitigation actions
	potential problem is undefined.	Corangamite CMA is also in ongoing discussions with CoGG regarding water quality issues that may be associated with urban run-off.

9. Increasing knowledge

Understanding knowledge gaps is an important part of managing risks associated with environmental water delivery. Recent studies undertaken for the Lower Barwon Wetlands that inform environmental watering management are outlined below and can be found on the CCMA e-library via our website. Current work includes spring/summer monitoring of breeding birds to inform adaptive management of draw-down. This information is presented under section 4. Seasonal review 2022-23. A list of referenced documents can be found in Appendix 2.

- **Water salt balance model for the Lower Barwon Wetlands. Summary report (Alluvium 2022)**

This report summarises the scope and processes undertaken to develop a Water Salt Balance Model for the Lower Barwon Wetlands in Source, as well as the results of scenario runs and high level interpretation for various key indicator species. The project also delivered the Source model files themselves which will be used to inform the next FLOWS study update in 2025.

- **Wetland monitoring and assessment program for environmental water: Stage 3 final report. Arthur Rylah Institute for Environmental Research Technical Report Series No. 322.**

This document reports on the vegetation changes that have been recorded at Reedy Lake through the WetMAP program Stage 3 from 2016-2020. Examples include improvement in recruitment of coastal salt marsh species and brackish herbs.

- **Lower Barwon Review 2020 - Issues and advice paper (Sherwood et al., 2020)**

The Lower Barwon Review 2020 has identified key knowledge gaps for further investigation, which are outlined in 8.3.

- **Flow ecology assessment (Lloyd et al., 2012)**

Recommended major change to past management (wet): Short Term – dry every year for 10 years. Long term – dry one in four years, low water levels two in four years (Flow ecology). Provided a detailed understanding of the watering requirements for Reedy Lake.

- **Hospital Swamps water regime advice (Lloyd L, January 2013).**

[Lloyd Environmental Pty Ltd memo to Corangamite CMA.] Additional advice to the Flow Ecology Assessment (Lloyd et al., 2012) relating to connectivity and salinity at Hospital Swamps.

- **Mobilising contaminants at Reedy Lake (Alluvium, 2013a).**

Desktop review of the risks of contaminant release. Supported that drying one in four years is appropriate. Recommended further contaminant investigation.

- **Investigation of alternative options to control tall reeds at Reedy Lake (Alluvium 2013b).**

Tall reed monitoring: identified that the constant wet state of the system is increasing tall reeds at exponential rate, currently at 200% above Ramsar guidelines. Explored alternative management approaches to manage the threats to the site.

- **Reedy Lake vegetation monitoring (Ecological Associates, 2014).**

Investigation of alternative options to manage Phragmites/Typha. Identified that a one in four-year drying regime is the best way to manage tall reeds, combined with tidal flushing to manage water levels and quality.

- **Lower Barwon Wetlands connectivity (Water Technology, 2014).**

Investigation of structure upgrades that will improve fish and eel connectivity and ecosystem function. Confirmed the ability to tidal flush Reedy Lake. Set a detailed baseline to monitor future ecological change. Identified habitat connectivity at the Lower Barwon Wetlands and priority watering structure upgrades to facilitate fish movement.

- **Reedy Lake contaminants measurement and assessment (GHD, 2015).**

Study implemented to fill knowledge gap. Study determined the risk of implementing a drying event is manageable if drying occurs to > 0 AHD. Drying at levels < 0 AHD present a risk of an acid event occurring.

- **Reedy Lake environmental flow & monitoring restoration project – Integrated monitoring report (GHD, 2017).**

A baseline study of surface water, sediment and groundwater quality, fish, birds, amphibians and vegetation. Additional advice was sought on ecological impact to vegetation communities (in raising water levels above current full level of 0.8m AHD (GHD 2017), recommending against raising the level due to risks of *Phragmites* and water button weed increase and decreases in coastal saltmarsh and submerged aquatic plants.

The advice on the impact to Growling grass frogs of drying regime (GHD 2018) indicated that the frogs will respond to the drying regime by moving into the deeper more permanent areas of the lake as it dried.

The advice on arsenic and copper (Reedy Lake water quality results, GHD 2018) stated that because concentrations (found in earlier work) are only slightly elevated above the guideline (for further investigation), it is highly unlikely there are any detectable impacts. In addition, the comprehensive Reedy Lake Integrated monitoring program did not identify impacts of any nature relating to metals or any other toxicants.

The Lower Barwon Review (Sherwood et.al., 2020) identified a number of knowledge gaps, including the lack of monitoring listed just above. These gaps include the critical need for a water-salt balance model and aerial imagery analysis to inform progress towards the agreed watering objective and Ramsar compliance, and to enable an informed update of the FLOWS study. The Water Salt Balance Model for Lower Barwon Wetlands was completed in 2022, and an aerial imagery analysis project is underway. An update of the FLOWS study is an action within the Central and Gippsland Region Sustainable Water Strategy (DELWP, 2022) but is currently unfunded.

Key knowledge gaps identified in recent years, and particularly in light of the Lower Barwon Review (Sherwood et al., 2020) are presented below in Table 15.

Table 15. Knowledge gaps in managing the Lower Barwon Wetlands

Knowledge gaps and project recommendation	Status
<p>Wadawurrung cultural value mapping and assessment.</p>	<p>Partially completed</p> <p>Cultural values common to all Wadawurrung Country have been referenced from work on the Barwon River system, but this work needs ground truthing and refinement to the wetland setting.</p> <p>No resources are currently available for a specific project to complete this work, but Wadawurrung Traditional Owners have released their <i>Paleert Tjaara Dja</i> - let's make Country good together 2020-2030 - Wadawurrung Country Plan (2020) which identifies wetlands as a key value. Corangamite CMA and Wadawurrung Traditional Owners meet fortnightly to share knowledge.</p>

Knowledge gaps and project recommendation	Status
<p>Potential for low pH and release of metals as a result of acid sulphate soil activation.</p> <p>Corangamite CMA undertook water and sediment monitoring in 2018-2019 to assess if the recently reinstated wetting and drying regime at Reedy Lake was resulting in activation of acid sulphate soils in the deeper sections of the lake. This work was repeated in the 2020-21 water year.</p>	<p>Partially completed</p> <p>Interim findings revealed:</p> <ul style="list-style-type: none"> • Measurements of pH in water and sediment were neutral or slightly alkaline and there was no evidence of pH levels being influenced by geochemical processes such as activation of acid sulphate soils. • Metals in sediments below guideline values are not considered to pose a risk to environmental and community values. • Measurements of metals in water were variable with chromium, cobalt, copper, manganese, nickel, vanadium, zinc and arsenic in some cases above guideline values. Variable exceedances of metals are not uncommon in modified environments with catchment inputs from urban areas and are considered low risk. • 2018/2019 monitoring results are similar to results from previous monitoring in 2016/2017. Previous analysis of sediments in 2014 also identified there was very low potential for leaching of metals from sediments into water as a result of implementing a drying regime. <p>Final rounds of sampling and analysis to be conducted following next draw-down event.</p>
<p>Water and salt balance model that will need to consider (recommendation of Lower Barwon Review (Sherwood et.al., 2020)):</p> <ul style="list-style-type: none"> • Reedy Lake, Hospital Swamps, Lake Connewarre and Sparrovale – Nubjitj yoorree • Surface water and groundwater interactions • A range of hydrologic conditions including drought years, average years and wet years • Future stormwater runoff from the Armstrong Creek development • Climate change scenarios. 	<p>Completed</p> <p>The Water Salt Balance Model was completed in 2022.</p> <p>This work is critical to inform the next FLOWS study update in 2025.</p>
<p>Aerial imagery analysis of the wetlands to determine if the encroachment of undesirable taxa of tall reeds (especially <i>Phragmites australis</i> and <i>Typha spp.</i>) is a problem that management actions should focus on (recommendation of Lower Barwon Review (Sherwood et.al., 2020))</p>	<p>Partially Completed</p> <p>Funding to do some focused work in this area has been received through the Ramsar program. The project is anticipated to commence in 2022-23.</p> <p>Corangamite CMA is also exploring imagery analysis capability within the organisation to determine if vegetation can be mapped looking back in time, and into the future. This would allow a better</p>

Knowledge gaps and project recommendation	Status
	understanding of changes in vegetation distribution historically, and allow some tracking of environmental watering outcomes going forward.
Carp and native fish population monitoring to inform management trigger (recommendation of Lower Barwon Review (Sherwood et.al., 2020))	There is currently no funding available for this work. Advice is currently being sought as to likely effectiveness of the carp screens on Reedy Lake inlet in light of the constant cleaning required to prevent flow reduction.
Monitoring of colonial bird nesting and potentially breeding Australasian bitterns to inform timing of annual draw-down (recommendation of Lower Barwon Review (Sherwood et.al., 2020))	Completed and ongoing. Undertaken in 2020-21, 2021-22, 2022-23 Monitoring for the presence and breeding stages of colonial nesters and the endangered bittern is being conducted through the spring/summer period in order to inform draw-down timing. The Ramsar team at Corangamite CMA is also supporting Geelong Field Naturalists to undertake population monitoring of water bird breeding colonies via drone. 2020 and 2021 surveys will serve as a baseline for future surveys.
Broader ecological monitoring (recommendation of Lower Barwon Review (Sherwood et.al., 2020)) Responses of vegetation, fish and waterbirds to the summer-full water regime applied in the fourth and final year of the current trial and implementation of a targeted monitoring regime to address key monitoring questions. The full year of the current four-year trial has passed, but Corangamite CMA would like to investigate opportunities to monitor bird and fish populations, connectivity and breeding in an ongoing way, to: <ul style="list-style-type: none"> • Better inform adaptive management of the watering regime. • Ground-truth the anticipated effects of the watering regime on species of interest in the wetlands and demonstrate outcomes. • Facilitate communication with interested community groups. 	There is currently no funding available for this work

10. Risk management

A risk assessment has been undertaken for the 2023-24 season, in line with the Victorian Environmental Water Holder (VEWH), *Victorian Environmental Watering Program, Risk Management Framework (2021)*. Appendix 4 presents the VEWH Risk Matrix used for the Risk Assessment. The risk assessment was undertaken with members from Barwon Water (BW), the VEWH, Parks Victoria and Corangamite CMA present.

This assessment identifies the risks associated with delivering water for the priority actions. Mitigation actions to reduce risks have been identified and should be undertaken as part of the release plan.

An overview of the risk assessment and management for the current plan with potential risk mitigation measures and associated residual risk assessment is outlined below in Table 16.

Table 16. Risk assessment for the Lower Barwon Wetlands environmental watering 2023-24

Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
CEBA2020-01	Environment	Ongoing implementation of low water regime for Reedy Lake is unable to be continued due to lack of stakeholder support leading to sub-optimal environmental outcomes.	<ul style="list-style-type: none"> - Continue to engage with the local community to build understanding and support. - Continue engagement with the eel fishery representatives in relation to the environmental watering regime. - Consult with Field & Game to flag potential dry seasonal conditions issues. - residual risk based on 22-23 environmental conditions 	CCMA	Unlikely	Minor	Low	Static
CEBA2020-02	Reputational	Inability to demonstrate outcomes from low water regime at Reedy Lake leading to a lack of public support for activities.	<ul style="list-style-type: none"> - Plan and implement monitoring program when drying regime is implemented, when funding available. - Communicate results of monitoring (including WetMAP) to community and stakeholders. 	CCMA	Unlikely	Minor	Low	Static
CEBA2020-03	Environment	Asset failure (including inability to operate unsafe structures) prevents implementation of planned environmental water management actions at the target site.	<ul style="list-style-type: none"> - Carryout pre-delivery inspection of structures and undertake annual maintenance actions. - Implement funded infrastructure upgrades on outlet structures, and continue 	CCMA	Unlikely	Minor	Low	Dynamic

Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
			to seek funding for automation and inlet structure upgrades (partly completed, Hospital Swamps structures not yet addressed and are continuing to decline). Note: Check indicates CCMA is asset owner at Hospital Swamp, however PV to offer support for funding applications as land manager - residual risk based on 22-23 environmental conditions					
CEBA2020-04	Environment	Unauthorised interference with structures may result in an inability to achieve planned watering actions, leading to a failure to achieve environmental objectives.	- Ensure structures are locked and monitor structure regularly to minimise likelihood of interference. - residual risk based on 22-23 environmental conditions	CCMA	Unlikely	Minor	Low	Dynamic
CEBA2020-05	Environment	Deteriorated conditions of access tracks prevents CMA safely accessing Reedy Lake and Hospital Swamps regulators, which results in an inability to operate these structures to deliver environmental water to the sites.	- CMA undertake annual track maintenance activities (note this is on behalf of PV) in a timely manner to allow safe access. - Installation of remote activation of Reedy Lake regulators to reduce need to traverse access tracks (in progress, completion expected in 2022-23 year)	CCMA	Unlikely	Minor	Low	Dynamic

Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
CEBA2021-06	Safety	Undertaking operational activities during duck hunting season (or during deer culling) creates safety risks for staff	<p>Deer culling</p> <ul style="list-style-type: none"> - Do not enter the site during deer culling activities - Ensure good communications between PV and CCMA <p>Duck Season</p> <ul style="list-style-type: none"> - Only visit the wetlands to undertake critical tasks during duck season. If undertaking critical tasks only visit the site in daylight hours, between dawn and dusk. - Pursue remote activation of structures to reduce need for staff site visits - Wear hi vis clothing while on site. - If an active hunter is seen, leave the area immediately - Follow CMA safe work procedures <p>Note: updated mitigations and residual risk rating developed by VEWH and CCMA following 2023 w'shop</p>	CCMA	Unlikely	Major	Low	Static
CEBA2020-07	Safety	Drying regime and lower water levels in wetlands (in combination with extensive reed growth),	- Undertake frequent communications and engagement with local duck hunting groups via Parks Vic	CCMA	Unlikely	Minor	Low	Dynamic

Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
		may lead to access issues and inconvenience for duck hunters wading at these sites under changed conditions.	networks to inform them about water level changes.					
CEBA2020-08	Reputational	Inability to demonstrate outcomes achieved through environmental watering activities may lead to a loss of public/political support for activities	<ul style="list-style-type: none"> - Maintain strong communications with key local stakeholders, including via social media. - Include Lower Barwon Community Advisory Committee in development of seasonal watering proposals. - Communicate findings from WetMAP monitoring at Reedy Lake to the local community - Communicate benefits of environmental watering to the broader community. 	CCMA VEWH	Unlikely	Moderate	Low	Static
CEBA2020-09	Cultural Heritage	"Inability to incorporate Wadawurrung inputs and knowledge into planning may lead to a failure to address T.O. values or damage heritage/artifacts and may impact on values or heritage Note: This risk assessment needs to be tested with T.O.s"	<ul style="list-style-type: none"> - Establish meaningful partnership arrangements with Wadawurrung people, leading to ongoing inclusion of T.O. values into watering proposals - Continue to partner and share knowledge with T.O.s to build capacity to actively engage in water related issues 	CCMA	Unlikely	Minor	Low	Static

Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
CEBA2020-10	Environment	Insufficient staff resources available to deliver all planned environmental watering actions, results in impacts on the environment	<ul style="list-style-type: none"> - Continue to actively prioritise actions and ensure key actions are delivered. - Seek funding for remote actuation of relevant structures to reduce the need for staff visitation. - residual risk based on 22-23 environmental conditions 	CCMA	Unlikely	Minor	Low	Static
CEBA2020-11	Environment	Environmental deliveries create improved conditions for pest plant and animal species (e.g. carp, tall reeds) leading to adverse environmental impacts.	<ul style="list-style-type: none"> - Manage water regimes in wetlands to control pest plant and animal species. 	CCMA	Unlikely	Minor	Low	Static
CEBA2020-12	Reputational	Community concern over adverse environmental outcomes (e.g. ibis chick deaths, fish deaths) lead to a loss of support for watering actions	<ul style="list-style-type: none"> - Undertake targeted communications to alert the community of possible risks as the season unfolds. - Engage the community in relation to dry conditions and possible environmental consequences, given the limited volumes of environmental water available, and deliver the message that rainfall will be the key driver of water availability for the environment. 	CCMA	Unlikely	Moderate	Low	Static

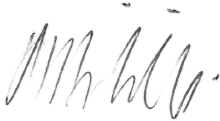
Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
			- Use bird breeding monitoring data to inform drawdown planning					
CEBA2021-13	Environment	Rainfall runoff and storm water from urban development prevents implementation of wetland drying regimes, adversely impacting on environmental watering outcomes.	<ul style="list-style-type: none"> - Continue to support City of Geelong to implement drainage diversion works (Southern diversion channel completed, operating rules being developed). - Encourage City of Geelong to undertake regular maintenance of structures on diversion drains and follows agreed operation rules. <p>Note: Effectiveness of diversion channels is being monitored</p>	CCMA	Possible	Moderate	Medium	Dynamic
CEBA2020-14	Reputational	Heavy rainfall following environmental deliveries may lead to unintended inundation of private land adjacent to Hospital Swamp resulting in impacts on landowner activities and assets.	<ul style="list-style-type: none"> -Ongoing communication of delivery plans to landholders. -Encourage City of Geelong to undertake regular maintenance of structures on diversion drains and follow agreed operation rules. <p>Note: Hospital Swamp overfills often in wet conditions and mitigations can only reduce but not eliminate the risk. residual risk consequence</p>	CCMA	Possible	Minor	Low	Static

Risk ID	Risk Category	Risk Description	Mitigation Actions	Lead Organisation	Likelihood	Residual Risk Consequence	Risk Rating	Risk Type
			based on lower impact due to partial control via diversion					
CEBA2021-28	Safety	Negative community sentiment in relation to government decisions/actions creates a safety risk for staff involved in environmental watering actions	<ul style="list-style-type: none"> - ensure staff are alerted to warnings about violent members of public (and intelligence is shared between partner organisations) - 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	Unlikely	Moderate	Low	Dynamic

11. Approval and endorsement

I, John Riddiford, the authorised representative of the agency shown below, approve the Interim Lower Barwon Wetlands Seasonal Watering Proposal for 2023-24.

SIGNED FOR AND ON BEHALF OF Corangamite Catchment Management Authority



Signature of authorised representative

John Riddiford

Name of authorised representative

14/04/2023

Appendix 1. Abbreviations

AHD	Australian Height Datum
CMA	Catchment Management Authority
CoGG	City of Greater Geelong
DELWP	Department of Environment Land Water and Planning
DEECA	Department of Energy Environment & Climate Action (formally DELWP)
DO	Dissolved Oxygen
EC	Electrical Conductivity
EPBC Act	Environmental Protection and Biodiversity Conservation Act
EVC	Ecological Vegetation Class
LBCAC	Lower Barwon Community Advisory Committee
PWA	Potential Watering Action
SWP	Seasonal Watering Proposal
VEWH	Victorian Environmental Water Holder
VEFMAP	Victorian Environmental Flows Monitoring and Assessment Program
WTOAC	Wadawurrung Traditional Owner Aboriginal Corporation
WetMAP	Wetlands Monitoring and Assessment Program
WMIS	Water Measurement Information System (DEECA)

Appendix 2. References

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Appendix 3. IAP2 spectrum of public participation

INCREASING IMPACT ON THE DECISION 					
	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

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Figure 20. IAP2 spectrum of public participation.

Appendix 4. VEWH risk matrix, likelihood & consequence tables

Table 17. VEWH risk rating matrix.

Likelihood		Consequence			
		Minor	Moderate	Major	Extreme
		1	2	3	4
Almost certain	4	Medium (4)	High (8)	Extreme (12)	Extreme (16)
Likely	3	Low (3)	Medium (6)	High (9)	Extreme (12)
Possible	2	Low (2)	Medium (4)	Medium (6)	High (8)
Unlikely	1	Low (1)	Low (2)	Low (3)	Medium (4)

Table 18. VEWH risk likelihood table.

Likelihood		Description	% Probability
4	Almost certain	<ul style="list-style-type: none"> The event is expected to occur in most circumstances and/or Risk will occur within the next 6 months/or several times a year and/or Controls associated with the risk are extremely weak and/or non-existent and without control improvement the risk will eventuate. 	75-100
3	Likely	<ul style="list-style-type: none"> The event is likely to occur in most circumstances and/or Risk will occur in the next 12 months/or once or twice a year and/or The majority of the controls associated with the risk are weak and without control improvement it is likely the risk will eventuate. 	50-74
2	Possible	<ul style="list-style-type: none"> The event might occur and/or Risk will occur in the next 24 months/or once in two years and/or Some controls need improvement and if there is no improvement it is possible the risk will eventuate. 	25-49
1	Unlikely	<ul style="list-style-type: none"> The event could occur at some time and/or Risk will occur in the next 60 months/or once in five years and/or Controls environment is strong with few control gaps and requires assurance check to maintain control effectiveness. 	0-24

Table 19. VEWH risk consequence table (harm)*.

Rating	Environment	Business Costs	People		Political/ Reputational	Legal and Compliance	Service Delivery	Cultural Heritage ¹	
			Safety and Well-being	People and Culture					
Minor	1	<ul style="list-style-type: none"> Limited effect on the natural and/or built environment and/or the environment suffers harm for up to 5 years. Environmental recovery on a minor scale up to 5 years. Mostly impacts environmental values at a single location in an individual system. 	<ul style="list-style-type: none"> Cost impact on total budget of up to 5%. 	<ul style="list-style-type: none"> Minor injuries or illness (physical/mental) requiring first aid or medical attention of staff, visitor, contractor, or member of the public. 	<ul style="list-style-type: none"> Staff complaints, passively upset, and uncooperative. 10-15% staff turnover with minor loss of skills, knowledge, and expertise. 	<ul style="list-style-type: none"> Adverse localised public and political interest. Limited attention on a single issue in local media over a short period. 	<ul style="list-style-type: none"> Non-compliance with legislation or breach of duty of care, identified externally and either: <ul style="list-style-type: none"> resolved internally with no further escalation; or resulting in minor compensation, and/or negative precedent. 	<ul style="list-style-type: none"> Minor short-term impact on business unit's delivery of services/functions. Customers/stakeholders/ communities slightly inconvenienced. Up to 1 day impact on business unit's critical activities. Minor impact (up to 10% delay) on project or program milestones. 	<ul style="list-style-type: none"> Limited potential impact on heritage sites/artefacts Exposure of previously unknown cultural heritage items
Moderate	2	<ul style="list-style-type: none"> Moderate effect on the natural and/or built environment and/or environment suffers harm for 5-10 years. Environmental recovery on a small scale and/or over a period 5-10 years. Impacts environmental values at multiple locations in an individual system. 	<ul style="list-style-type: none"> Cost impact on total budget between 5-10%. 	<ul style="list-style-type: none"> Significant injury or illness (physical/mental) requiring in-patient hospitalisation of staff member, visitor, contractor, or member of the public. 	<ul style="list-style-type: none"> Low morale, disengagement, increased absenteeism, and workplace conflict. 15-25% staff turnover with loss with resignations of some key staff. 	<ul style="list-style-type: none"> Adverse localised negative public and political attention. Short term negative local media attention. Local community concern on a single issue over a sustained period. 	<ul style="list-style-type: none"> Non-compliance with legislation or breach of duty of care resulting in: <ul style="list-style-type: none"> external investigation or report to responsible authority; and/or prosecution or civil action, with one of moderate level of compensation or moderate level of negative precedent. 	<ul style="list-style-type: none"> Moderate impact on business unit's delivery of services/functions. Customers/stakeholders/ communities inconvenienced. Up to 3 days impact on business unit's critical activities. Significant impact (10-20% delay) on project or program milestones. 	<ul style="list-style-type: none"> Moderate potential impact on heritage sites/artefacts Damage to previously unknown cultural heritage items or values
Major	3	<ul style="list-style-type: none"> Major effect on the natural and/or built environment and/or environment suffers harm for 10-20 years. Environmental recovery on a large scale and/or over a period of 10-20 years. Impacts regional environmental values or affects connected systems. 	<ul style="list-style-type: none"> Cost impact on total budget between 10-20%. 	<ul style="list-style-type: none"> Extensive and/or permanent injury or illness (physical/mental) of staff member, visitor, contractor, or member of the public. 	<ul style="list-style-type: none"> Major morale issues, high absenteeism. 25-50% staff turnover with resignations of key staff. Staff are not skilled to meet priorities. 	<ul style="list-style-type: none"> Serious adverse public attention at State/National level. Negative State/National media on one or more issues over a prolonged period. Repeated displeasure by the Minister. Medium-term negative public interest (correspondence and phone calls) and political interest (in Parliament). 	<ul style="list-style-type: none"> Non-compliance with legislation or breach of duty of care resulting in: <ul style="list-style-type: none"> external investigation or report to responsible authority; public inquiry (i.e. Royal Commission/ Parliamentary Committee); prosecution or civil action with high level compensation and high-level negative precedent; and/or sanctions imposed by external regulator. 	<ul style="list-style-type: none"> Ongoing difficulties in delivering the business unit's services/functions. Major impact on customers/ stakeholders/ communities Up to 10 days impact on business unit's critical activities Major impact (20-50% delay) on project or program milestones 	<ul style="list-style-type: none"> Major potential impact on heritage sites/artefacts Damage to known cultural heritage items or values
Extreme	4	<ul style="list-style-type: none"> Very serious effect on the natural and/or built environment and/or environment suffers long term harm (20+ years). Environmental recovery on a very large scale and/or over a long period (20+ years). Impacts environmental values statewide. 	<ul style="list-style-type: none"> Cost impact on total budget >20%. 	<ul style="list-style-type: none"> Single or multiple deaths or severe permanent disability or illness (physical/mental) of staff, visitor, contractor, or member of the public. 	<ul style="list-style-type: none"> Organisation wide morale issues and absenteeism. >50% staff turnover. Staff are not skilled to meet core corporate outputs. 	<ul style="list-style-type: none"> Very serious public outcry at State/National level. Negative State/National media over a prolonged period. Breakdown of public confidence in the Government / department / Minister or key project/program. On-going or prolonged negative public interest (correspondence and phone calls) and political interest (in Parliament). 	<ul style="list-style-type: none"> Non-compliance with legislation or breach of duty of care resulting in: <ul style="list-style-type: none"> prosecution or civil action leading to imprisonment of an officer; public inquiry (i.e. Royal Commission/ Parliamentary Committee) uninsured compensation payments negative precedent requiring very serious impact and major reform to the department; and/or severe sanctions imposed by external regulator. 	<ul style="list-style-type: none"> Long term and severe impact on delivery of services/functions Severe impact on customers /stakeholders/communities More than 10 days impact on business unit's critical activities Vital or very serious delays (>50% delay) to program/project delivery or project/program objective is not met 	<ul style="list-style-type: none"> Very serious potential impact on heritage sites/artefacts Destruction of cultural heritage items or values

* In assessing risks in this category, consideration will need to be given to actions that have been approved through a Cultural Heritage Management Plan (CHMP) and how this fit with the legislation. Impact of actions authorised by Traditional Owners under a CHMP will have a much lower rating compared with unauthorised impacts – which may immediately meet the 'extreme' category. This method will require documentation.

Appendix 5. Wadawurrung Traditional Owners – letter of endorsement



Office 3, 110 Creswick Road
Ballarat Central, VIC 3350
Australia
P (03) 4308 0420
F (03) 4308 0421

March 2023

Attn: Sharon Blum-Caon (via email)

RE: Lower Barwon Wetlands Seasonal Watering Proposal

Dear Sharon,

Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC) is a Registered Aboriginal Party (RAP) under the Aboriginal Heritage Act 2006 (Vic) and was established in 1998. WTOAC is governed by a Board of Directors of Wadawurrung Traditional Owners. Each director represents a family group of the Wadawurrung People.

The role of the Corporation is to protect and advance the aspirations of Wadawurrung People by managing their cultural heritage rights and interests while providing a representative voice for Traditional Owners in relation to the management of Wadawurrung Country.

I am pleased to advise that Wadawurrung Traditional Owners Aboriginal Corporation support the Corangamite Catchment Management Authority's Seasonal Watering Proposal for the Lower Barwon wetlands system and the potential watering actions 2023-24.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Paul Davis', written in a cursive style.

Paul Davis

CEO

Ph: 0417 593 000

E: paul@wadawurrung.org.au

Appendix 6. Parks Victoria – letter of support

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Parks Victoria
Tenancy 5 Building 6
Wharf Street East
QUEENSLIFF VIC 3225

Telephone 13 19 63
parks.vic.gov.au
ABN 95 337 637 697

3 April 2023

Sharon Blum-Caon
Senior Project Officer – Estuaries and Environmental Water
Corangamite Catchment Management Authority
64 Dennis Street
PO Box 159
COLAC VIC 3250

Dear Sharon,

Letter of support for the 2023-24 Corangamite Catchment Management Authority Seasonal Watering Proposal

Parks Victoria has reviewed the seasonal watering proposals for the Lower Barwon Wetlands. We support submission of this watering proposal to the Victorian Environmental Water Holder subject to consideration of the matters below.

Prior to implementing any of the four proposed watering actions on Parks Victoria estate, at Reedy Lake and Hospital Swamps, we advise the Corangamite Catchment Management Authority (CMA) should:

- Assess whether on-ground works are required to facilitate the delivery and seek advice to determine what approvals are required by Parks Victoria. This advice should be sought early to ensure approvals can be processed in a timely manner.
- Advise local Parks Victoria staff (cc Kathryn Stanislawski) regarding the proposed opening and closing of the water regulating structures.
- Provide notice (28 days) where Parks Victoria is required to operate delivery infrastructure so we can schedule these actions, ensure resources are available, and safety requirements can be satisfied.

As Land Manager, Parks Victoria has co-responsibilities for mitigating risks at this site. To assist us in managing these risks (Risk ID CEBA2 020-03 and CEBA2 020-04, found in Appendix 4), could you please ensure sufficient lead time is provided for planning and resourcing purposes. Parks Victoria continues to seek better ways to respond to environmental watering risks and to pursue opportunities that improve our capacity, as an active partner in Environmental Watering activities. In addition, Parks Victoria is aware that community engagement is a shared responsibility with the Corangamite CMA regarding Environmental Water and its impacts on flow regime and ecological processes. As such, Parks Victoria seeks to strengthen our partnership with the Corangamite CMA, by developing appropriate and shared communications messages that closely align between the two agencies during managed watering activities. For example, information signage or targeted social media alerts that inform the community about the importance of environmental watering.



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Parks Victoria is committed to working with the Wadawurrung Traditional Owners Aboriginal Corporation to protect cultural values and landscapes. We encourage you to continue to engage with the relevant groups and individuals in the upcoming planning and delivery stages of the proposed watering actions, and to involve us in these interactions.

The key contacts for consultation regarding local matters are:

Jodi Heath

District Manager | Western Basalt District

T (03) 8427 3882

Jodi.Heath@parks.vic.gov.au

Stuart Lardner

Area Chief Ranger | Geelong

T (03) 8427 3479

stuart.lardner@parks.vic.gov.au

For broader environmental water-based queries or issues across Parks Victoria estate please consult with:

Kathryn Stanislawski

Program Leader – Ecological Water

T (03) 8427 3201

M 0488021692

Yours sincerely



Jodi Heath

A/Regional Director | Western Victoria
Parks Victoria



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