



Lower Barwon Wetlands Seasonal Watering Proposal 2022-23

FINAL April 2022



*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, Traditional Owners of the land of the 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 2022-23, 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 2020-21.

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 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 year, 2021-22 has been a wet year, with birds breeding at Reedy Lake, and a full wetland was largely maintained over summer. Draw-down commenced during the first week of March, following receipt of bird advice. This fits with the seasonally adaptive approach. At Hospital Swamps, no active draw-down was undertaken. However, with the inlet closed for flood mitigation, and the outlet closed to slow evaporative loss while bittern monitoring was underway, water levels continued to drop through evaporation and the 2021-22 summer draw down was achieved in February. Monitoring of bird breeding continued through this time and verbal advice was received that the rate of evaporative drop was not a threat to breeding activity.

Once again for 2022-23 a seasonally adaptive approach, in line with the long-term Lloyd recommendations, will be taken. Watering actions for 2022-23 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 2022-23: 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
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.	from December to May (as informed by bird monitoring if available)
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
Draw down to summer low – gradually reduce water levels to approximately 0.1m-0.3m. Topping up or drawing down as required to maintain 0.1-0.3m.	from December to May (as informed by bird monitoring if available)

A risk assessment was undertaken for the 2022-23 season, and the results are presented in section 10. Two high risks were identified for the 2022-23 water year. These are;

1. 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. This will be mitigated through VEWH funded maintenance works each year.
2. Rainfall runoff and storm water from urban development prevents implementation of wetland drying regimes, adversely impacting on environmental watering outcomes. This risk can only be mitigated in the longer term through the Southern Diversion Channel coming on line to Sparrovale Wetlands.

Only the latter risk remained high, following mitigation actions.

1. Introduction

This SWP outlines Corangamite CMA's proposed priorities for the use of environmental water in the Lower Barwon Wetland system in 2022-23, as required under section 192A of the *Water Act 1989*. The VEWH will use the SWP to inform the development of the Seasonal Watering Plan 2022-23. The SWP also meets objectives identified in the *Corangamite Waterway Strategy 2014-2022* (Corangamite CMA, 2014) 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 (Figure 1 and Figure 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 and 2022.

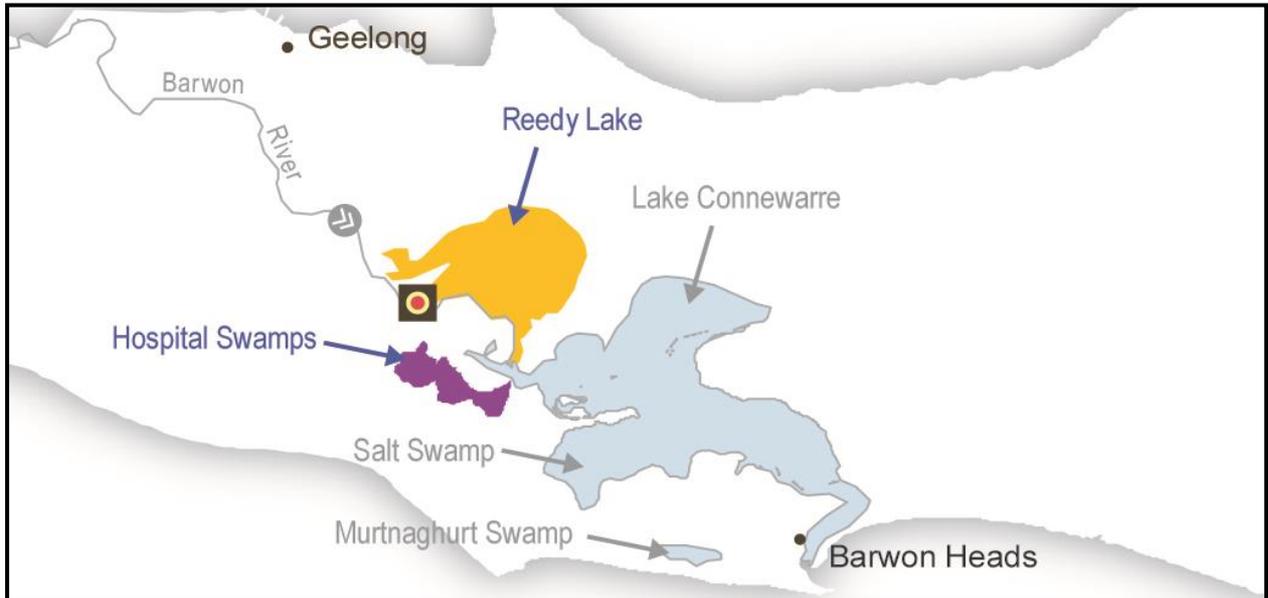


Figure 1. Lower Barwon Wetlands

The Lower Barwon Wetlands are a culturally significant area for Wadawurrung Traditional Owners. 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 also 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 Connewarre 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 also 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 full level all 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 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 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 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.

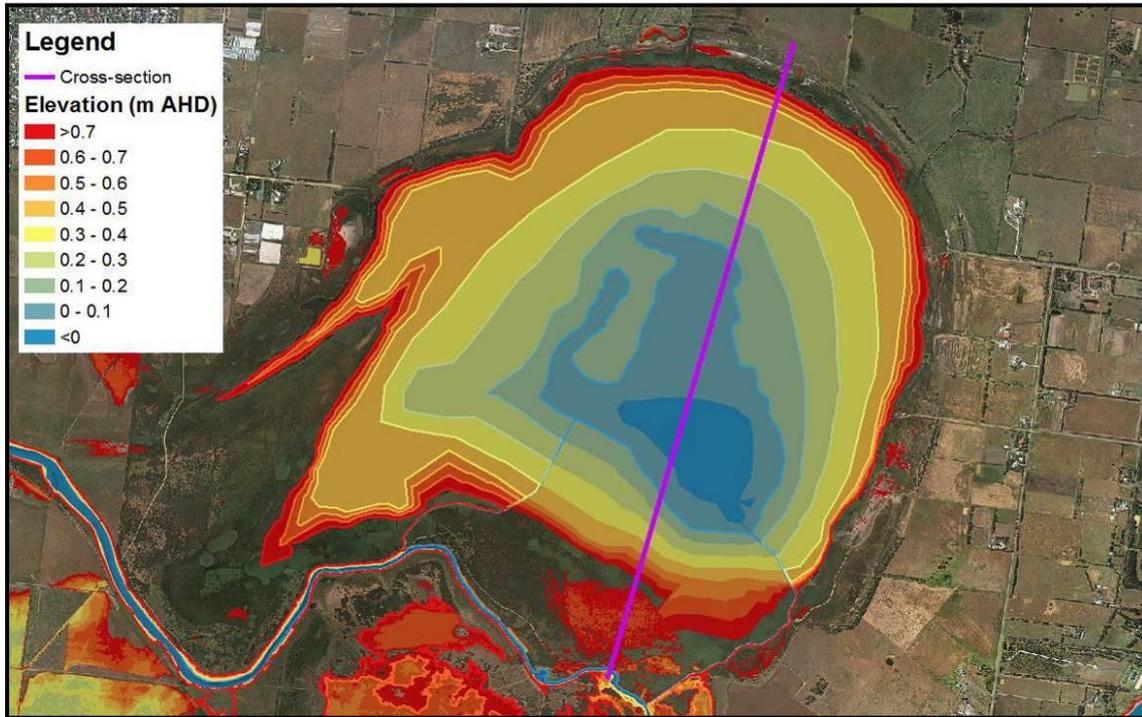


Figure 3. Bathymetry mapping of Reedy Lake, showing water extent at various levels



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

The currently recommended wetting and 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) recommends 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 recommends 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 plans to divert existing and future increased stormwater flow into the new Sparrovale Nature Reserve, as pictured below in Figure 6. The 500-hectare parcel of land was acquired by CoGG in 2019 for this purpose.



Figure 6. Sparrovale Nature Reserve, south-east of Geelong

The diverse natural and constructed wetlands will occupy about 200 hectares of the property, 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. Work has commenced on preparing the Sparrovale Nature Reserve to receive storm water, but it is yet to be fully connected to the developments through a diversion channel.

Corangamite CMA and CoGG will continue to work together on managing stormwater on wetlands 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 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 as an advisory committee providing 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 that has 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), and the anticipated review of FLOWS recommendations in 2022 (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 2021-22

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
Government agencies	Department of Environment Land Water and Planning 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 Geelong Field Naturalists Club EstuaryWatch	Involve	Representation on LBCAC Meeting <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. 	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.

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
			<ul style="list-style-type: none"> • 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"> • 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>
Traditional Owners	Wadawurrung Traditional Owners Aboriginal Corporation (Wadawurrung)	Collaborate	<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. • Provide an opportunity for individuals, agencies and groups to contribute to the proposed watering actions and intended outcomes. • Identify opportunities to achieve shared benefits.

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
Recreational users	Field and Game Australia (Geelong branch) Geelong Gun and Rod Association Inc. Geelong and District Angling Clubs 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. Attendance at Community forums. Direct engagement (one on one)	Specific focus on supporting Traditional Owner values through SWP. 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. Specific focus on recreational interests
Landholders/Farmers	Individual landholders Commercial eel fishers	Involve	Membership of 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. Attendance at Community forums.	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.

Who	Stakeholders	IAP2 level	Engagement Method	Engagement Purpose
			Direct engagement (one on one)	<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 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>Direct engagement (one on one) Corangamite CMA involvement on linked or related CoGG projects</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. • 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. Parks Victoria have also provided verbal support (per comms. S. Lardner 28.3.22).

Osseels expressed concern over the level of low water targeted via draw down at both wetlands, particularly under hot conditions and the related use of tidal topping up at Reedy Lake when necessary. They also had concerns regarding potential misinterpretation of the agreed watering objective and the use of the term pre-European conditions. This term has been removed to improve clarity.

Geelong Gun and Rod do not support the Lower Barwon Wetlands Seasonal Watering Proposal, with the majority of feedback relating to the Water Salt Balance Model project.

Detail of the comments received (other than letters of support) and Corangamite CMA responses are provided to the LBCAC via the Lower Barwon Wetlands Seasonal Watering Proposal 2022-23. Other individuals or organisations can contact Corangamite CMA at info@ccma.vic.gov.au to request a copy of the Lower Barwon Wetlands SWP 2022-23 Comments Register.

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

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. The Wadawurrung Traditional Owners 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 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
- Include 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. Wadawurrung Traditional Owners have reviewed, edited and approved relevant section content in this SWP, and are also part of the 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 2022-23

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	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	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>target, and generations of duck hunters have enjoyed duck hunting season at the Lower Barwon Wetlands, particularly Reedy Lake, returning to the same hide locations over many years.</p>	<p>Game Management Authority.</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).</p> <p>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</p>

Lower Barwon Wetlands Seasonal Watering Proposal 2022-23

Waterway	Beneficiary	Connection to the wetlands	Values / uses / objectives / opportunities	How have these benefits been considered?
				efficient and effective water delivery which can be utilised by other recreational and commercial stakeholders for their desired purposes.

4. Seasonal review 2021-22

4.1 Climate

The year 2021 was the coolest year since 2012, but still the 19th warmest year on record with the national mean temperature at 0.56°C warmer than the 1961-1990 average. Rainfall was above average for eastern Victoria; however, parts of western Victoria were below average. La Niña remained through summer 2020-21, returning to neutral during March, before becoming established again in November 2021. A negative Indian Ocean Dipole in winter and spring fuelled above average winter/spring rainfall in parts of southern Australia (Bureau of Meteorology 2022a).

Overall, it was a wet year, with higher than average rainfall in spring and noticeable peaks in both January and October 2021, and February 2022. The wet conditions and spilling reservoirs through late winter and spring on both the Upper Barwon and Moorabool systems has meant that water levels in the lower Barwon have been high. Water levels did not drop below 0.7m AHD meaning there were no restrictions to watering the wetlands from the entitlement, due to river level. Water top ups can still be required over summer even in a draw down year once the nominal minimum wetland level is reached. How these conditions played out in terms of watering both wetlands can be seen below in figures 8 and 9.

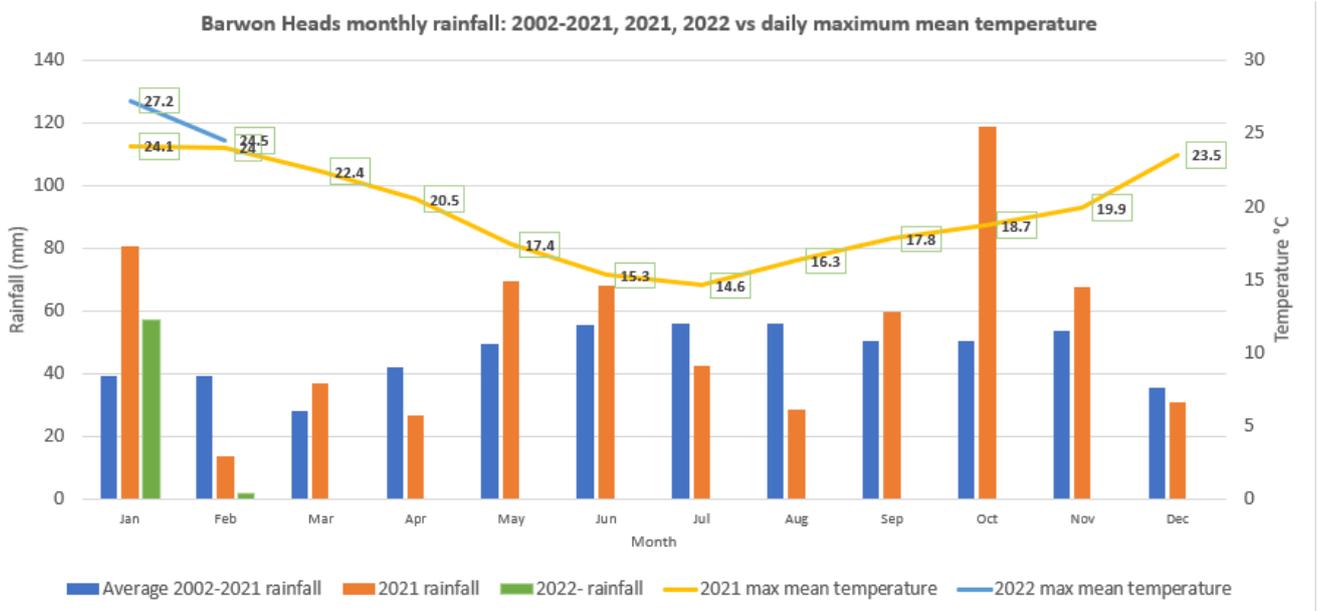


Figure 7. Average monthly temperature and rainfall at Barwon Heads: 2002-2021, 2022

4.2 Hydrological achievement

Reedy Lake

Due to wet conditions and probable bittern breeding in the 2020-21 water year, Reedy Lake was only drawn down gradually to a low of 0.77m AHD by early April, coming down from a high level of 0.93m AHD in early February. A flow through setting was then instigated in early May 2021 to top up the wetland for winter fill, while maximizing connectivity. The 2021-22 water year started with a full wetland which was maintained throughout winter and spring. The wetland stayed above its nominal fill level throughout this period with the Barwon River running high. This was a result of wet conditions with both urban storage reservoirs on the Moorabool and upper Barwon Rivers spilling. Water levels in the Barwon River above the tidal barrage reached a peak of almost 1.7m AHD in early October. Overall, levels in Reedy Lake have been dropping with the river since mid-December.

2021-22 was intended to be a summer draw-down year, following full years in 2019-20 and 2020-21. Whilst water levels have been dropping naturally with the river through summer, assisted draw down will not be commenced until supporting advice has been received from consultants monitoring the bird breeding.

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.

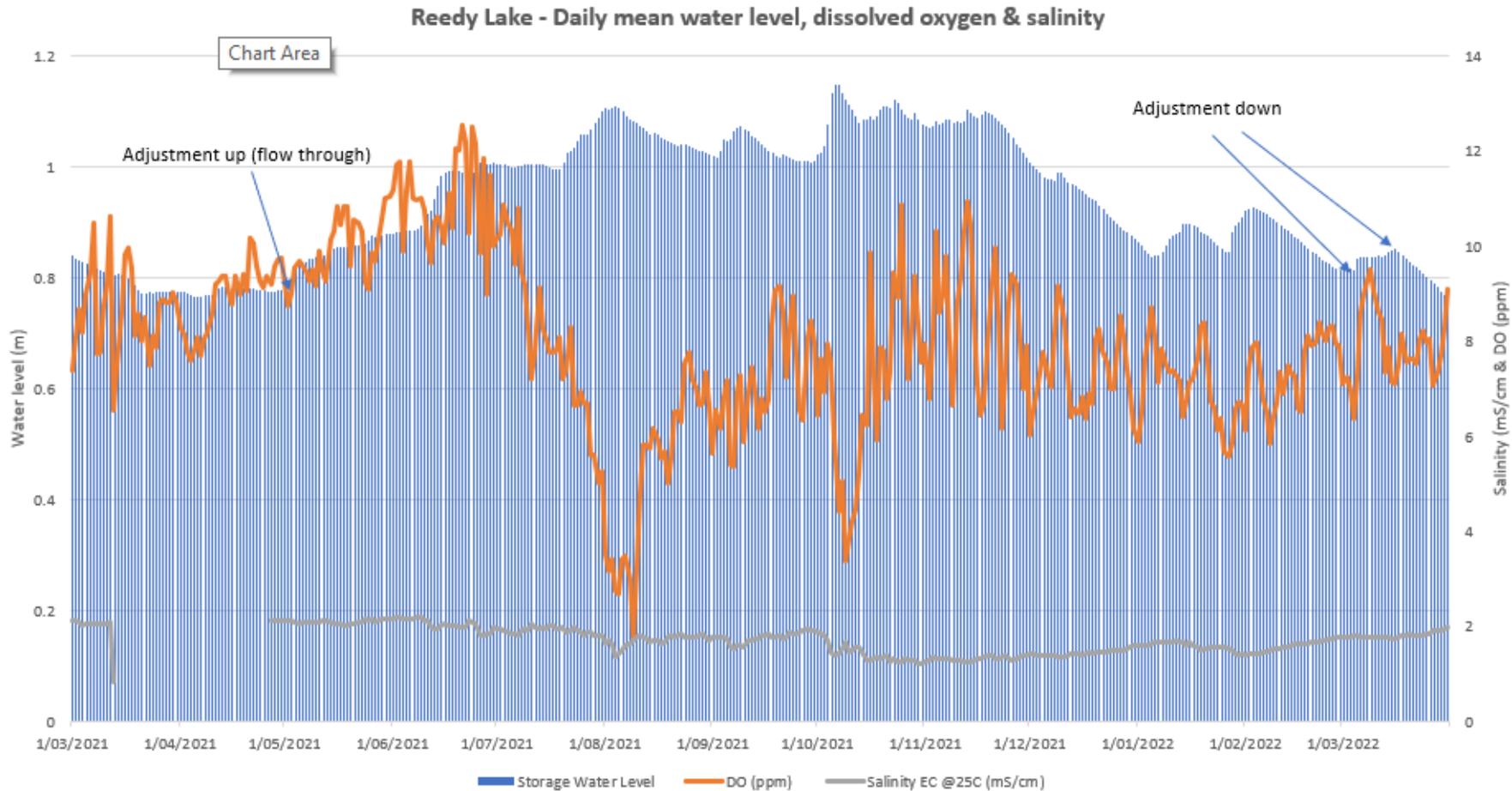


Figure 8. Water levels and key parameters at Reedy Lake 2021-22 (data from WMIS)
 (note: unreliable or absent data appears as a gap in the line plot)

Hospital Swamps

Hospital Swamps was adjusted upward in early May 2021 to fill the wetland for winter. The 2021-22 water year started with a full wetland which was successfully maintained throughout winter and spring. Like Reedy Lake, wet conditions kept Hospital Swamps above the nominal 'full level' of 0.5m AHD. In the case of Hospital Swamps, this was despite having the inlet closed since May, and the outlet fully open until just before Christmas. Large quantities of stormwater runoff from new urban developments west of Hospital Swamps and Baenches wetland are assumed to be the cause, with the Southern Diversion Channel yet to come on line to Sparrovale. Water levels remained high into early summer. All parameters trended within a relatively narrow range through this period of steady high wetland levels. As rain eased off in December, the outlet was shut to steady water levels while waterbird monitoring took place.

Despite the closing of the outlet, water levels continued to drop through evaporation and the 2021-22 summer draw down was achieved in February. Monitoring of bird breeding continued through this time and verbal advice was received that the rate of evaporative drop was not a threat to breeding activity. This advice will be formalised in the final report from consultants SMEC.

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.

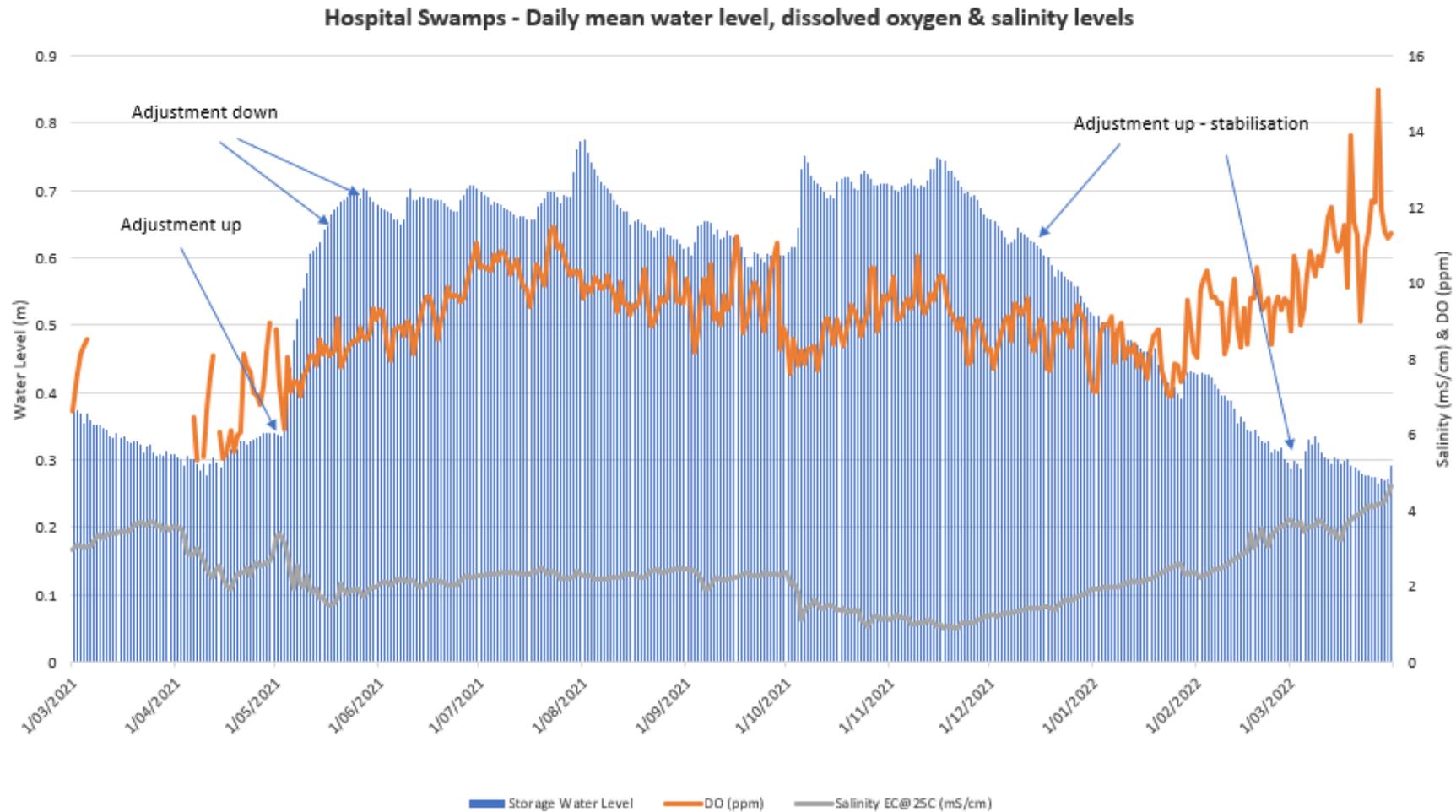


Figure 9. Water levels and key parameters at Hospital Swamps 2021-22 (data from WMIS)

(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 2011-12 to 2021-22 has been completed. The analysis in Table 4 below shows that Reedy Lake and Hospital Swamps have met their planned watering regime.

Table 4. Hydrological achievement of flow regime in the Lower Barwon Wetlands: 2011 - 2021

Site	Flow component achievement by year											Ecological outcomes / observations 2021-2022
	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22	
Reedy Lake	E	E	E	E	E	E	E	E	E	E	E	Wet conditions and breeding activity associated with colonial nesting birds, and booming of EPBC listed Australasian bitterns delayed draw down until the end of February. The wetland was still quite full (0.76m AHD) at the end of March, meaning that wading mud flat habitat provision and dry spells for coastal salt marsh species are likely to have been reduced. The 2021-22 year has been marked as a draw down year at the time of SWP finalisation (April 2022), but this may be amended in future SWPs depending on the final level achieved in 2022. Large choruses of growling grass frogs were also observed during listening surveys for breeding water birds.
Hospital Swamps	E	E	E	E	E	E	E	E	E	E	E	Formal monitoring for Australasian bitterns was conducted at Hospital Swamps for the first time this year. Booming bitterns were observed and recorded at Hospital Swamps, despite a gradual lowering of water levels with closed regulators over the summer months.

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 been part of the ARI WetMAP program for vegetation assessment. WetMAP Stage 3 is complete with Stage 4 planning underway. In addition, in response to observations in recent years of endangered Australasian bitterns in the wetlands, Corangamite CMA engaged consultants SMEC to conduct surveys of bitterns and colonial nesting water bird species in Reedy Lake and Hospital Swamps in spring and summer 2021-22. This monitoring was a recommendation of the Lower Barwon Review (2020) and informs the timing of planned draw down watering actions. The SMEC surveys also included incidental observations of frogs. The primary purpose of the surveys was to detect and monitor any breeding activity, to inform draw-down. Visual and aural observations as well as sound recordings were used to assess when the majority of breeding was likely to be completed. In addition to this, field observations have been provided by both Geelong Field and Game and Geelong Field Naturalists. Members of the general public have also made and recorded bird observations through e-bird at both wetlands. These contributions from the community are extremely valuable in building the picture of bird activity in the wetlands. Figures 11 and 12 capture some of the monitoring activity through the 2021-22 season.

A summary of recent WetMAP findings, SMEC surveys, and highlights from other observations is provided below. This includes some observations recorded in e-bird for both systems. Full records can be accessed at www.ebird.org/australia

Reedy Lake

WetMAP

The Wetland Monitoring and Assessment Program (WetMAP) Stage 3, led by the Arthur Rylah Institute, monitored the effect of environmental watering on wetland vegetation.

The most recent and final update from WetMAP Stage 3 at Reedy Lake was provided by ARI in February 2020. Key findings in relation to vegetation at Reedy Lake were as follows (incidental observations of birds and carp included):

Aquatic vegetation condition, extent and relationship with water regime

- WetMAP data from 2017 to 2020 has demonstrated an increase in the cover of the condition and extent of aquatic and submerged aquatic herbs in the open water parts of Reedy Lake, since the implementation of the new water regime (with three draw down years), including species such as *Thyridia repens* and *Myriophyllum spicatum*. Notably, these species were in very low abundance and cover in the first survey that followed the long period of sustained inundation.
- There is high species richness in the Brackish Aquatic Herbland community. This includes the following species: *Myriophyllum spicatum*, *Stuckenia pectinata*, *Potamogeton crispus*, *Ruppia polycarpa*, *Althenia preissii*, *Althenia bilocularis*, *Ranunculus trichophyllus* and *Vallisneria spiralis*. While the extent and cover of the species in this community is highly variable, under suitable conditions it is very likely that they will increase in cover across the site.

- The draw down periods have supported the germination and expansion of brackish herbs such as *Thyridia repens*, *Selliera radicans*, *Lilaeopsis polyantha*, *Triglochin striata* and to a lesser extent *Sarcocornia quinqueflora*, whereas under more static water levels these species can become restricted to narrow zones based on water depth and duration of inundation. The variation in water levels has enabled these species to occupy a much broader zone. Under a prolonged drier phase some areas contained a large amount of *Sarcocornia quinqueflora* recruitment which is now largely submerged. Allowing the species present within the wetland system to flower and set seed in a range of areas/hydrological regimes will ensure there is variability in the seed system and resilience in the wetland to be able to respond to changing conditions.

Birds

- Many waterbirds were observed, including Australasian Bitterns (2) flushed from the Tall Marsh, Brolgas (7) in the Wet Saltmarsh Herbland and Hypersaline Saltmarsh, Magpie Geese (50) and Eastern Great Egrets (>10). These observations should be carefully considered in the context of the response to the recently implemented water regime.

Carp

- Carp activity was particularly evident on the northern side of the wetland near Moolap Station Road and Whitehorse Road, with large numbers of individuals observed swimming through the area. The turbidity was high at this location. Some areas appeared to be unaffected, notably these were generally locations that have a much higher cover of *Bolboschoenus caldwellii* or were pools/sections of the site that are almost sectioned off by the dense stands of *Typha spp.* and *Phragmites australis* (i.e. were inaccessible or very unfavourable to carp). The draw down periods (shorter inundation periods) have likely limited the abundance and impact of carp on the Brackish Aquatic Herbland community.

During Stage 3 of the WetMAP program at Reedy Lake, ARI also took some regular aerial images by drone in order to help answer the question as to whether tall reeds were increasing in extent over the wetland. Images were taken over a two and a half year period, and a visual assessment concluded that there had only been a very slight increase (<1–2% of the total wetland area) in extent of Tall Marsh since 2018 in some parts of the wetland. Whilst the assessment period is very short, the insignificant increase supports the conclusion by the Lower Barwon Review (Sherwood et al., 2020) that there little evidence to support the idea that tall reeds have expanded significantly over Reedy Lake.

SMEC (2022), D. Weller *Pre-draw down surveys of ibis, bitterns and frogs at Reedy Lake, Spring/Summer 2021-22*, including supporting observations by Geelong Field and Game and Geelong Field Naturalists.

The information below has been summarised from an email report available at the time of writing. A final report will be available via Corangamite CMA at the conclusion of the bird monitoring project.

Australasian Bitterns

Bitterns boom throughout the period of establishing a territory, mating, nest-building, laying and incubation (~25 days), which is a minimum of five weeks. The nesting period until fledging of Australasian Bitterns is approximately 55 days from when regular booming ceases; however, chicks begin to roam from nest from about two weeks of age. To determine when regular booming ceases, a series of listening surveys and sound recordings was made at both Reedy Lake and Hospital Swamps, with timing guided by last year's findings. Personal listening surveys were made up to the point at which it was determined that the Songmeter recording devices were effectively detecting bittern calls, and then monitoring was switched to a more passive, but intensive, monitoring approach using these units. They are recording every morning and night.

Initial in-person survey 11/11/2021 3:30am start

Site	Wetland	Australian Bitterns detected
Baenschs Lane	Hospital Swamp	Yes, single bird calling NW of carpark
Hospital Swamp Rd	Hospital Swamp	No
Woods Road	Reedy Lake	No
Moolap Station Road	Reedy Lake	Yes, single bird calling E of end of walking track
Whitehorse Road	Reedy Lake	Yes, faint booming heard towards middle of lake
O'Halloran Road	Reedy Lake	No
Fitzgerald Road	Reedy Lake	Yes, faint booming heard towards middle of lake

Second personnel survey 12/12/2021 3:30am start

Site	Wetland	Australian Bitterns detected
Baenschs Lane	Hospital Swamp	No
Hospital Swamp Rd	Hospital Swamp	No
Woods Road	Reedy Lake	Not surveyed
Moolap Station Road	Reedy Lake	No
Whitehorse Road	Reedy Lake	Not surveyed
O'Halloran Road	Reedy Lake	No
Fitzgerald Road	Reedy Lake	No

Third in-person survey (planned for second week of January)

Not undertaken given Songmeters successfully detecting booming. See Songmeter summary below.

Songmeters

Hospital Swamp – Australasian Bitterns detected almost daily at this location; in some cases consultants estimate up to four individual birds could be heard calling on the one recording. Hundreds of calls have been recorded through this process which allows refinement of the identification classifier within the analysis software, but also gives a very good indication of breeding activity and the ability to determine when regular booming has started to waver. Calls reduced in frequency from early January and the latest detection was identified on January 20, 2022. Of interest is that during the 6/1 to the 27/1 birds can be clearly identified calling on the 6,8, 9, 11,12,15,16,18 and 20th of January, but the number of calls detected decreased from 6 until the 20th (only one call on this day during the recording period).

A graphical representation of single bittern booming at the lower Barwon wetlands in 2021-22 is presented below in Figure 10. Three individual booming calls can be seen in this image.

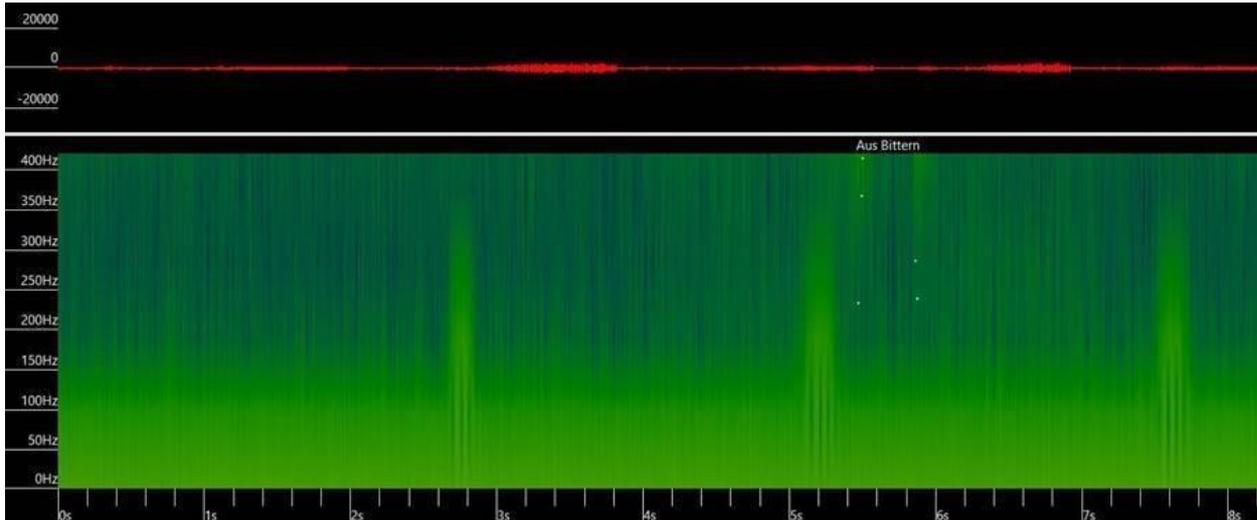


Figure10. Short duration booms from individual at Hospital Swamps, 2021-22 (D. Weller)

Reedy Lake (Fitzgerald Road) – Australasian Bitterns detected at Fitzgerald Road, although only a likely single male has been detected calling on this unit at this location. Calls recorded at this location are a lot fainter than those recorded at Hospital Swamp, so the consultants feel that the bird detected here may actually be calling some distance away, either south of Fitzgerald Road, or perhaps north – closer to O’Halloran Road. In addition, Growling Grass Frogs have been present growling loudly on almost every single recording since the units were deployed, and only really tapering off from the second week of January this year.

Given the similarities in habitats and general geographic location, the consultants have recommended that the Hospital Swamps birds be used as indicators for Reedy Lake to guide draw down, as the Hospital Swamps data is more consistent and better quality.

Colonial waterbirds

Initial survey 11/11/2021

Large numbers of both Straw-necked and Aust White Ibis seen across the northern parts of Reedy Lake. Estimates of 3000+ Straw-necked and up to 600 Aust White Ibis flying, soaring or bringing in nesting materials during the first listening surveys.

Second survey 12/12/2021

Consultants waded off the end of Moolap Station Road on the 12/12, following early morning dawn Bittern listening surveys. Multiple small clusters (up to 30 nests per group) of breeding Straw-necked Ibis and Australian White Ibis, and one potential pair of breeding Magpie Geese (based on behaviour) were located. Of interest was the significant variation in Ibis nesting stages. Of those encountered, the full range of nest development, from nest building (birds flying in and constructing nests), incubation of eggs, recently hatched chicks, right through to runners and chicks that would be approximately 1-2 weeks from fledging was observed. Overall counts of Straw Necked Ibis were

approximately 2900, Australian White Ibis 700. Also, a big group, approximately 230 birds, of Whiskered Tern was observed.

Third survey 12/1/2022

Consultants observed approximately 500 Straw Necked Ibis foraging at the end of the Fitzgerald Road turnaround. Via kayak, a pair of Brolgas, 50 Black Swans with a few cygnets and a group of Australian Pelicans were also observed; and in the northwest of Reedy Lake approximately 100 Straw Necked Ibis chicks in large groups that were not yet fledged but highly mobile and having well-developed plumage/feathers, as well as approximately 50 adult birds in the same area.

No active nests nor any evidence of nest building/maintenance were observed, although only a small proportion of the rookery was visible. Approximately 20 Australian White Ibis were also in the vicinity although no chicks were located. Based on the young birds that were located, the consultants estimate that fledging is not far off, perhaps 1-2 weeks before they will be able to fly (end of January).

The area out from Moolap Station Road was also inspected, although access was difficult. Consultants found what appeared to be several old rookery/roosting sites that had the characteristic flattened reeds, grasses and rudimentary platforms and lots of whitewash and feathers, but only approximately 20 Australian White Ibis adults were visible, and no chicks or juvenile birds.

Final survey 27/1/2022

Water levels had receded/evaporated approximately 30cm since initial visits, due to falling river levels and the flow through set up of the inlet and outlet regulators. Significantly reduced ibis activity across most parts of Reedy Lake was observed, which aligns with observations made during the previous kayak survey. Based on the reduced number of ibis across the lake, no signs of active nesting, and several smaller flocks of adults (<15 birds per group) were observed flying accompanied by juveniles; the consultants indicated that the main spring/summer 21/22 ibis breeding event is near completion. As such drawing down the water level in Reedy Lake is unlikely to adversely affect Straw-necked or Australian White Ibis, noting that monitoring of Australasian Bitterns is still in progress.

Growling Grass Frog (incidental from bird surveys)

First survey 11/11/2021

Site	Time	Growling Grass Frog Details
Hospital Swamp Rd	3:30 – 3:55am	4 x calling 30-40 m 240° SW of carpark
HoSw – Baenschs Lane	4:08 – 4:30am	~5 heard calling NW of carpark
ReLa – Woods Road	4:55 – 5:20 am	1st group – 3x calling 100m, 170° S of carpark

Site	Time	Growling Grass Frog Details
		2 nd group – x5+ calling 200m, 90° E of carpark
Fitzgerald Rd	3:30-3:50am	GGF x 3, close to edge of submerged carpark
O'Halloran Rd	4:00 -4:20am	None heard
Whitehorse Road	4:40-5:00am	No GGF during survey, but were heard calling here during recy 25/10
Moolap Station Rd	5:15 – 5:35am	GGF x 5+ (east of track)

Second survey, including wading to Ibis colony 12/12/2021

None recorded, no individuals calling despite conditions being cool but still suitable

Third survey 12/1/2022

Heard calling throughout the day in various locations during the kayak outing

Songmeters

Almost constant at both Hospital Swamp and Fitzgerald Road sites. Patches of heightened activity align with rain events and warmer weather, and typical reduction in calling activity post December compared with earlier in Summer/late Spring. Multiple individuals, estimated at >10 at Hospital Swamp, >30 at Fitzgerald Road and >10 at Baensch Lane wetland (initial deployment of 5 days).

Listening only to recordings, it is very hard to work out how many individuals are calling at each location, but with the data that has been collected we can get a very good indication of the cessation of their active calling season which will assist with future monitoring for this species at this location(s).

Draw down advice

Based on the songmeter data and Australasian Bittern call detections SMEC advised that Reedy Lake draw down could occur gradually from the end of the last week of February. Draw down was commenced, by closing two of the three inlet gates on March 2. The third gate was closed on March 16. This advice took into consideration the cessation of regular calling from the Hospital Swamp birds in the second week of January; consideration of the 55 days till fledging period; and the additional knowledge that the chicks are mobile from around day 14.



Figure 11. SMEC consultants and Geelong Field Naturalist volunteer monitoring for bitterns December 2021 (S. Blum-Caon)



Figure 12. Straw Necked Ibis chicks on nests made of trampled reeds, 20 December 2021 photo: (T. Leen)

E-bird observations

Reedy Lake current year 2021-22:

In 2022, eBird checklists extended to 42 species through regular observation of Reedy Lake from the urban boundaries. Records have noted the presence of colonial breeders such as Australian White Ibis and Straw-necked Ibis, as well as migratory waterbird such as the Sharp-tailed Sandpiper. Endangered (in Victoria) Magpie Geese and vulnerable Musk Ducks and Brolga were also observed. A full set of e-bird observations can be found at <https://ebird.org/australia>

Hospital swamps current year 2021-22:

A large diversity of woodland birds and waterbirds has been recorded at several locations through Hospital Swamps over the 2021-22 water year. eBird counts have occurred across the wetlands with most activity occurring at Hospital Swamp Rd. In just six weeks in 2022, 90 species from 21 checklists were recorded at this site including culturally significant Wedge-tailed Eagle, vulnerable Musk Duck and Brolga, and migratory species Sharp-tailed Sandpiper, Australian Reed Warbler and Latham's Snipe. A full set of e-bird observations can be found at <https://ebird.org/australia>

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 2021-22 water year, where they exist.

Table 5. Shared benefit review for the Lower Barwon Wetlands: 2021-2022

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 settlement. 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 Traditional Owners. 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 2021-22 water year.
	Corangamite CMA strives to provide as much as water as possible in the wetland 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 2022 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 the productivity of the wetlands 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 threatened by poor diversity of vegetation due to the historic lack of variation in water levels. Wetting and drying cycles support a diversity of 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 continually 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 dynamic and 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 watering actions that were partially targeted to control tall reeds. 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 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 can 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 by 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 13).

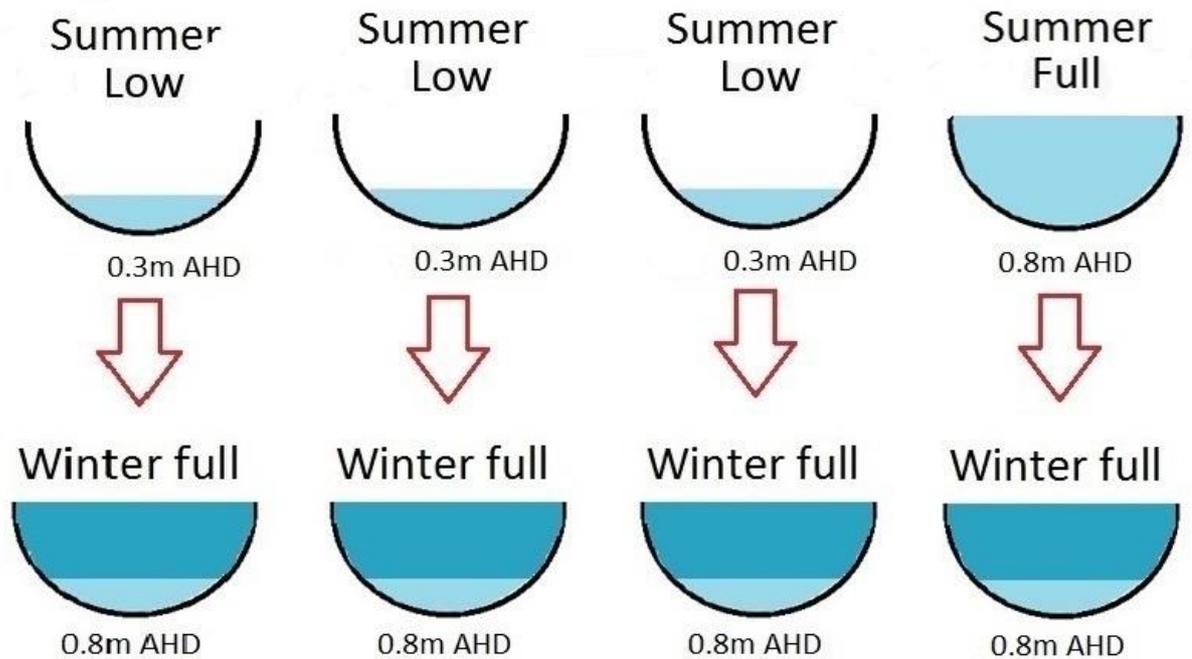


Figure 13. Reedy Lake's nominal four-year watering regime (2022-23 a draw-down year)

Individual watering actions are then presented in more detail in Tables 6 and 7.

Table 6. Potential watering action 1 at Reedy Lake 2022-23.

<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.
<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> <p>Provide connecting flows to the river</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 2022-23</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 7. Potential watering action 2 at Reedy Lake 2021-22.

<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).</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 2022-23</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 may not achieve draw down again. This would make 3 full years in a row. However, even if draw down is achieved in 2021-22, draw down in summer for 2022-2023 will still be the priority 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).</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></p> <p>Inlet gate:- open or opening increased if Barwon River >0.7m AHD</p> <p>Outlet gate:- closed or opening reduced</p> <p><u>Top ups (via tidal Barwon River downstream of barrage)</u></p> <p>Inlet gate:- closed</p> <p>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. 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 14). 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.

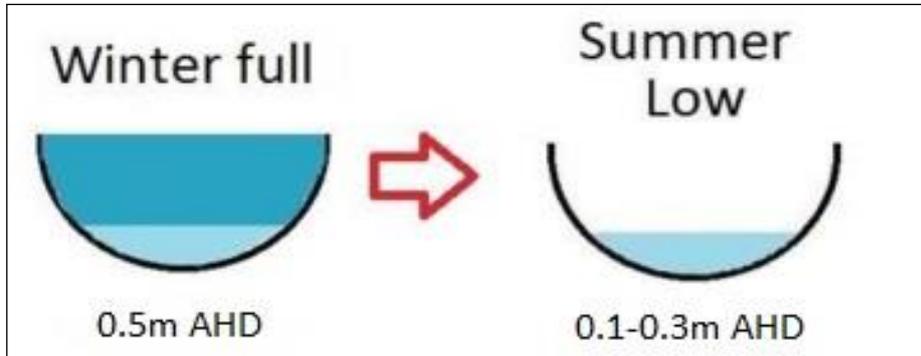


Figure 14. Hospital Swamps watering regime 2022-23

Individual watering actions are then presented in more detail in Tables 8 and 9.

Table 8. Potential watering action 1 – Hospital Swamps 2022-23

<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.
<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 2022-23</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 regular 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 9. Potential watering action 2 – Hospital Swamps 2021-22

<i>Potential watering action 2</i>	Draw down to summer low – gradually reduce water levels to approximately 0.1m-0.3 m AHD from December to May. Topping up or drawing down as required to maintain 0.1-0.3m AHD.
<i>Expected watering effects</i>	<p>Increase wetland salinity as groundwater discharge increases in proportion to surface water</p> <p>Shallow wetland basins exposed (creates open water habitat upon refilling)</p> <p>Restart wetland processes</p> <p>Allow egg banks to be produced and laid</p> <p>Provide waterbird food supply from access to tubers, seeds and invertebrates in shallow water</p> <p>Soil salinity increases in shallow wetland basins and deep wetland basin</p> <p>Chara and <i>Stuckenia</i> die back</p> <p>Limited colonisation of wetland bed by annual herbland plants</p> <p>Exposed reeds and other emergent macrophytes become dormant</p> <p>High soil salinity excludes reeds</p> <p>Expose mudflats for waterbird feeding</p> <p>Allow nutrient re-cycling</p> <p>Control carp populations</p>
<i>Environmental objectives</i>	<p>Wading bird habitat over summer</p> <p>Recruitment of aquatic macrophytes at wetland fringes</p> <p>Retard reed colonisation of low-lying areas</p> <p>Control carp</p> <p>Increase lake productivity</p>
<i>Rationale for proposed application in 2022-23</i>	<p>The system is recommended to have a wetting and drying cycle most years, meaning a summer draw down in 2022-23. A draw down no earlier than December 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 Sparrowvale wetlands.</p>

<p><i>Potential watering action 2</i></p>	<p>Draw down to summer low – gradually reduce water levels to approximately 0.1m-0.3 m AHD from December to May. Topping up or drawing down as required to maintain 0.1-0.3m AHD.</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></p> <p>Inlet gate:- open if Barwon River >0.7m AHD</p> <p>Outlet gate:- closed</p> <p><u>Top ups (via tidal Barwon River downstream of barrage)</u></p> <p>Inlet gate:- closed</p> <p>Outlet gate:- open</p>

6. Scenario planning

6.1 Outlook for 2022-23

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).

Australia's temperature and rainfall variability are influenced by global warming caused by human activities, with the nation's climate warming by around 1.44 °C since 1910 (BOM, 2021b). Southern Australia has seen a reduction of 10-20% in cool season (April-October) rainfall in recent decades (Climate Driver Update Archive (bom.gov.au)). 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.

In 2022, the BOM (2022c) predicts February to April is likely to be wetter than average for much of Australia and eastern Victoria, but makes no prediction for southwest Victoria. Whilst the outlook may indicate wetter than average conditions, the southern part of Australia is in its drier season, therefore even if rainfall is above average it is not likely to be enough to relieve long-term rainfall deficits. Minimum temperatures for January to March are likely to be warmer than median in Victoria. The second year of La Niña in the Pacific Ocean and the positive Southern Annular Mode (SAM) are likely the influence these climate outlooks.

On balance it is thought that an average or wet year of rainfall is likely for the upcoming water year.

6.2 Scenario planning

Table 10 (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 DELWP'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 10. 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 the summer of 2021-22, 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 2021-22 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 December/January 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 increased in the Barwon River and the wetland was 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</p>	<p>High chance that stormwater run-off from nearby developments would</p>

Climatic Conditions	Possible impact on Reedy Lake	Possible impact on Hospital Swamps
	<p>during lowering of wetland water 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>slow the draw down of Hospital Swamps over summer.</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, and local rainfall runoff.</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 11 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 is scheduled for 2022. 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 15) require regular preventative maintenance to keep them operational, and safe to operate.



Figure 15. A section of the Hospital Swamps' watering infrastructure at the bottom of the barge hole section of 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 11. 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 2022.
	Access to inlet/outlet impassable due to flooding and/or disrepair of tracks	Cannot water wetland due to inaccessibility	Annual grading and vegetation slashing and spraying to ensure tracks are passable.

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 will be offset to a degree with installation of automated regular control at Reedy Lake in 2022.

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 has been a very wet year. 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 12. 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 will start construction of a channel to divert flows from the new developments to the Sparrovale wetland in 2021.

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 and feral species. A summary of confounding factors is provided below in Table 13.

Table 13. 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. This has 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 ¹ owned): CoGG are 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. Also outcompeting 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	Corangamite CMA currently has a project underway to assess the potential impact

¹ CoGG = City of Greater Geelong

Confounding factor	Impact	Mitigation actions
	ecosystems, but this potential problem is undefined.	of acid sulphate soils. Results to date indicate a low risk. 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. 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 2020-21. A list of referenced documents can be found in Appendix 2.

- **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

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 14.

Table 14. 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 three 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 • 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>The Water Salt Balance Model commenced in late 2021 and is scheduled to be completed by December 2022.</p> <p>This work is critical to inform the next FLOWS study update in the near future.</p>

Knowledge gaps and project recommendation	Status
<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>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 understanding of changes in vegetation distribution historically, and allow some tracking of environmental watering outcomes going forward.</p>
<p>Carp and native fish population monitoring to inform management trigger (recommendation of Lower Barwon Review (Sherwood et.al., 2020))</p>	<p>There is currently no funding available for this work. Advice is currently being sought as to likely effectiveness of the carp screens on Reedy inlet in light of the constant cleaning required to prevent flow reduction.</p>
<p>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))</p>	<p>Undertaken in 2020-21 and 2021-22.</p> <p>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.</p> <p>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.</p>
<p>Broader ecological monitoring (recommendation of Lower Barwon Review (Sherwood et.al., 2020))</p> <p>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.</p> <p>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:</p>	<p>There is currently no funding available for this work</p>

Knowledge gaps and project recommendation	Status
<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. 	

10. Risk management

A risk assessment has been undertaken for the 2022-23 season, 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 15.

There are two high risks were identified for the 2022-23 water year. These are:

1. Deteriorated conditions of access tracks prevent Corangamite 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. This will be mitigated through VEWH funded maintenance works each year.
2. Rainfall runoff and storm water from urban development prevents implementation of wetland drying regimes, adversely impacting on environmental watering outcomes. This risk can only be mitigated in the longer term through the Southern Diversion Channel coming on line to Sparrovale Wetlands.

Appendix 4 presents the VEWH Risk Matrix used for the Risk Assessment.

Table 15. Risk assessment for the Lower Barwon Wetlands environmental watering 2022-23

Risk ID	Risk category	Risk description	Likelihood	Conseq	Risk Rating	Mitigation actions	Lead	Remains med / high after mitigation.	Risk type Static/Dynamic
CEBA2 020-01	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.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> • Continue to engage with the local community to build understanding and support. • Continue engagement with eel fishery representatives in relation to the environmental watering regime. • Consult with Field & Game to flag potential dry seasonal conditions issues. 	Corangamite CMA		Static
CEBA2 020-02	Reputational	Inability to demonstrate outcomes from low water regime at Reedy Lake leading to a lack of public support for activities.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> • Plan and implement monitoring program when drying regime is implemented. • Communicate results of monitoring (including WetMAP) to community and stakeholders. • Undertake mid-term review of watering actions with independent oversight to identify possible improvements. 	Corangamite CMA		Static
CEBA2 020-03	Environment	Asset failure (including inability to operate unsafe structures) prevents implementation of planned environmental water management actions at the target site.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> • Carry out pre-delivery inspection of structures and undertake annual maintenance actions. • Implement funded infrastructure upgrades on outlet structures, and continue to seek funding for automation and inlet structure upgrades (partly completed, Hospital Swamps structures not yet addressed and are continuing to decline). <p><i>Note: Check indicates CCMA is asset owner at Hospital Swamp, however PV to offer support for funding applications as land manage).</i></p>	Corangamite CMA		Dynamic

Risk ID	Risk category	Risk description	Likelihood	Conseq	Risk Rating	Mitigation actions	Lead	Remains med / high after mitigation.	Risk type Static/ Dynamic
CEBA2 020-04	Environment	Unauthorised interference with structures may result in an inability to achieve planned watering actions, leading to a failure to achieve environmental objectives.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> • Ensure structures are locked and monitor structure regularly to minimise likelihood of interference. • Install explanatory signage to communicate the environmental watering purpose of the structures. 	PV Corangamite CMA		Dynamic
CEBA2 020-05	Environment	Deteriorated conditions of access tracks prevent 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.	Almost certain	Moderate	High	<ul style="list-style-type: none"> • 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 	Corangamite CMA		Dynamic
CEBA2 021-06	Safety	Undertaking operational activities during duck hunting season (or during deer culling) creates safety risks for staff relating to accidental shooting and/or conflict with hunters. <i>Note: conflict with hunters was also assessed as possible and major (medium risk)</i>	Unlikely	Extreme	Medium	<ul style="list-style-type: none"> • Avoid staff visitation during high risk period such as dawn or dusk. • Ensure good communications between PV and Corangamite CMA. • Follow CMA safe work procedures. • Pursue remote activation of structures to reduce need for staff site visits. 	Corangamite CMA		Static
CEBA2 020-07	Safety	Drying regime and lower water levels in wetlands (in combination with extensive reed growth), may lead to	Possible	Minor	Low	<ul style="list-style-type: none"> • Undertake frequent communications and engagement with local duck hunting groups via Parks Vic networks to inform them about water level changes. 	Corangamite CMA		Dynamic

Risk ID	Risk category	Risk description	Likelihood	Conseq	Risk Rating	Mitigation actions	Lead	Remains med / high after mitigation.	Risk type Static/ Dynamic
		access issues and inconvenience for duck hunters wading at these sites under changed conditions.							
CEBA2 020-08	Reputational	Inability to demonstrate outcomes achieved through environmental watering activities may lead to a loss of public/political support for activities	Possible	Major	Medium	<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. 	Corangamite CMA Corangamite CMA Corangamite CMA VEWH		Static
CEBA2 020-09	Cultural Heritage	Inability to incorporate Wadawurrung inputs and knowledge into planning may lead to a failure to address T.O. values or damage heritage/artefacts and may impact on values or heritage <i>Note: This risk assessment needs to be tested with T.O.s</i>	Possible	Minor	Low	<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. 	Corangamite CMA		Static
CEBA2 020-10	Environment	Insufficient staff resources available to deliver all planned environmental	Possible	Moderate	Medium	<ul style="list-style-type: none"> • Continue to actively prioritise actions and ensure key actions are delivered. • Seek funding for remote actuation of 	Corangamite CMA		Static

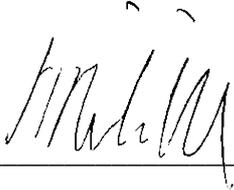
Risk ID	Risk category	Risk description	Likelihood	Conseq	Risk Rating	Mitigation actions	Lead	Remains med / high after mitigation.	Risk type Static/ Dynamic
		watering actions, results in impacts on the environment				relevant structures to reduce the need for staff visitation.			
CEBA2 020-11	Environment	Environmental deliveries create improved conditions for pest plant and animal species (e.g. carp, tall reeds) leading to adverse environmental impacts. <i>Note: assessment has regard for previous permanent water regime as baseline</i>	Unlikely	Minor	Low	<ul style="list-style-type: none"> • Manage water regimes in wetlands to control pest plant and animal species. 	Corangamite CMA		Static
CEBA2 020-12	Reputational	Community concern over adverse environmental outcomes (e.g. ibis chick deaths, fish deaths) lead to a loss of support for watering actions	Possible	Major	Medium	<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. • Use bird breeding monitoring data to inform draw down planning. 	Corangamite CMA		Static
CEBA2 021-13	Environment	Rainfall runoff and storm water from urban development prevents implementation of wetland drying regimes, adversely impacting on	Almost certain	Moderate	High	<ul style="list-style-type: none"> • Continue to support City of Geelong to implement drainage diversion works (Southern diversion channel under construction). • Encourage City of Geelong undertakes regular maintenance of structures on 	Corangamite CMA	High	Dynamic

Risk ID	Risk category	Risk description	Likelihood	Conseq	Risk Rating	Mitigation actions	Lead	Remains med / high after mitigation.	Risk type Static/Dynamic
		environmental watering outcomes.				diversion drains and follows agreed operation rules. <i>Note: This risk is still rated as high after mitigation actions.</i>			
CEBA2 020-14	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.	Unlikely	Moderate	Low	<ul style="list-style-type: none"> • Ongoing communication of delivery plans to landholders. • Ensure City of Geelong undertakes regular maintenance of structures on diversion drains and follows agreed operation rules. 	Corangamite CMA		Static
CEBA2 021-28	Safety	Negative community sentiment in relation to government decisions/actions creates a safety risk for staff involved in environmental watering actions	Possible	Moderate	Medium	<ul style="list-style-type: none"> - ensure staff are alerted to warnings about violent members of public - Strategic Communication of benefits of e-water and concern over safety to wider public (with co-ordination between partners) - ensure safe operational procedures for staff are followed 	All		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 2022-23.

SIGNED FOR AND ON BEHALF OF Corangamite Catchment Management Authority



Signature of authorised representative

John Riddiford

Name of authorised representative

Appendix 1. Abbreviations

AHD	Australian Height Datum
CMA	Catchment Management Authority
CoGG	City of Greater Geelong
DELWP	Department of Environment Land Water and Planning
DO	Dissolved Oxygen
EC	Electrical Conductivity
EPBC Act	Environmental Protection and Biodiversity Conservation Act
EVC	Ecological Vegetation Class
LBCAC	Lower Barwon Community Advisory Committee
PAG	Project Advisory Group (Lower Barwon Review)
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 (DELWP)

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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Figure16. IAP2 spectrum of public participation.

Appendix 4. VEHW Risk Matrix

Table 16. VEWH risk rating table.

Likelihood	Consequence				
	Negligible	Minor	Moderate	Major	Extreme
Almost certain	Low	Medium	High	Extreme	Extreme
Likely	Low	Medium	High	Extreme	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Low	Medium	High	Extreme
Rare	Low	Low	Low	Medium	High

Table 17. VEWH risk likelihood table.

Rating		Description	Probability
Rare	1	Event may occur only in exceptional circumstances	0-5%
Unlikely	2	The event could occur at some time	5-20%
Possible	3	The event might occur	20-50%
Likely	4	The event will probably occur in most circumstances	50-80%
Almost certain	5	The event is expected to occur in most circumstances	80-100%

Table 18. VEWH risk consequence table.

Rating		Environment	Business Costs	People		Political/ Reputational	Legal	Service Delivery
				Safety and Well-being	People and Culture			
Negligible Harm	1	No material effect on the environment, contained locally within a single site/ area. Environment affected for days.	Cost impact of up to 2.5% of allocated operational budgets (including capital budget); OR a cost impact of up to \$2.5m	On-site first aid treatment only	Staff disgruntlement	Minimal adverse local attention (1 day only)	Non-compliance with legislation, identified internally and resulting in internal acknowledgement and process review.	Insignificant impact to the partnership's capability in providing its services – no inconvenience to customers/ stakeholders
Minor Harm	2	Limited effect on the environment, restricted to a single township or locality. Environment affected for weeks.	Cost impact between 5%-10% of allocated operational budgets (including capital budget); OR a cost impact of up to \$5m	Minor injuries/illness requiring medical attention	Complaints, passively upset, and uncooperative	Adverse localised public attention on a single issue over a short period. (up to 1 week)	Non-compliance with legislation or breach of duty of care, identified externally and either (1) resolved without prosecution or civil action, or (2) resulting in prosecution or civil action involving low level of resourcing required to defend, exposure to low level remedies or damages, and low-level risk of negative precedent	Minimal short-term temporary impact to the partnership's capability in providing its services – customers/ stakeholders slightly inconvenienced
Moderate Harm	3	Moderate effect on the environment, impacting on a municipality or multiple localities. Environment affected for months.	Cost impact >10% of allocated operational budgets (including capital budget); OR a cost impact of up to \$10m	Significant injury/illness requiring inpatient hospitalisation	Low morale, disengagement, increased absenteeism and workplace conflict	Adverse localised negative public attention on a single issue over a sustained period (up to 2 months)	Non-compliance with legislation or breach of duty of care resulting in prosecution of, or civil action, with one of high level of resourcing required to defend; exposure to high level remedies or damages	Significant impact to the partnership's capability in providing its services – customers/ stakeholders inconvenienced

							or high-level risk of negative precedent.	
Major Harm	4	Major effect on the environment, impacting on a region or multiple municipalities. Environment affected for 1-3 years.	Cost impact between \$10m-\$50m	Extensive and/or permanent injury/ illness	Major morale issues, high absenteeism and resignations of key staff	Serious adverse public attention on more than one issue over a prolonged period (up to 2 years)	Non-compliance with legislation or breach of duty of care resulting in prosecution of or civil action (with <i>all</i> high level of resourcing required to defend, exposure to high level remedies or damages, and high-level risk of negative precedent); or public enquiry	Continuing difficulties in the partnership's capability in servicing customers/stakeholders over a protracted period
Extreme Harm	5	Very serious effect on the environment, impacting on the state or multiple regions. Environment affected for >3 years.	Cost impact of over \$50m	Death or permanent disability/ illness	Partnership wide morale issues, mass resignations and absenteeism	Very serious public outcry over a prolonged period (greater than 2 years), or leading to a formal inquiry, serious investigation of another major political event	Non-compliance with legislation or breach of duty of care resulting in prosecution of or civil action (leading to imprisonment of an officer and/or uninsured compensation payments).	Long term detrimental effect on the partnership's capability in providing services to customers/ stakeholders

Appendix 5. Wadawurrung Traditional Owners – letter of endorsement



Wadawurrung
Traditional Owners
Aboriginal Corporation

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17th February 2022

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 Catchment Management Authority's Seasonal Watering Proposal and the potential watering actions 2022-23.

Yours sincerely,

Paul Davis
CEO
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