



Broken Wetlands

Seasonal Watering Proposal

2023-2024



GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

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Executive Summary

This Seasonal Watering Proposal covers the environmental watering requirements for 2023-2024 for the Broken catchment wetlands, of which there are three, as managed by the Goulburn Broken Catchment Management Authority (GB CMA). This includes Black swamp, Moodie swamp and Kinnairds wetland.

The promotion of drying Black Swamp, Kinnairds Wetland and Moodie Swamp is proposed in the Broken catchment in 2023-2024.

The water regime of these wetlands has been highly modified with changes to the frequency, duration and timing of wetting and drying. Environmental water is currently being used to restore a more natural wetting regime to these sites to protect, enhance and restore the health of the wetlands.

Environmental watering objectives for Broken Catchment wetlands are to:

- Provide a wetting cycle that promotes healthy wetland vegetation communities.
- Provide feeding and breeding habitat for a range of waterbirds, amphibians and reptiles and,
- Provide a drying period that assists with the completion of a nutrient cycle for wetlands.

Seasonal review 2022-2023

Environmental water deliveries were planned at Black Swamp and Kinnairds Wetland in 2022-2023 with a total of 680ML was proposed to be delivered. Of this, no water was delivered due to a large rainfall event and flooding which filled all the wetlands in October 2022.

The key objective of the 2022-2023 Seasonal Watering Proposal was to deliver environmental water to Black Swamp and Kinnairds Wetland in autumn 2023 and promote drying at Moodie Swamp over 2022-2023.

A large rainfall event occurred in autumn 2021 and primed Moodie Swamp, which encouraged GB CMA staff to bring the proposed autumn 2022 watering forward to spring 2021. This occurred after four Brolga were observed displaying courtship behaviour at the site in winter 2021. The swamp then held water for the duration of 2023 due to high inflows from the Broken Creek entered the swamp in January and February 2022. The swamp then filled and spilled in October 2022 after a large rainfall event and flooding of the Broken Creek occurred.

Black Swamp filled naturally in September 2022 after a large rainfall event and was still holding water at full capacity at the time of writing this proposal. Its proposed watering in autumn 2023 did not occur due to still holding water at the time.

Kinnairds wetland obtain some water from the Muckatah drain in early October 2022. Water was diverted from the drain into the swamp to relieve water pressure from the drain due to high inflows. The swamp partially filled due to this diversion. In mid-October flooding of the Muckatah system occurred which filled the wetland. The wetland was still holding water at full capacity at the time of writing this proposal.



Figure 1. A flooded boardwalk at the southern end of Kinnairds Wetland – January 2023

Photo: D. Andrews, Moira Shire.

The 2022-2023 environmental water priorities, objectives and delivery status for Broken wetlands are summarised in Table 1.

Table 1: Watering priorities for 2022-2023

| Priority | Wetland | Potential Watering Action | Climate Scenario and ML Water | | | |
|-----------------|------------------|--|-------------------------------|-----|---------|-----|
| | | | Ex. Dry | Dry | Average | Wet |
| 1 | Black Swamp | Fill Black Swamp in autumn 2023 to a maximum depth of 1m in the deepest parts, for 6-8 months to maintain or improve Red Gum Swamp EVC and provide habitat for waterbirds and frogs. Top up in spring 2023 if required to achieve desired wetting duration. | 80 | 80 | 80 | 40 |
| 1 | Kinnaids Wetland | Fill Kinnaids Wetland in early autumn 2023 to a maximum depth of 1m in the deepest parts for 6-8 months to promote vegetation growth and recruitment and provide habitat for waterbirds and frogs. Top up in spring 2023 if required to achieve desired wetting duration. | 600 | 600 | 600 | 300 |
| NA | Moodie Swamp | Promote drying at Moodie Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | 0 | 0 | 0 | 0 |
| Total ML | | | 680 | 680 | 680 | 340 |

Priorities for 2023-2024

In consultation with Traditional Owners, the Goulburn Broken Wetland Technical Reference Group and the Goulburn Broken Environmental Water Advisory Group, the GB CMA proposes promote a drying phase for all the Broken Wetlands. The proposal for these sites is dry these sites in all climate scenarios. It is currently forecast that deliveries in 2023-2024 will occur under a neutral climate scenario which indicates no strong indication of either El nino or La nina conditions (agriculture.vic.gov.au The Fast Break, BOM 2023). Scenario planning for the Broken Wetlands under these conditions will mostly likely fall under “average to dry” conditions (Table 2).

Priorities for the Broken system wetlands is to promote drying of Black Swamp, Kinnaids Wetland and Moodie Swamp for 2023-2024.

This proposal considers environmental water deliveries under a range of possible climate scenarios from extremely dry to wet. The potential watering actions under the different climate scenarios are outlined below (Table 2). These have been categorised into Tier 1 and Not Applicable. Tier 1 watering actions are the critically important watering actions that should be achievable based on estimates of supply and other available resources under each planning scenario (VEWH, 2022). No environmental watering is requested for the Broken system wetlands in 2023-2024 therefore the Potential Watering Actions have been prioritised as Not Applicable (NA). The promotion of a drying period at these sites is important for a variety of ecological outcomes and to allow these sites to complete their nutrient cycles.

Table 2: Summary of potential water actions for 2023-2024

| Priority | Wetland | Potential Watering Action | Climate Scenario and ML Water | | | |
|-----------------|------------------|---|-------------------------------|-----|---------|-----|
| | | | Ex. Dry | Dry | Average | Wet |
| NA | Black Swamp | Promote drying at Black Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | 0 | 0 | 0 | 0 |
| NA | Kinnaids Wetland | Promote drying at Kinnaids Wetland. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | 0 | 0 | 0 | 0 |
| NA | Moodie Swamp | Promote drying at Moodie Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | 0 | 0 | 0 | 0 |
| Total ML | | | 0 | 0 | 0 | 0 |

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Introduction

This seasonal watering proposal outlines the Goulburn Broken Catchment Management Authorities priorities for the use of environmental water for delivery to Broken Catchment wetlands in 2023-2024 to protect and enhance their environmental values and health.

The purpose of the seasonal watering proposal is to:

- Identify the environmental water requirements of wetlands to adaptively manage their watering regime and enable water for the environment to be delivered under a range of climatic scenarios.
- Identify the drying requirements of wetlands to assist with the completion of the nutrient cycle within wetlands.
- Provide information for the development of the VEWH seasonal watering plan as per section 192A of the *Water Act 1989* (Vic).

System overview

The Broken River basin is 772,386 ha or 3.4 per cent of Victoria's total area. The Broken River is a tributary of the Goulburn River where it joins the river at Shepparton. The basin also includes the catchment of the Broken Creek that diverges from the Broken River west of Winton Wetlands and flows north-west to the Murray River.

Within the catchment, several wetlands are formally recognised for their conservation significance. This includes the Ramsar listed Barmah Forest (Figure 2 – listed as Barmah National Park). Moodie Swamp is nominated in 'A Directory of Important Wetlands in Australia' (EA, 2001) under the Broken Creek (VIC036) listing. Black Swamp is classified as bioregionally significant defined in the 'National Land and Water Audit' (Cth, 2002).

Within the Broken catchment only four wetlands have currently received environmental water. These are Barmah Forest, Black Swamp, Kinnairds Wetland and Moodie Swamp. These wetlands have been prioritised due to their ecological values, significance to the community and traditional owners, and because they have the infrastructure required to receive environmental water. As the wetland environmental program progresses, other wetlands of high ecological and cultural values will be considered for watering, provided they have the necessary infrastructure in place to deliver water and land manager approvals are met.

A separate seasonal watering proposal will be developed for Barmah Forest and is not considered in this document.

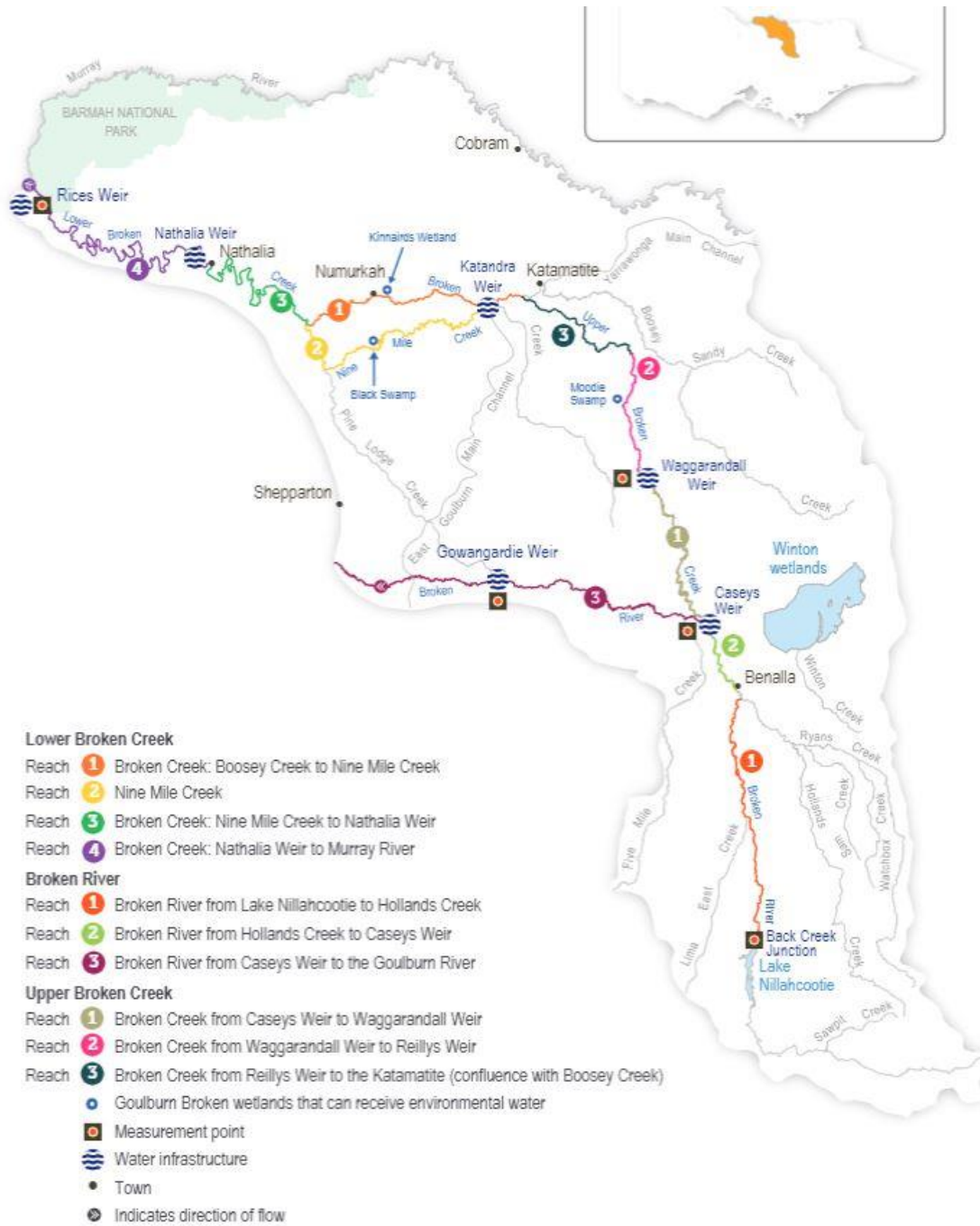


Figure 2: Broken Wetlands considered in this proposal

Black Swamp

Black Swamp is a 16.5-hectare red gum swamp managed by Parks Victoria and is part of the Black Swamp Wildlife Reserve (Figure 3). Prior to European settlement Black Swamp would have filled on a near annual basis from rainfall and flooding from the Nine-Mile Creek. Due to the wetlands relatively shallow depth it would have dried out most years over the summer-autumn period. The water regime of the wetland changed in the 1960's when irrigation was introduced to the area resulting in higher flows into the wetland during the irrigation season (August-May). In the 1970's a channel was constructed from Nine Mile Creek to flood the wetland during duck hunting season. The high irrigation flows in Nine Mile Creek and construction of the channel caused the swamp to become almost permanently inundated, reducing the diversity and abundance of biota found at the swamp. In 2008, the GB CMA upgraded water delivery infrastructure and delivered environmental water to the wetland for the first time. This has reinstated a more natural wetting and drying regime to the swamp.



Figure 3: Black Swamp in relation to Nine Mile Creek and link channel

Note: Orange line indicates link channel connection between Nine Mile Creek and Black Swamp

Environmental water can be delivered by a link channel connected to the swamp from Nine Mile Creek (Figure 3). Black Swamp is listed as bioregionally significant in the *National Land and Water Resource Audit* (Cth, 2002). Environmental flows can only be delivered to the swamp when flows in the Nine Mile Creek exceed 100ML/day (GBCMA, 2011a). This regularly occurs during the irrigation season (August – May). The wetland may only require environmental water during extended dry periods or to enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation. Black Swamp also meets several criteria under *Schedule 8* of the Basin Plan – *Criteria for identifying an environmental asset*. This includes criteria 3a (i), 3a (iii), 3b, 4a and 4c (refer to appendix 1 for criteria description).

Black Swamp provides habitat for a wide variety of aquatic and terrestrial fauna and flora species. To date 67 wetland dependent fauna and 82 wetland dependent flora species have been recorded at the site. Wetland dependent fauna and flora species listed as threatened can be found in Appendix 2a and

2b. Black Swamp contains a significant population of the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC 1999) listed River Swamp Wallaby-grass (*Amphibromus fluitans*) which emerges in autumn. Water Nymph (*Najas tenuifolia*), which is classified as rare in Victoria was first recorded at Black Swamp in February 2016.

Kinnairds Wetland

Kinnairds Wetland is a 96-hectare red gum swamp jointly managed by Goulburn-Murray Water and Moira Shire (Figure 4). It is located on the floodplain of the lower Broken Creek, approximately two kilometres north-east of Numurkah. It consists of a natural depression, part of which has been modified into a constructed wetland. It is a significant wetland for Royal Spoonbill (*Platalea regia*) breeding and has the largest known recorded population of the EPBC (1999) listed Ridged Water Milfoil (*Myriophyllum porcatum*) in Victoria. The numerous walking tracks, bird hides, picnic shelters, interpretive signage and opportunities to spot wildlife attracts 100's of visitors to the wetland each year.

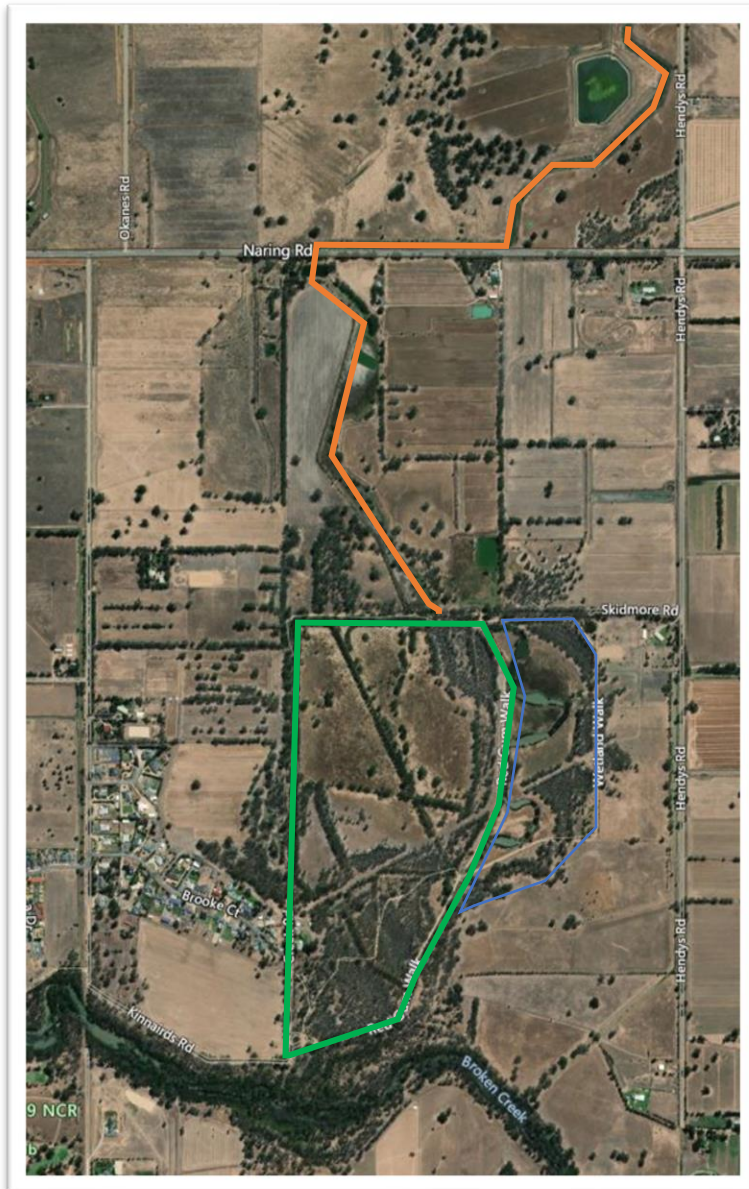


Figure 4: Kinnairds Wetland

Note: Orange line indicates Muckatah Depression entering Kinnairds Wetland. Green outline depicts Moira Shire managed area of Kinnairds Wetland. Blue outline depicts Goulburn Murray Water managed area.

Environmental Water is currently delivered to the wetland by out-falling water from an irrigation channel (MV5/3) into the Muckatah Depression (Figure 3) approximately 16 km upstream of the wetland (GBCMA, 2011b). The water takes approximately one week to reach the wetland and can

take 40-50 days to deliver the required volume of water. A project to design new water delivery infrastructure is currently underway and if constructed would significantly improve the efficiency, measurement, flexibility and control of environmental water deliveries to the wetland.

Kinnairds Wetland meets several criteria outlined in *Schedule 8* of the Basin Plan – *Criteria for identifying an environmental asset*. This includes criteria 1b, 3a(i), 3a(iii), 4a, 4c (refer to appendix 1 for criteria description).

A total of 83 wetland dependent fauna species and 85 wetland dependent flora species have been recorded at the site. Of these species, 26 are listed as threatened (refer to appendix 2a and 2b).

Moodie Swamp

Moodie Swamp is a 180-hectare Southern Cane-grass (*Eragrostis infecunda*) wetland managed by Parks Victoria and is part of the Moodie Swamp Wildlife Reserve (Figure 5). It is located on the floodplain of the upper Broken Creek approximately 40 km north of Benalla. The wetland is listed under 'A Directory of Important Wetlands in Australia' (EA, 2001) as part of the Broken Creek.



Figure 5: Moodie Swamp

Note: Orange line indicates delivery channel (Gearys channel) from Broken Creek to Moodie Swamp

Water can be delivered to Moodie swamp via a water delivery channel (figure 5) from the upper Broken Creek (GBCMA, 2012). There has been no survey or modelling of catchment conditions to determine changes to the natural frequency and duration of flooding events at Moodie Swamp. However, it is likely the frequency and duration of flooding at Moodie Swamp has been reduced by the regulation of the Broken River and Broken Creek (SKM, 2006). Therefore, the wetland may require environmental water to provide a more natural flooding regime and enhance natural inundation events to ensure the success of bird breeding events or to provide optimal growth conditions for water dependent vegetation.

Moodie Swamp meets several criteria outlined in *Schedule 8* of the Basin Plan – *Criteria for identifying an environmental asset*. This includes criteria 3a (i and iii), 4a and 4c (refer to appendix 1 for criteria description).

Moodie Swamp provides important Brolga (*Antigone rubicunda*) breeding habitat and habitat for other wetland dependent fauna species. Since monitoring of the site began in 2008, 65 species of wetland dependent fauna and 42 species of wetland dependent flora have been recorded at the site. Of these species 26 are listed as threatened (refer to appendix 2a and 2b).

Flora at Moodie Swamp continues to change as a more natural wetting and drying regime has been returned with the assistance of environmental water. Monitoring in 2008 indicated that Southern Cane-grass (*Eragrostis infecunda*) was a dominant species within the wetland. Since the wetland's watering regime has changed, it has begun to show signs of an aquatic herb land EVC. This includes a large population of the EPBC (1999) listed Rigid Water-milfoil (*Myriophyllum porcatum*).

Engagement

This proposal was prepared by the Goulburn Broken CMA with input from Yorta Yorta Nation Aboriginal Corporation (18th January 2023), Goulburn Broken Wetland Technical Reference Group (GB WTRG) and the Goulburn Broken Environmental Water Advisory Group (GB EWAG).

The GB WTRG is made up of members from Rakali Consulting, Water's Edge Consulting and Senior Scientists from Department of Environment Land Water and Planning and Arthur Rylah Institute for Environmental Research. An email was sent to the committee for their advice on not watering the sites in which they were all in agreement.

The GB EWAG meets at least three times a year and additionally if required to discuss findings from wetland monitoring, wetland condition, watering objectives and watering for the coming year. The group met via Microsoft™ Teams 2nd February 2023 and members were provided with a copy of the draft proposal for comment. Comments have been incorporated into this report.

The GB EWAG (previously Goulburn Broken Wetland Management Group), established in 2012, is made up of delivery partners, Traditional Owners, industry, community groups and community members. Current membership includes Parks Victoria, Taungurung Land & Waters Council, Yorta Yorta Nation Aboriginal Corporation, Goulburn Murray Landcare Network, Goulburn-Murray Water, Moira Shire, City of Greater Shepparton, Victorian Environmental Water Holder and community members. Meetings are usually held two or three times a year to discuss the current conditions of the wetlands, the outcomes of the previous season's delivery of environmental water, and proposed watering. When possible, the group visits the wetlands to hear and see firsthand the delivery and wetland responses to environmental watering.

The Goulburn Broken CMA has an agreement with Yorta Yorta Nation Aboriginal Corporation that outlines the legal requirements that GB CMA need to abide by when undertaking natural resource management works in areas covered by these agreements.

The Aboriginal Cultural Heritage Land Management Agreement (ACHLMA) is an agreement between the GB CMA and Yorta Yorta Nation Aboriginal Corporation which is legislated by the *Aboriginal Heritage Act 2006*. This includes the following activities that are permissible under the agreement:

- Environmental Monitoring Activities at wetlands.
- Environmental water – returning natural flows at wetlands across the catchment.

Some wetlands are not included in this agreement which are situated along the Lower Goulburn National Park (not relevant to this plan).

The Goulburn Broken CMA will continue to build community understanding of how natural wetland wetting regimes have changed and how water for the environment is being used to protect and restore the wetlands. This will be achieved through reports, traditional and social media and direct contact with special interest groups and school groups.

The engagement process the Goulburn Broken CMA has undertaken during the development and implementation of this seasonal water proposal is outlined in Table 3. All communication activities will be undertaken in accordance with the communication and media protocols of the VEWH.

Table 3: Engagement undertaken in development of Seasonal Watering Proposal 2023-2024

| Category | Who | IAP2 level of engagement | Engaged on 2023-24 seasonal watering proposal | Engagement methods | Engagement Purpose |
|----------------------------|---|--------------------------|--|---|--|
| Government Agencies | Delivery Partners | Collaborate | Goulburn-Murray Water (River Operations Planning, Diversions) VEWH Parks Victoria Moira Shire Council of Greater Shepparton DEECA (Land Manger, Environmental Water) | Formal advisory group (GB WMG) Direct engagement Review of draft proposal | Seek input into the development of the proposal. Ensure program partners understand the watering proposed and intended outcomes |
| Traditional Owners | Traditional Owners | Involve | Yorta Yorta Nation Aboriginal Corporation | Formal advisory groups (GB WMG) On-line meetings | Seek input into the development of the proposal by reviewing document, providing feedback and writing a letter of endorsement. Assist with the monitoring of the watering events |
| Recreational Users | Field and Game Australia Local fishing clubs | Involve | Field and Game Trellys Fishing and Hunting | Formal advisory groups (GB WMG) Direct engagement | Ensure understanding of the watering proposed and intended outcomes. Review SWP and provide feedback/ input. |
| Community Groups | Environment Groups | Involve | Goulburn Murray Landcare Network Goulburn Valley Environment Group Turtles Australia | Formal advisory groups (GB WMG) Direct | Ensure understanding of the watering proposed and intended outcomes. Review SWP and provide feedback/ input. |
| Local Landholders | Landholders | Involve | Landowners that adjoin wetlands that receive environmental water and/or use the delivery channel | Direct engagement (one-on-one) or email/mail drop. | Ensure understanding of the watering proposed and intended outcomes. Seek feedback – local knowledge |
| Technical experts | Scientists and Consultants | Collaborate | Research Scientists from Arthur Rylah Institute Rakali Consulting Water's Edge Consulting | Formal advisory group (GB WTRG) Direct engagement | Seek input into the development of the proposal and ecological and hydrological objectives. Review SWP and provide feedback/ input. |

Aboriginal cultural values and use of waterways

Traditional Owner consultation and involvement with the development of this Seasonal Watering Proposal is imperative for the conservation and protection of cultural sites, connection to country and establishing strong linkages.

The Broken Wetlands in this Seasonal Water Proposal are all part of Yorta Yorta Nation Aboriginal Corporation Country (Figure 6 shaded dark blue). The GB CMA have engaged with Yorta Yorta to discuss drying of wetlands in 2023-2024.

Yorta Yorta Nation Aboriginal Corporation country lands lie on both sides of the Murray River roughly from Cohuna to Albury / Wodonga. They include towns such as Echuca, Shepparton, Benalla, Corowa and Wangaratta and extend northwards to just south of Deniliquin (Figure 6 shaded dark blue). Moodie Swamp, Black Swamp and Kinnairds Wetland are in Yorta Yorta country.

GOULBURN BROKEN CATCHMENT



Figure 6. Map of Traditional Owner Country within the Goulburn Broken Catchment

GB CMA engaged with YYNAC to discuss potential non-watering of wetlands in 2023-2024 via on-line meetings. YYNAC were asked to complete the table below (Table 4) to assist the GB CMA in ensuring environmental water can support the cultural values of wetlands in our catchment. YYNAC have also approved this seasonal watering proposal by reviewing the proposed watering actions and providing a letter of endorsement.

Table 4. Traditional Owner values and uses of wetlands in the Broken Catchment

| Wetland | Traditional Owner Group | Values | How will this be considered in 2023-2024? |
|--------------------------|-------------------------|---|--|
| Black Swamp | Yorta Yorta | Black Swamp has significant diversity within the landscape, multiple varieties of Nardoo (food source), native grasses, old man Weed (medicinal) and basket weaving sedges/rushes are in the area. The ephemeral wetlands support a wide array of bird life and other fauna that provide a variety of cultural values i.e., food, clothing etc. Evidence of cooking mounds present around perimeter of the swamp. | Promoting the drying of the site may allow increased access to native food sources and weaving material. |
| Kinnairds Wetland | | Presence of Moira Grass and other culturally important species including but not limited to Old Man Weed/Sneezeweed, Nardoo (food), grasses used for weaving. | Promoting the drying of the site may allow increased access to native food sources and weaving material. |
| Moodie Swamp | | Nardoo (food source), native grasses, old man Weed (medicinal) and basket weaving sedges/rushes are in the area. The ephemeral wetlands support a wide array of bird life and other fauna that provide a variety of cultural values ie food, clothing etc. | Promoting the drying of the site may allow increased access to native food sources and weaving material. |

Social, recreational and economic values and uses of waterways

Water for the environment is used to protect and restore the environmental condition of rivers and wetlands. In addition, there are recreational, social, economic and Aboriginal cultural benefits in delivering environmental water. Environmental watering of wetlands increases opportunities and visitation of wetlands for community events, bird watching, picnicking, photography, walking, camping and hunting (previously State Game Reserves reclassified as Wildlife Reserves). Wetlands provide resources for Traditional Owners for hunting, food, medicinal and traditional activities.

A summary of potential shared benefits of the 2023-2024 proposed environmental water deliveries are listed in Table 5.

Table 5. Shared benefits of watering wetlands in the Broken Catchment in 2023-2024

| Wetland | Beneficiary | Connection to wetland | Value | How have these benefits been considered? |
|--------------------------|--|---|--|---|
| Black Swamp | Bird watchers Photographers | Recreation and tourism play an important role in the Moira shire. Tourism is the seventh largest contributor to economic output with an estimated \$90 million for the local community. | Environmental watering provides opportunities for activities such as bird watching and photography. | At the time of writing this proposal Black Swamp was holding water after flooding in September 2022. Waterbirds flourish at the site whilst it is wet. As the swamp draws down and dries, Black Swamp and its surrounding woodland provide good habitat for terrestrial bird species. |
| Kinnairds Wetland | Recreation users including: Bird watchers Photographers Walkers Community members Wildlife watchers | Recreation and tourism play an important role in the Moira shire. Tourism is the seventh largest contributor to economic output with an estimated \$90 million for the local community. The local community are able to access the wetland site. It provides a location for community gatherings and encourages outdoor activity, promoting wellbeing and mental health. | Environmental watering provides opportunities for activities such as walking, bird watching and photography. The site provides highly pleasing aesthetics and amenity. There is a walking path around the wetland along with interpretive signage, wildlife viewing platforms and picnic spots. | At the time of writing this proposal Kinnairds Wetland was holding water after flooding in October 2022. Waterbirds and aquatic plants flourish at the site which encourages bird watchers and nature enthusiasts to visit the site. Even as the site dries, Kinnairds wetland provides a good woodland site for terrestrial species and is aesthetically pleasing for locals and tourists visiting the site. |
| Moodie Swamp | Bird watchers Photographers Walkers | Recreation and tourism play an important role in the Moira shire. Tourism is the seventh largest contributor to economic output with an estimated \$90 million for the local community. | Environmental watering provides opportunities for activities such as walking, bird watching and photography. | At the time of writing this proposal Moodie Swamp was holding water and has been since 2021. Waterbirds flourish at the site encouraging bird watchers to visit the site. Even dry, Moodie Swamp and its surrounding woodland provide good habitat for terrestrial bird species. |

Seasonal review 2022-2023

Climatic conditions

Climatic conditions (BoM, 2023) observed from the Cobram Station (Station ID 80109) indicate that rainfall over the 2022 year was above the long term mean average except for the months of May, June and July 2022 and January 2023 (Figure 7). These large rainfall events contributed to a wet catchment and provided natural inflows filling all the wetlands including Black Swamp, Moodie Swamp and Kinnairds Wetland. Water for the environment was not delivered to Black Swamp and Kinnairds wetland in Autumn 2023 because of filling in October 2022 and holding water at the time of writing this plan.

Wetter conditions have meant most of the wetlands in the Broken catchment are wet. The wetting and drying pattern for each wetland from 2013-2023 is shown in Table 8. Further information regarding key observations and findings from the watering actions is provided in the below sections.

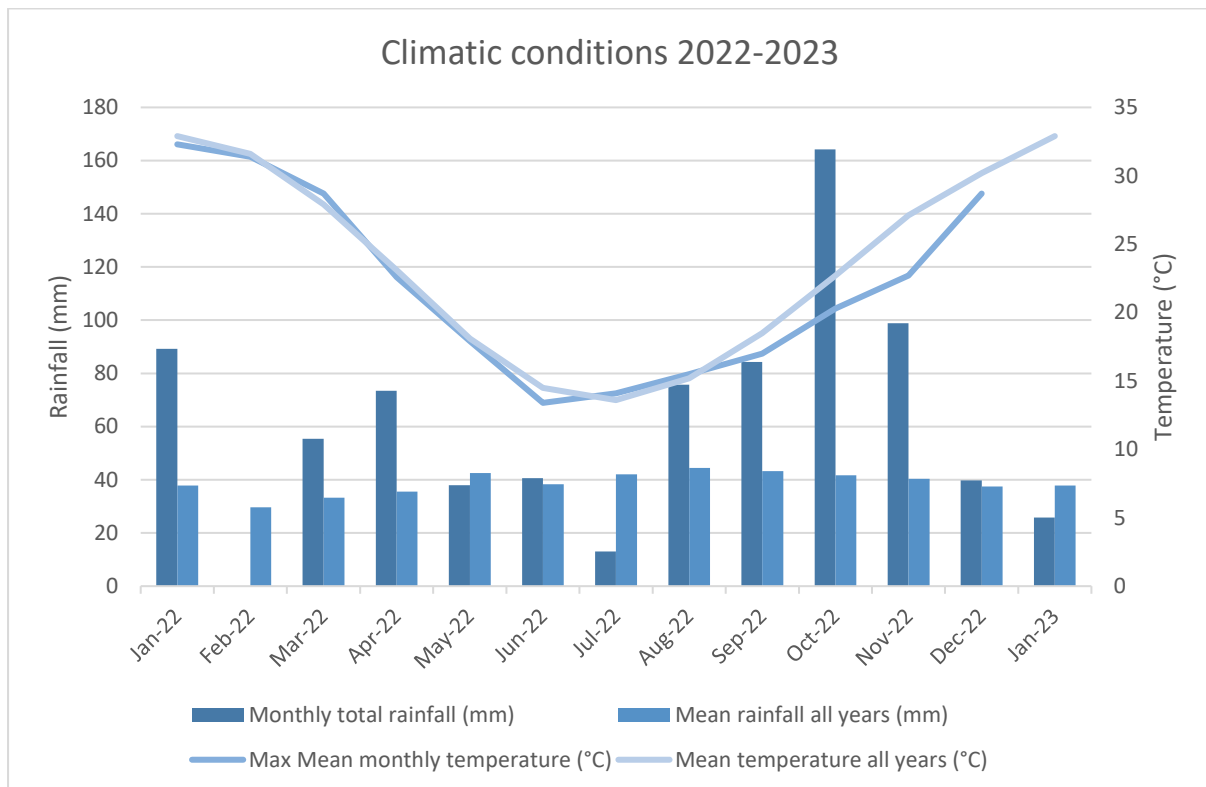


Figure 7. Climate conditions for the Broken region over 2022 and early 2023

Assessment of watering actions 2022-2023

The environmental watering objectives for the Broken Wetlands in 2022-2023 were to:

- Provide wetting cycles that promote healthy wetland vegetation communities; and
- Provide feeding and breeding habitat for a range of waterbirds at Black Swamp and Kinnairds Wetland.
- Promote drying at Moodie Swamp.

The aim of the 2022-2023 seasonal watering proposal was to:

- Fill Black Swamp in autumn 2023 to a maximum depth of 1m in the deepest parts, for 6-8 months to maintain or improve Red Gum Swamp EVC and provide habitat for waterbirds and frogs.
- Fill Kinnairds Wetland in early autumn 2023 to a maximum depth of 1m in the deepest parts for 6-8 months to promote vegetation growth and recruitment and provide habitat for waterbirds and frogs. Top up in spring 2023 if required to achieve desired wetting duration.
- Promote drying at Moodie Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period.

Deliveries to Black Swamp and Kinnairds Wetland did not occur due to filling naturally in September and October 2022 and still holding water and near full capacity at the time of writing this plan. The promotion of drying Moodie Swamp did not occur due to the site flooding in October 2022. Table 6 shows regulated vs unregulated events at Broken system wetlands. This indicates that Black Swamp and Kinnairds Wetland have exceeded their proposed watering regimes in years but not necessarily in ponding duration. Monitoring of these sites indicates that the exceedance of the proposed watering regimes has not had any detrimental effects. Moodie Swamp has met its proposed watering regime in ten years. Moodie Swamp optimal ponding duration missed out by one year. Table 7 outlines the potential watering actions from 2022-2023 and an assessment of how they were achieved.

Table 6: Watering of Broken Wetlands since 2013-2014 to 2022-2023

| Wetland | Proposed Water in 10 years | Optimal Ponding (months) | Optimal Drying (months) | Unregulated events since 2013 | Unregulated events that met wetting duration since 2013 | E-water deliveries | E-water delivery that met ponding duration | Total wet events in 10 years (unregulated and e-flows) | Optimal ponding duration met in 10 years (unregulated and e-flows) |
|--------------------------|----------------------------|--------------------------|-------------------------|---|---|-------------------------------------|--|---|--|
| Black Swamp | 5 | 6 to 8 | 6 | 4 (2015-16 regulator tampered with and water let into swamp – not natural inundation. This was on back of 2015-16 e-water event). | 1 (2022-23) | 5 (2014, 2015-16, 2018, 2020, 2021) | 1 (2013-14) | 8 (2014 = e-water; 2015-16 e-water and unreg combined; 2016 = unreg; 2017 = unreg; 2018 = e-water; 2020 = e-water; 2021 = e-water; 2022 = unreg) | Optimal ponding duration meets 3 in 10 years. |
| Kinnairds Wetland | 5 to 7 | 6 to 8 | 6 to 9 | 6 (2014, 2016, 2017, 2020, 2021, 2022) | 1 (2022-23) | 5 (2014, 2015, 2018, 2020, 2021) | 1 (2015-16) | 8 (2014 = e-water and unreg combined; 2015 = e-water; 2016=unreg; 2017 = unreg; 2018 = e-water; 2020 = e-water and unreg combined; 2021 = e-water and unreg combined; 2022 = unreg) | Optimal ponding duration meets 3 in 10 years (2014 = e-water and unreg flows meet optimal ponding duration; 2015 = e-water delivery meets optimal ponding duration; 2022 = unreg meets optimal ponding duration) |
| Moodie Swamp | 5 | 6 | 6 to 9 | 4 (2016,2020, 2021,2022) | 1 (2019-20) | 4 (2014,2016,2018, 2021) | 1 (2014) | 5 (2014 = e-water, 2016 = e-water and unreg combined; 2018 = e-water; 2020 = unreg; 2021-22 = e-water and unreg combined) | Optimal ponding duration meets 4 in 10 years |

indicates total times site has been wet. If site has had an environmental water delivery and unreg flow event and has not dried out in between these two events, this is classed as one watering.

Table 7: Watering priorities and delivery status for Broken wetlands in 2022-2023

| Priority | Wetland | Flow component | Timing | Potential Watering Action | Achievement 2022-2023 |
|----------|-------------------|----------------|-------------|--|---|
| 1 | Black Swamp | Partial fill | Autumn 2023 | Fill Black Swamp in autumn 2023 to a maximum depth of 1m in the deepest parts, for 6-8 months to maintain or improve Red Gum Swamp EVC and provide habitat for waterbirds and frogs. Top up in spring 2023 if required to achieve desired wetting duration. | Target achieved naturally. Black Swamp filled due to a large rainfall event in September 2022. At the time of writing this proposal the swamp had reached its optimal wetting regime and it was decided that no additional water was required in autumn 2023. |
| 1 | Kinnairds Wetland | Fill | Autumn 2023 | Fill Kinnairds Wetland in early autumn 2023 to a maximum depth of 1m in the deepest parts for 6-8 months to promote vegetation growth and recruitment and provide habitat for waterbirds and frogs. Top up in spring 2023 if required to achieve desired wetting duration. | Target achieved naturally. Kinnairds Wetland filled due to a large rainfall event in October 2022. At the time of writing this proposal the wetland was still full and was near reaching its optimal wetting regime. It and it was decided that no additional water was required in autumn 2023. |
| NA | Moodie Swamp | Dry | 2022-2023 | Promote drying at Moodie Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | Not achieved. Moodie Swamp has been wet since priming in Autumn 2021 with the addition of environmental water in September 2021. Rainfall in January and February 2022 kept the swamp topped up over the summer months and into Autumn 2022. Winter and Spring of 2022 were above average in rainfall and the swamp flooded in October 2022 after a large rainfall event occurred across the region. At the time of writing this plan, Moodie Swamp is still holding water and the promotion of drying is yet to be achieved. |

Key observations and findings in 2022-2023

Black swamp

Black Swamp was to receive an environmental water delivery of 80ML in Autumn 2023. This allocation did not occur as the site filled in September 2022 and flooded in October 2022 due to large rainfall events. At the time of writing the plan the swamp was still holding water. A large number of waterbirds have utilised the swamp since filling with Ducks, Herons and egrets and Ibis being observed. Large nests were observed at the site in March 2023. No birds were seen sitting on them but were suspect Swans nests. Terrestrial species have also utilised the swamp and its bird activity with a large Goanna sighted with a bird in its mouth. Aquatic vegetation has responded well with a small patch of southern cane-grass and tangled lignum being observed. The mosaic of Phragmites and Typha within the swamp has remained without encroaching into the swamp. This mosaic provides habitat for cryptic waterbird species that utilise the swamp. Management of this mosaic of Typha and Phragmites at the site has been assisted by using environmental water.

An Index of Wetland Condition assessment of the site was undertaken in 2010 which found the swamp to be in a moderate condition at the time. Water for the environment has been delivered five out of ten years with an additional four events because of unregulated natural conditions (Table 6). This has provided optimum conditions to maintain the moderate condition of the site and for the wetland to achieve desired ecological outcomes for aquatic vegetation and birdlife.



Figure 8. Dusky Woodswallow, ominous clouds over Black Swamp and Nardoo during environmental water delivery 2021 (photos to be updated by final report).

Kinnairds wetland

Kinnairds Wetland was to receive an environmental water delivery in autumn 2023. Due to a large rainfall event in October 2022 and the wetland flooding, no environmental water allocation was delivered. Kinnairds Wetland was holding water at the time of writing this plan. The site has been wet for five months and is expected to meet the optimum ponding duration of six months. The wetland flourished with the flood water with Yellow-Billed and Royal Spoonbills being seen with the breeding plumage and colour showing. Swans nested at the site with other bird species being present such as Black Duck, Purple Swampheens, Australian White Ibis and both White-faced and White-necked Herons. European Carp were also observed within the wetland body and the promotion of a dry phase in 2023-2024 will assist with the management of these. Aquatic plants such as spike sedge were beginning to develop around the margins of the wetland in January 2023. Due to the flooding event Carp have also moved into the wetland. A drying phase I 2023-2024 will assist with the management of these.

An Index of Wetland Condition (IWC) assessment in 2010 indicated that Kinnairds Wetland was in moderate condition. A combination of both environmental water and unregulated flows have provided water to the wetland eight years in ten (Table 6). This has exceeded the optimum requirement of wetting five to seven years in ten for floristic diversity. Unregulated flows over the past ten years have ponded for approximately 4.5 months and environmental flows for six months.

Monitoring of the site shows that floristic diversity at the site has increased since the introduction of environmental water and has not seem to have been affected by the wetting regime of eight in ten years.



Figure 9. Kinnairds Wetland holding water in January 2023

Left to right: Southern boardwalk, top right track heading from southern drain crossing towards eastern bird hide, bottom left track and boardwalk leading to northern bird hide.

Moodie swamp

Moodie Swamp was primed in July 2021 after a large rainfall event occurred. The proposed autumn 2022 delivery was brought forward to spring 2021 after the observation of four Brolga were observed displaying courtship behaviour. Delivery of 1000ML began in September and finished in late December 2021. The swamp held water for the duration of 2022 with natural top-up inflows entering the swamp in January, February, and October 2022, due to large rainfall events. Field inspections of the site in late January and early February 2023 observed swans nesting. Tangled Lignum flowered profusely and many aquatic herbs and grasses such as Southern Cane-grass were prolific. At the time of writing this proposal the swamp was still holding water and has moved into a prolonged wetting phase. Monitoring of the swamp in March 2022 showed the site to be in good condition with Cane grass becoming prolific across the swamp. In areas of more open water, Myriophyllum species dominated, and margins of the swamp were diverse in aquatic plants such as Otelia, rushes and tangled lignum. Carp have moved into the swamp via Gearys channel from the Broken Creek. The proposed drying of the swamp will assist with the management of these. Brolga were observed at the site with a large number of water birds including Whistling Ducks and Herons. Spotted Marsh Frog were observed calling in large numbers at the swamp.

An Index of Wetland Condition (IWC) assessment in 2010 found Moodie Swamp to be in good condition. Monitoring by Rakali consulting since 2008 has indicated that Moodie Swamp vegetation condition and EVC condition has improved since the beginning of environmental water delivery to the site, with ecological objectives for EVCs having been met (Cook and Just, 2019). Moodie Swamp has been wet nine in ten years with five of these years being unregulated flows into the swamp (Table 8 and 9). Environmental water has been delivered to the site four in the last ten years, with an average ponding duration of six months, compared to unregulated flows which average 8.5 months ponding.

Optimal watering conditions for the swamp which were identified in the Moodie Swamp Environmental Water Management Plan (2010) was an optimal ponding duration of six months with five in ten years being wet. Water for the environment is critical to maintaining ecological objectives at the site, as the swamp would only receive water via Geary's channel in times of high flows or flooding in the Broken creek otherwise, and in a drying climate this has the potential to impact upon the significant values at the site. A drying cycle is now required at the site, with no water proposed to be delivered until Spring 2024. If the site dries before the end of 2023, this will surpass the optimal drying period of 6-9 months, however, consultation with the GB Scientific Reference Committee determined this would be the most beneficial outcome for the swamp to complete its nutrient cycle.



Figure 10. Moodie Swamp holding water in January 2023 after flooding in October 2022

Photos: Top left: Water level gauge, top right: Swans nest, bottom left: Wandering percher, middle: Tangled Lignum in flower, bottom right: A very full Moodie Swamp in December 2022.

Table 8: Wetting and drying patterns for each wetland from 2013 to 2023

| Wetland Name | 2013-14 | | | 2014-15 | | | 2015-16 | | | 2016-17 | | | 2017-18 | | | 2018-19 | | | 2019-20 | | | 2020-21 | | | 2021-22 | | | 2022-2023 | | | | | | | | | | | | |
|--------------------------|---------|----|----|---------|-----|----|---------|---|---|---------|----|----|---------|----|----|---------|----|----|---------|---|---|---------|----|---|---------|----|----|-----------|---|----|----|---|---|-----|---|---|---|---|---|---|
| | W | Sp | Su | A | W | Sp | Su | A | W | Sp | Su | A | W | Sp | Su | A | W | Sp | Su | A | W | Sp | Su | A | W | Sp | Su | A | W | Sp | Su | A | | | | | | | | |
| Black Swamp | U | U | D | E | E | DD | D | D | D | E | E | D | D | D | U | D | D | D | E | D | D | D | D | D | E | D | D | D | D | D | E | D | D | D | U | U | U | | | |
| Kinnairds Wetland | U | U | D | E/U | E/U | DD | D | D | D | E | E | DD | D | D | U | D | D | U | U/DD | D | D | E | D | D | D | D | D | E | E | D | D | D | D | E/U | D | D | D | U | U | U |
| Moodie Swamp | U | U | D | E | E | E | D | D | D | D | D | E | E | U | U | U | DD | U | D | E | D | D | D | D | D | D | U | U | U | D | D | U | E | E/U | U | U | U | U | U | |

Legend

| | | | | | |
|---------|-------------------|---|-------------------------------|---|-----------------------|
| Dry (D) | Drawing Down (DD) | Unregulated event and drawing down (U/DD) | Environmental Water Event (E) | E-water event and unregulated flows (E/U) | Unregulated flows (U) |
|---------|-------------------|---|-------------------------------|---|-----------------------|

Table 9: 2022-2023 Ecological outcomes for Broken Wetlands

| Wetland | 2022-23 Ecological outcomes |
|--------------------------|--|
| Black Swamp | Black Swamp is currently wet due to inflows from a large rainfall event in September 2022. The proposed Autumn 2023 watering will not go ahead due to this natural wetting event. The swamp has now reached its optimal ponding regime of 6-8 months and now requires a drying regime of at least 6 months. Large numbers of waterbird utilising the swamp in March 2023 and aquatic vegetation such as cane grass moving into the site. Waterbirds abundant at the site with Ducks, Herons, Egrets and Ibis all utilising the swamp. Possible swans nests observed. |
| Kinnairds Wetland | Kinnairds Wetland is currently wet due to inflows from a large rainfall event in October 2022. The proposed Autumn 2023 watering will not go ahead due to this natural wetting event. The swamp has now reached its optimal ponding regime of 6-8 months and requires a drying regime of at least 6 months. Spoonbills seen with breeding plumage and nesting at the site. |
| Moodie Swamp | Moodie Swamp is currently wet and has been wet since Winter 2021. E-water delivery in 2021 and natural inflows into the swamp in January, February and October 2022 have prevented the swamp from drawing down and drying. The swamp has exceeded its optimal ponding regime of 6 months and now requires a drying regime of 6-9 months (up to 12-36 months max). Waterbirds utilising open water sections of the site. Three Brolga observed feeding in March during monitoring run. |

Shared benefits 2022-2023

A review of the shared benefits of the Broken wetlands in 2022-2023 is listed Table 10 below.

Table 10: Shared benefits 2022-2023

| Beneficiary | Review of benefits |
|----------------------------------|---|
| Recreational users/ local groups | The benefit of the Broken wetlands receiving natural inflows in 2022 is that Bird observer groups may utilise these flooding/ filling events to record species at the site. The fullness of wetlands attracts new populations and higher numbers of bird species that may not usually be seen during an environmental water delivery. |

Environmental Objectives

Long-term ecological and hydrological objectives have been established in Environmental Water Management Plans for the three wetlands considered in this proposal. The ecological objectives for the Broken wetlands are outlined below in Tables 11-13. The objectives vary by wetland, but all have an objective relating to either providing feeding and roosting habitat for waterbirds, waterbird breeding opportunities and/or maintaining/improving populations and species diversity of native wetland flora.

Table 11. Potential watering actions and environmental objectives for Black Swamp 2023-2024

| | |
|---|---|
| Potential Watering action | Promote drying at site. |
| Expected Watering Effects | None |
| Environmental Objectives | Promote drying of the site to prevent prolonged inundation and the spread of Typha and Phragmites within the body of the swamp and complete nutrient cycle. |
| Rationale for proposed application in 2023-2024 | Black Swamp filled in September 2022 and over topped in October 2022 after large rainfall events inundated the area. Black Swamp was holding water at the time of writing this proposal. The swamp has now reached its optimal wetting period of 6-8 months and a drawing down and drying regime is required. Allowing the swamp to drawdown and dry for at least 6 months will assist with the completion of the nutrient cycle. |

Table 12. Potential watering actions and environmental objectives for Kinnairds Wetland

| | |
|---|---|
| Potential Watering action | Promote drying at site. |
| Expected Watering Effects | None |
| Environmental Objectives | Promote drying of the site to prevent prolonged inundation, manage carp that have entered the swamp during flooding and complete nutrient cycle. |
| Rationale for proposed application in 2023-2024 | Kinnairds Wetland filled in October 2022 after large rainfall events inundated (flooded) the area and was holding water at the time of writing this proposal. The wetland has now reached its optimal wetting period of 6-8 months and a drawing down and drying regime is required. Allowing the swamp to drawdown and dry for at least 6 months will assist with the completion of the nutrient cycle. Large numbers of Carp entered the wetland from the flooding in October 2022. Drying out the wetland will assist with the management of these pest species. |

Table 13. Potential watering actions and environmental objectives for Moodie Swamp

| | |
|---|---|
| Potential Watering action | Promote drying at site. |
| Expected Watering Effects | None |
| Environmental Objectives | Promote drying of the site to prevent effects of prolonged inundation, manage carp that have entered the swamp during flooding and complete nutrient cycle. |
| Rationale for proposed application in 2023-2024 | Moodie Swamp became primed in autumn 2021 due to a large rainfall event that occurred. Delivery to the swamp proposed for autumn 2022, was bought forward to September 2021 due to Broilga displaying courtship behaviours at the site in July 2021. Since then, the swamp has received natural inflows from the Broken Creek due to higher-than-average flows in January, February and October 2022. At the time of writing this proposal the swamp was still holding a significant amount of water. The swamp has now surpassed its optimal watering regime of six months with aquatic plant diversity possibly beginning to change due to this prolonged flooding. Drawing down and drying of the swamp will assist with this potential loss of diversity at the site. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. |

Scenario planning

The demand and utilisation of environmental water will vary according to climatic conditions. In drier periods reduced natural inflows and restricted water resources may mean that less environmental water is available and hence strategic planning of sites that provide refuge or require protection to avoid critical loss. However, in wetter periods the ecological and hydrological objectives of a wetland may be largely met by natural inflows and only small volumes of environmental water may be required.

According to the latest weather outlook information from the Bureau of Meteorology, March to May has below median rainfall and warmer than median temperature conditions in the Goulburn and Broken Catchments. Lake Nillahcootie is currently 92% full and water is continuing to be released to meet irrigations demands. At the same time last year Lake Nillahcootie was 94% full.

The current (February 2023 – Table 14) Broken system outlook for seasonal determinations indicate:

- an opening high security water share seasonal determination of 34 % in a wet Climate scenario, 15% in average scenario and 0% in dry and extreme dry scenarios;
- a high security water shares seasonal determination of 100% by October 2023 in wet and average Climate scenarios and 63% in a dry Climate scenario; and
- a high security water shares seasonal determination of 0% in July and August 2023 and 4% in October 2023 and 7% in February 2024 in an extreme Climate scenario.

Table 14: Broken system outlook for seasonal determination of high reliability shares

| Climate Scenario | 3 July 2023 | 15 August 2023 | 16 October 2023 | 15 February 2024 |
|------------------|-------------|----------------|-----------------|------------------|
| Wet | 34% | 38% | 100% | 100% |
| Average | 15% | 38% | 100% | 100% |
| Dry | 0% | 6% | 34% | 63% |
| Extreme Dry | 0% | 0% | 4% | 7% |

The scenarios are based on receiving catchment inflows with a Probability of Exceedance (PoE) and the likely availability of environmental water, based on data from Goulburn-Murray Water. The scenarios are extreme dry/drought (99% PoE), dry (90% PoE), average (50% PoE) and wet (10% PoE). These scenarios were chosen as they may result in different natural inflows to the wetlands and the volume of environmental water required. No watering is proposed for any of the Broken wetlands during 2023-2024.

Potential watering actions 2023-2024

The environmental water management priorities currently being considered for inclusion in 2023-2024 Seasonal Watering Proposal are listed below (Table 15). These have been categorised into Tier 1 and Not Applicable. Tier 1 watering actions are the critically important actions that should be achievable based on estimates of supply and other available resources under each planning scenario.

In 2023-2024, under all climatic scenarios there are no proposed potential watering actions at any Broken catchment wetlands.

Table 15: Potential Watering Actions for 2023-2024

| Priority | Wetland | Potential Watering Action | Climate Scenario and ML Water | | | |
|--------------|-------------------|---|-------------------------------|----------|----------|----------|
| | | | Ex. Dry | Dry | Average | Wet |
| NA | Black Swamp | Promote drying at Black Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | 0 | 0 | 0 | 0 |
| NA | Kinnairds Wetland | Promote drying at Kinnairds Wetland. Allowing the wetland to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. This will also assist with management of Carp that entered the wetland during flooding events in October 2022. | 0 | 0 | 0 | 0 |
| NA | Moodie Swamp | Promote drying at Moodie Swamp. Allowing the swamp to draw down and dry for at least 6 months will assist with the completion of the nutrient cycle and to reach its optimal drying period. | 0 | 0 | 0 | 0 |
| Total | ML | | 0 | 0 | 0 | 0 |

Delivery constraints

A notice period of one to two days minimum, preferably four days, is required for environmental water orders from Broken system storages. If constraints, such as high irrigation demand, in making environmental water available are foreseen by Goulburn-Murray Water, the Environmental Water Manager will be advised accordingly. The physical delivery of environmental water to the wetlands may only take 1-3 days during the irrigation season depending on system demands.

Black Swamp can only receive environmental water when the Nine Mile creek is running at approximately 100ML/day. This regularly occurs during the irrigation season however, if irrigation demand is high during the required delivery period, environmental water delivery into the Swamp may be delayed.

Kinnairds Wetland environmental water delivery occurs via the Muckatah Main Drain. Water is delivered to the drain via the channels entering the drain approximately 15km upstream which can cause some transition losses along the way. Kinnairds Wetland does not have a delivery share, therefore environmental water can only be delivered when there is spare capacity to carry water in the channels and drain. Investigations into a more efficient delivery channel to the site are currently being undertaken. Reasonable notification to Goulburn-Murray Water of a potential delivery to the site will assist with this issue.

If watering was planned for 2023-2024, Goulburn Broken Catchment Management Authority would coordinate any planned delivery of environmental water with the VEWH, Goulburn-Murray Water, Moira Shire and Parks Victoria. Further delivery arrangements would be outlined in delivery plans.

If delivery was to occur in delivery constraints for Broken catchment wetlands are summarised below in Table 16.

Table 16: Possible delivery constraints to wetlands in the Broken system in 2023-2024

| Priority site | Delivery Constraint | Impact/Consequence | Mitigation Action | Temporary/ Systemic Constraint |
|--------------------------|--|--|--|--------------------------------|
| Black Swamp | Nine Mile creek (delivery source) must be running at 100ML/day to be able to deliver water to Black Swamp so may be not able to deliver to wetland at desired times. | Delivery may not occur if creek is not running high enough. This may impact upon promotion of EVCs and the loss of threatened species populations such as River Swamp Wallaby Grass | GB CMA to discuss appropriate timing of watering with GMW to meet both irrigation demands and environmental water delivery requirements. | Systemic |
| Kinnairds Wetland | No delivery share for this wetland, therefore environmental water can only be delivered when there is spare channel capacity. | Impact on delivery timing and duration if water not available. Impact on target waterbird breeding, May also impact upon threatened species populations such as the Rigid Water-milfoil. | GB CMA to discuss appropriate timing of watering with GMW to meet both irrigation demands and environmental water delivery requirements. | Systemic |

Confounding Factors

Confounding factors are other environmental factors that have the potential to limit or impact desired environmental watering outcomes. Regulation of the Broken River and land use changes have altered the landscape reducing and changing vegetation and therefore habitat for many species. Species diversity and richness has been severely impacted which may result in some of the watering outcomes not able to be realised. Many wetlands are small and often disconnected from the main river channel and each other resulting in a disconnected landscape limiting the movement of plants and animals. Invasive animals and plants such as foxes, European carp and blackberry can have serious impacts on native flora and fauna. As water delivery will not be occurring at any of the Broken Wetlands in 2023-2024, no confounding factors will be discussed in this proposal.

Increasing Knowledge

WetMAP - Victoria's Wetland Monitoring and Assessment Program for environmental water is a state-wide monitoring program designed to assess the ecological response of vegetation, waterbirds and fish to the delivery of environmental water in Victorian wetlands. The WetMAP program objectives are:

- Build on current knowledge and conceptual models to improve the understanding of the relationships between environmental flows and ecological response/ outcomes.
- Determine whether the current ecological objectives for environmental watering are being met.
- Inform environmental flow management for CMAs – inform the development of objectives and planning for environmental water delivery.
- Communicate the ecological outcomes of environmental water delivery in Victorian wetlands to the Minister, water industry stakeholders and broader community.
- Contribute to Victoria's Murray Darling Basin Plan reporting requirements.

WetMAP monitoring began at Moodie Swamp and Black Swamp in late 2017 (<https://www.ari.vic.gov.au/research/wetlands-and-floodplains/assessing-wetland-response-to-water-for-the-environment>). This monitoring will complement the monitoring being undertaken by the GB CMA staff.

Compliance monitoring is also undertaken during the delivery of environmental water. This includes monitoring regulator operation and the volume of water delivered. This has been complimented by regular field observations by staff and acoustic monitoring to help determine the presence and number of waterbirds and frogs, and wetland condition. The information collected has been highly valuable in informing the ongoing management of these wetlands, and State Government and VEWH reporting.

In the event of wetlands naturally filling, waterbird monitoring, water depth and extent will be monitored on a regular basis to determine when and if environmental water is required. If environmental water is delivered to a wetland these attributes will continue to be monitored along with the volume of water delivered. Attention will be paid to water levels to ensure nests are not exposed by water losses and nests close to the water surface are not inundated by environmental water deliveries. Monitoring of ecological attributes such as vegetation will be dependent upon available funding and staff resources.

Knowledge Gaps and Limitations

One of the key knowledge gaps associated with wetland environmental water management in the Broken Catchment is the limited information on the flood regime tolerances of aquatic dependent ecological vegetation communities and their associated flora species such as Southern Cane-grass and EPBC (1999) listed Rigid Water-milfoil and River Swamp Wallaby-grass.

These knowledge gaps do not prevent environmental water being delivered to the wetlands. However, more information on the flood regime tolerances of aquatic dependent ecological vegetation communities and their associated flora species would help refine wetland flood regimes and the management of environmental water.

Reporting

The first level of reporting is on the use of environmental entitlements. Weekly reporting advises environmental entitlement holders of progressive water use and on any adaptive water deployment decisions made.

The second level of reporting is on environmental outcomes achieved. Information on the use of environmental water, environmental outcomes recorded, and any knowledge gained will be reported to GB CMA partners and the board monthly and summarized in the 2024-2025 Broken System Wetlands Seasonal Watering Proposal. WETMAP also produces annual reports on the results of the program.

Risk Management

The risks associated with the proposed delivery of environmental water to the wetlands in the Goulburn Broken Catchment are outlined in Table 17 below, along with their mitigation actions and the organisation responsible for their implementation. These will be reviewed and updated prior to the delivery of environmental water in site specific environmental water delivery plans.

Table 17: Risk assessment of proposed water delivery

| Pre-Mitigation Risk | | | | | | | | Residual Risk | | | | |
|---------------------|---------------|----------------------|--|--|------------|-------------|-------------|---|--------------------------------|------------|-------------|-------------|
| Risk ID | Risk category | Relevant to Wetlands | Requires inclusion and tailoring in delivery plan | Risk description | Likelihood | Consequence | Risk Rating | Mitigation actions | Lead organisation for action | Likelihood | Consequence | Risk Rating |
| NOGB2020-01 | Environment | Yes | Yes - depends on the volume of the delivery (affects consequence rating). Treatment may be similar, however. | Specified flow rates are insufficient to achieve the intended extent of wetland inundation or magnitude and duration of river flows, resulting in a failure to achieve planned environmental outcomes. | Possible | Major | Medium | <ul style="list-style-type: none"> • Include contingency allowance in estimated watering requirements, based on previous event data, and consider a contingency in the duration of the event to achieve desired wetland inundation. • Monitor event (especially for deliveries to new sites or for previously untested events) and adjust flows as necessary, or terminate event if it becomes clear that insufficient water is available. • Identify and address constraints that may limit the flow rates for environmental deliveries. | CMA CMA CMA/GMW | Possible | Minor | Low |
| NOGB2020-02 | Reputational | Yes | Yes - depends on the volume of the delivery (affects consequence rating). | Specified flow rates are insufficient to achieve the intended extent of wetland inundation or magnitude and duration of river flows, resulting in a failure to achieve planned environmental outcomes and loss of community support. | Possible | Major | Medium | <ul style="list-style-type: none"> • Communications on the environmental benefits of watering actions. • Monitor event (especially for deliveries to new sites or for previously untested events) and adjust flows as necessary or terminate event if it becomes clear that insufficient water is available. • Communicate the need for complimentary measures to optimise the benefits of environmental watering actions. | CMA | Unlikely | Minor | Low |
| NOGB2020-03 | Environment | Yes | No- generic risk that is mitigated prior to delivery plan process | Overestimates of environmental water demand prevents planning for supplying demands at other locations <i>Notes: Planning watering actions also includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i> | Possible | Minor | Low | <ul style="list-style-type: none"> • CMAs review demand estimates and targets met by unregulated flows throughout the delivery cycle and regularly advise VEWH of any changes so unused water can be reallocated. • CMAs review demand estimates at the conclusion of the watering year, prior to the development of the following seasonal watering proposal, so estimates of future requirements are more accurate. • River operators provide regular updates on flows, including through OAG meetings • Manage Water Holdings to maximise supply opportunities for all sites | CMA CMA MDBA/GMW VEWH | Unlikely | Minor | Low |

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|-------------|----------------|--|--|--|----------|----------|--------|---|---|----------|-------|-----|
| NOG82020-04 | Environment | Yes | Yes – consequence level likely to vary depending on volume and needs to be actively managed during delivery | Inaccurate accounting and measurement or operational error results in target flows either not being achieved or being exceeded, leading to a failure to achieve planned environmental outcomes Occurring in Upper Broken Ck below Casey's weir offtake due to weed growth, which is also limiting flow capacity (likelihood for Broken is "possible") | Unlikely | Moderate | Low | <ul style="list-style-type: none"> Review accounting and measurement processes to be used to ensure that techniques are agreed, and monitoring/measurement sites are operational. - Apply agreed arrangements as documented in the Murray and Goulburn Systems Operating Arrangement documents - GMW to undertake additional gaugings - Weed control in Bkn Ck programmed for autumn (weather conditions permitting) | GMW (MDBA in some waterways such as Barmah) GMW/VEWH GMW GMW/CMA | Unlikely | Minor | Low |
| NOG82020-05 | Business Costs | Yes | Yes – consequence level likely to vary depending on volume and needs to be actively managed during delivery | Volumes of environmental water delivered or released exceed volumes approved for use in the event, leading to potential overdraw of accounts or preventing other planned actions being undertaken. <i>Notes: Planning watering actions also includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i> | Unlikely | Major | Low | <ul style="list-style-type: none"> Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume. Ensure ordering and delivery procedures are kept up-to-date and adhered to. Ensure metering and reporting processes for temporary pump operations are suitable and effective | CMA & GMW GMW/CMA/VEWH CMA | Unlikely | Minor | Low |
| NOG82020-06 | Environment | Yes | Yes – depends on the volume of the delivery (affects consequences rating). Treatment may be similar however. | Environmental water account is overdrawn, leading to water not being available as per approved watering statement to complete planned actions and environmental benefits not being achieved. <i>Notes: Planning watering actions also includes decisions around the carryover and trade of water as alternatives to current year water use decisions.</i> | Unlikely | Major | Low | <ul style="list-style-type: none"> Monitor ABA balances and undertake regular communications with CMA and RWC as part of portfolio management activities. Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume. | VEWH CMA & GMW | Unlikely | Minor | Low |
| NOG82020-07 | Environment | Yes (where delivered via infrastructure) | No, managed prior to delivery plan development | Planned maintenance of water delivery infrastructure results in planned/specified flows not being achieved, leading to a failure to achieve planned environmental outcomes. | Likely | Minor | Low | <ul style="list-style-type: none"> Undertake early planning and communications between the CMA and storage operator to minimise likelihood of constraints, enable scheduling of maintenance outside of high demand periods or identify alternative environmental water delivery windows to avoid scheduled maintenance activities. Consider adding time contingencies to planned maintenance schedules to ensure works are completed prior to commencement of watering actions. | CMA and GMW CMA | Unlikely | Minor | Low |
| NOG82020-08 | Environment | Yes | Yes, requires consideration, if possible, for the site during delivery plan process (i.e.: where site is known to have poorly maintained infrastructure) | Failure of poorly maintained environmental delivery infrastructure results in planned/specified flows not being achieved, reducing the ability to achieve planned environmental outcomes. (Including failure or damage due to vandalism) | Likely | Moderate | Medium | <ul style="list-style-type: none"> Asset ownership is clarified, and the asset owners perform regular maintenance, and pre-event asset inspections, on delivery infrastructure. <i>*Note that insufficient resources are likely to limit the asset owner's ability to regularly inspect and maintain infrastructure. Increased resources for these activities may further reduce the likelihood and risk ratings.</i> | Asset Owner Asset Owner Asset Owner CMA Asset Owner PV | | | |

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|-------------|-------------|--|--|---|----------|----------|--------|---|---|----------|----------|-----|
| | | | | Requires site specific risk assessment - relevant to wetlands, not rivers and streams, apart from perhaps Warrigal Creek (not targeted with e-water). Risk only relevant to wetlands sites - residual risk rating to be assessed at Delivery Plan/Event Plan phase | | | | <ul style="list-style-type: none"> Report vandalism to police. Review asset design to minimise opportunities for interference or damage. For privately owned assets, arrange approvals to use/operate assets and undertake pre-delivery inspections Communicate failures to the CMA Initiate documentation of asset ownership and management arrangements in national parks. <p>Consider monitoring options to detect vandalism, interference, or failure of assets at individual sites with elevated risks.</p> | | | | |
| NOG82020-09 | Environment | Yes – where delivered via infrastructure | Yes, requires consideration, if possible, for the site during delivery plan process (i.e.: where site is known to have poorly maintained infrastructure) | <p>Poor condition of delivery infrastructure results in the asset owner being unable to operate the structure due to OH&S risks, leading to failure to deliver environmental flows and to achieve environmental objectives.</p> <p>Note: This issue may affect multiple sites</p> <p><i>GMW to confirm OH&S status and likelihood rating</i></p> | Likely | Moderate | Medium | <ul style="list-style-type: none"> Asset owner to undertake regular maintenance and pre-event asset inspections on delivery infrastructure. <i>*Note that insufficient resources are likely to limit the asset owner's ability to regularly inspect and maintain infrastructure. Increased resources for these activities may further reduce the likelihood and risk ratings.</i> Communicate failures to the CMA Develop design for new regulating structure and seek funding to implement necessary upgrades in conjunction with asset owner. <i>Note: PV proposing to issue operating licences for BMF regulators</i> | Asset Owner Asset Owner CMA (MDBA in Barmah Forest) | Unlikely | Minor | Low |
| NOG82020-10 | Environment | Yes | Yes | <p>High operational and consumptive water demands lead to reduced access for environmental deliveries, with the result that target flows/volumes cannot be achieved, impacting on environmental outcomes</p> <p>Note: Goulburn R is a particular risk - see new separate Goulburn risk added</p> | Likely | Minor | Low | <ul style="list-style-type: none"> Event planning will seek to avoid peak demand periods, and events will be monitored and adjusted as necessary. System operators to provide longer term forecasts for future consumptive demands as an input to planning watering proposals Develop longer term agreements on river capacity access for environmental deliveries. Investigate opportunities to undertake deliveries outside the irrigation season with consideration of appropriate delivery costs | CMA and GMW GMW/MDBA VEWH CMA and VEWH | Possible | Minor | Low |
| NOG82020-12 | Legal | Yes | Yes, where relevant | <p>Environmental releases, either on their own or potentially in combination with unexpected tributary inflows, cause unauthorised inundation of private land, resulting in impacts on landowner activities and assets.</p> <p>Note that 2022 floods have caused erosion or damage to the riverbanks which may result in Environmental releases (at previously acceptable flow rates) causing unauthorised inundation of private land, resulting in impacts on landowner activities and assets.</p> | Possible | Major | Medium | <ul style="list-style-type: none"> Ensure currency of any landholder agreements for inundation of private land. Release plans designed to avoid exceeding operational thresholds or unauthorised flooding. Monitor events and adjust releases to avoid overbank flows. This may include limiting deliveries to daylight hours only, where feasible and consistent with watering requirements. Monitor forecast rainfall and tributary inflows and adjust releases to avoid overbank flows. Monitor deliveries to new locations to build an understanding of flow patterns and inundation thresholds and adjust releases accordingly. Investigate post flood to determine commence to flow of major erosion in the Mid Goulburn (and other systems as required). | CMA CMA GMW/MDBA GMW/MDBA CMA CMA/Storage operator | Unlikely | Moderate | Low |

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| | | | | | | | | <ul style="list-style-type: none"> Seek advice from storage operator of any known changes in bank levels and commence to flow levels. | | | | |
| NOGB2020-13 | Reputational | Yes | Yes | Public land and/or access routes into public land areas may be inundated by delivery of environmental water, leading to potential impacts on recreational opportunities for park users (e.g. access to boat ramps, fishing spots, firewood collection etc.). Applies to Lower Goulburn | Almost certain | Moderate | High | <ul style="list-style-type: none"> Watering proposals to identify potential impacts, communication of planned events, access closures, alternative recreational opportunities and alternative access routes | CMA Land Manager | Almost certain | Minor | Medium |
| NOGB2020-15 | Business Costs | Yes | Yes | Public land visitor vehicles cause damage to tracks, or to other assets in the surrounding landscape, due to off-road activity (by users going off track to avoid floodwaters) during and after environmental watering. Risks only relevant to wetland sites – residual risk rating to be assessed at delivery plan phase. | Likely | Moderate | Medium | <p>Land Managers:</p> <ul style="list-style-type: none"> implement management activities to prevent access to flooded roadways (e.g. close roads, communicate planned events, install signage) repair damage during and after environmental watering events maintain key higher ground tracks to enable alternative access routes during environmental watering. <p><i>*Note that insufficient resources may limit the land manager's ability to implement management activities and hence ability to effectively mitigate the described risk.</i></p> | Land Manager | | | |
| NOGB2020-17 | Service Delivery | Yes | Yes | Access routes into public land areas may be inundated by delivery of environmental water, leading to potential impacts on land management and maintenance activities (e.g. fire mgmt. works) Risks only relevant to wetland sites – residual risk rating to be assessed at delivery plan phase. | Almost certain | Moderate | High | <ul style="list-style-type: none"> Early planning and communications of proposed actions with land manager to minimise likelihood of impacts, and scheduling of maintenance works outside of planned delivery periods. | CMA | | | |
| NOGB2020-19 | Reputational | Yes | No- generic risk with treatment at program level | Environmental water deliveries result in low DO levels, with adverse environmental impacts. | Unlikely | Major | Low | <ul style="list-style-type: none"> Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies and management agencies. Communicate the benefits of environmental water management and inform the local community of environmental water management activities and the underlying rationale, including black water mitigations. Inform communities of black water vs hypoxic black water issues, to build understanding and support | VEWH CMA - VEW/CEWO | Unlikely | Moderate | Low |

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|-------------|----------------|-----|---|---|----------------|----------|--------|--|--|----------|-------|-----|
| NOGB2020-20 | Environment | Yes | Possible inclusion in delivery plan. Site level consideration and mitigation. | Environmental water deliveries may generate or mobilise BGA blooms, with adverse water quality and/or health impacts (including to people, livestock and pets), resulting in cessation of releases and environmental impacts | Possible | Major | Medium | <ul style="list-style-type: none"> Consider likelihood of initiating BGA blooms in event planning and amend as required to manage risk. Land managers or water corporation implement a risk-based monitoring program during environmental watering events, and where issues are identified, activate BGA response processes. <p><i>*Notes: Parks Victoria are currently writing a BGA risk management plan for Northern Victoria Region that considers the potential risk of environmental water events. This plan will outline proactive and reactive monitoring and management responsibilities that Parks Victoria commits to as a Local Waterway Manager for BGA. Adequate BGA resourcing is being considering as part of this plan.</i></p> <ul style="list-style-type: none"> Regional monitoring and advice on BGA status. | CMA / GMW Land Manager GMW | Unlikely | Minor | Low |
| NOGB2020-21 | Reputational | Yes | Yes if known issues at site and specific actions required | Environmental water management activities may conflict with or not complement water based recreational objectives, leading to loss of community support for activities. | Almost certain | Moderate | High | <ul style="list-style-type: none"> Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies. Engage with local recreational user groups to inform them of environmental water management activities and the underlying rationale. Adjust events or actions to reduce/avoid impact where practical without reducing environmental outcomes. Communicate alternate recreational opportunities. Enhance community understanding of water system operations and entitlement frameworks (water literacy). | VEWH CMA CMA Land Manager VEWH | Possible | Minor | Low |
| NOGB2020-22 | Business Costs | Yes | Possible inclusion in delivery plan. Site level consideration and mitigation. | Insufficient resources available (including staff, funding for maintenance of roads, regulators etc.) across partner organisations to deliver all planned environmental watering actions, leading to cancellation or interruptions of deliveries. Risk only relevant to wetlands sites - residual risk rating to be assessed at Delivery Plan phase (e.g. Gaynor Swamp + NE sites - rely on others to monitor pumps). Not as much of an issue for rivers/creeks post-COVID. | Possible | Major | Medium | <ul style="list-style-type: none"> Partners notify the CMA and VEWH of resource constraints in advance of deliveries and VEWH convene OAG meetings to consider implications and potential solutions. Continue to actively prioritise actions to match available resources and ensure key actions are delivered. Reallocate tasks and available funds to ensure highest priority watering actions are delivered. | VEWH CMA CMA | | | |
| NOGB2020-23 | Environment | Yes | Possible – mitigated through other processes at existing sites, however, could be included at a new site where watering is being undertaken as a trial to collect this information. | Insufficient information and knowledge available to inform environmental water deliveries | Unlikely | Moderate | Low | <ul style="list-style-type: none"> Identify important knowledge gaps and secure funding to improve scientific understanding. Consider deferring deliveries until sufficient information is available to mitigate unacceptable risks. Implement adaptive management processes and undertake trials to collect data. Seek necessary resources to undertake approvals and assessments. | CMA | Unlikely | Minor | Low |

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|-------------|-------------------|-----|--|--|----------|----------|--------|---|---------------------------|----------|----------|--------|
| NOGB2020-24 | Legal | Yes | No | Failure to recognise cultural heritage issues at a site targeted for watering may result in necessary permits and approvals not being obtained, leading to prosecution and fines. | Possible | Moderate | Medium | <ul style="list-style-type: none"> Undertake desktop reviews and site assessments with archaeologists, traditional owners and land managers, to identify approval needs and contingency measures. Obtain any necessary formal approvals/permits and implement required actions. | CMA | | | |
| NOGB2020-25 | Cultural heritage | Yes | Possible | Environmental watering causes harm to identified cultural heritage <i>Note: difficult to assess consequence under cultural heritage category - needs further testing with TOs. Hard for non-TOs to try and assess, so doesn't really fit within a traditional risk assessment process</i> | Unlikely | Moderate | Low | <ul style="list-style-type: none"> Work with Traditional Owners to ensure that the potential impact of environmental water deliveries on cultural heritage is understood and agreed, minimised or avoided. Consider opportunities for additional resourcing for TO groups to engage in risk assessments | CMA DEECA/VEWH | Unlikely | Moderate | Low |
| NOGB2020-26 | Reputational | Yes | No | 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"> Rationalise and refocus current monitoring programs (e.g. Wetmap) to better identifying outcomes. Seek additional funds to address gaps in monitoring programs and knowledge. Communicate the benefits of environmental watering and monitoring results (Note: It may not be possible/affordable to address all monitoring gaps, so this risk may still be rated as medium after mitigation actions.) | DEECA VEWH CMA | Possible | Minor | Low |
| NOGB2020-27 | Environment | Yes | Yes | Environmental deliveries improve conditions for non-native species (e.g. carp, invasive species, feral horses) and over-abundant native species (e.g. kangaroos, Red Gum encroachment) leading to adverse environmental impacts. | Likely | Moderate | Medium | <ul style="list-style-type: none"> Study/understand life history of species and develop high level management strategies. Develop and implement site specific management strategies aimed at eradication/control of existing populations (e.g. carp management strategy, willow removal program, water-lily spraying program, feral animal programs). Implement pest reduction efforts prior to delivery of water, to ensure increases in populations remain within "tolerable" levels (Note: This risk is still rated as medium after mitigation actions.) | DEECA CMA/Land Manager | Likely | Moderate | Medium |
| NOGB2020-28 | Environment | Yes | Yes – risk to be assessed for delivery | Environmental watering actions trigger non-targeted environmental responses (e.g., bird breeding) causing unintended consequences (or lost opportunities) for other environmental values. | Likely | Moderate | Medium | <ul style="list-style-type: none"> Undertake monitoring and communicate these issues as they arise and apply adaptive management and review of delivery plans. Consider including contingency allowance in delivery plan water volumes to complete breeding events. | CMA | Possible | Minor | Low |
| NOGB2020-29 | Environment | Yes | No | Ineffective planning and/or uncoordinated water ordering results in administrative obstacles that prevent watering opportunities. | Unlikely | Moderate | Low | <ul style="list-style-type: none"> Enable the full range of watering actions possible in seasonal watering proposals and the seasonal watering plan (as per SWP guidelines) Review and update the Murray system environmental watering ordering template | CMA/VEWH VEWH/MDBA | Unlikely | Moderate | Medium |
| NOGB2020-33 | Reputational | Yes | No | Community concern over environmental releases under dry seasonal conditions may lead to a loss of support for | Unlikely | Moderate | Low | <ul style="list-style-type: none"> Communicate benefits of environmental watering to the community, especially in relation to strategic watering in dry periods. Enhance community understanding of water system operations and | CMA VEWH | Unlikely | Minor | Low |

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| | | | | environmental watering actions. | | | | entitlement frameworks (water literacy). | | | | |
|--------------------|--------------|-----|-----|---|----------|----------|--------|--|-----|----------|-------|-----|
| NOGB2020-34 | Reputational | Yes | No | Under dry conditions, community expectations of the extent of environmental watering that can be achieved are not met, leading to a loss of support for environmental watering actions. Note - e-water deliveries may be constrained in 22-23 due to high consumptive avail. | Possible | Moderate | Medium | <ul style="list-style-type: none"> Communications to inform the community on the limits of environmental water holdings and the extent of actions possible under dry conditions. <i>Note that public concern in this regard may be heightened as a result of the Menindee 2019 fish death events.</i> | CMA | Unlikely | Minor | Low |
| NOGB2020-35 | Environment | Yes | No | Limited environmental deliveries may reduce opportunities to test ecological responses to environmental flows, impacting on effectiveness of research projects. | Unlikely | Minor | Low | <ul style="list-style-type: none"> Review monitoring program and adjust if possible. Reprioritise future flow targets. | CMA | Unlikely | Minor | Low |
| NOGO2022-42 | Reputational | Yes | Yes | Watering wetlands in wetter conditions leads to community concern over incr. flood risk resulting in loss of support for environmental watering program. Note: especially for Loch Garry flood protection district | Possible | Moderate | Medium | <ul style="list-style-type: none"> communicate results of modelling to d/s landholders demonstrating low impacts notification of planned delivery events to landholders staged trial flows with increasing flows over several years to enable monitoring and assessment of outcomes | CMA | | | |

Approval

I, Chris Cumming, the authorised representative of the Goulburn Broken Catchment Management Authority, approve the Seasonal Watering Proposal for the Broken Wetlands 2023-2024.

SIGNED FOR AND ON BEHALF OF Goulburn Broken Catchment Management Authority

A handwritten signature in black ink, appearing to read 'CC', is written over a faint, illegible stamp.

Signature of authorised representative

Name of authorised representative

Chris Cumming (CEO)

Date: 6 April 2023

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Appendices

Appendix 1 - Schedule 8 – Criteria for identifying an environmental asset

Taken from the Basin plan <https://www.legislation.gov.au/Details/F2012L02240>

| Item | Criteria |
|---|---|
| Criterion 1: The water-dependent ecosystem is formally recognised in international agreements or, with environmental watering, is capable of supporting species listed in those agreements | |
| 1 | <p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it is:</p> <ul style="list-style-type: none"> (a) a declared Ramsar wetland; or (b) with environmental watering, capable of supporting a species listed in or under the JAMBA, CAMBA, ROKAMBA or the Bonn Convention. |
| Criterion 2: The water-dependent ecosystem is natural or near-natural, rare or unique | |
| 2 | <p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it:</p> <ul style="list-style-type: none"> (a) represents a natural or near-natural example of a particular type of water-dependent ecosystem as evidenced by a relative lack of post-1788 human induced hydrologic disturbance or adverse impacts on ecological character; or (b) represents the only example of a particular type of water-dependent ecosystem in the Murray-Darling Basin; or (c) represents a rare example of a particular type of water-dependent ecosystem in the Murray-Darling Basin. |
| Criterion 3: The water-dependent ecosystem provides vital habitat | |
| 3 | <p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it:</p> <ul style="list-style-type: none"> (a) provides vital habitat, including: <ul style="list-style-type: none"> (i) a refugium for native water-dependent biota during dry spells and drought; or (ii) pathways for the dispersal, migration and movements of native water-dependent biota; or (iii) important feeding, breeding and nursery sites for native water-dependent biota; or (b) is essential for maintaining, and preventing declines of, native water-dependent biota. |
| Criterion 4: Water-dependent ecosystems that support Commonwealth, State or Territory listed threatened species or communities | |
| 4 | <p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it:</p> <ul style="list-style-type: none"> (a) supports a listed threatened ecological community or listed threatened species; or <p style="padding-left: 40px;">Note: See the definitions of listed threatened ecological community and listed threatened species in section 1.07.</p> <ul style="list-style-type: none"> (b) supports water-dependent ecosystems treated as threatened or endangered (however described) under State or Territory law; or (c) supports one or more native water-dependent species treated as threatened or endangered (however described) under State or Territory law. |
| Criterion 5: The water-dependent ecosystem supports, or with environmental watering is capable of supporting, significant biodiversity | |
| 5 | <p>Assessment indicator: A water-dependent ecosystem is an environmental asset that requires environmental watering if it supports, or with environmental watering is capable of supporting, significant biological diversity. This includes a water-dependent ecosystem that:</p> <ul style="list-style-type: none"> (a) supports, or with environmental watering is capable of supporting, significant numbers of individuals of native water-dependent species; or (b) supports, or with environmental watering is capable of supporting, significant levels of native biodiversity at the genus or family taxonomic level, or at the ecological community level. |

Appendix 2a – Threatened fauna species recorded at Broken Wetlands

| Common Name | Scientific Name | Black Swamp | Kinnairds Wetland | Moodie Swamp | EPBC | FFG |
|---------------------------|-----------------------------------|-------------|-------------------|--------------|------------|-----------------------|
| Australasian Bittern | <i>Botaurus poiciloptilus</i> | Y | Y | Y | Endangered | Critically Endangered |
| Australasian Shoveler | <i>Anas rhynchotis</i> | Y | Y | Y | | Vulnerable |
| Australian Little Bittern | <i>Ixobrychus dubius</i> | Y | | | | Endangered |
| Blue-billed Duck | <i>Oxyura australis</i> | | Y | Y | | Vulnerable |
| Brolga | <i>Antigone rubicunda</i> | | Y | Y | | Endangered |
| Caspian Tern | <i>Hydroprogne caspia</i> | | | Y | | Vulnerable |
| Eastern Great Egret | <i>Ardea modesta</i> | Y | Y | Y | | Vulnerable |
| Freckled Duck | <i>Stictonetta naevosa</i> | Y | Y | | | Endangered |
| Hardhead | <i>Aythya australis</i> | Y | Y | Y | | Vulnerable |
| Lace monitor | <i>Varanus varius</i> | Y | | | | Endangered |
| Little Egret | <i>Egretta garzetta nigripes</i> | | Y | | | Endangered |
| Magpie Goose | <i>Anseranas semipalmata</i> | Y | Y | | | Vulnerable |
| Musk Duck | <i>Bizura lobata</i> | | | Y | | Vulnerable |
| Plumed Egret | <i>Ardea intermedia plumifera</i> | Y | Y | Y | | Critically Endangered |
| Sloane's Froglet | <i>Crinia sloanei</i> | Y | | Y | Endangered | Endangered |
| White-bellied Sea Eagle | <i>Haliaeetus leucogaster</i> | Y | Y | Y | | Endangered |
| White-throated Needletail | <i>Hirundapus caudactus</i> | | Y | | Vulnerable | Vulnerable |

Appendix 2b – Threatened flora species recorded at Broken Wetlands

| Common Name | Scientific Name | Black Swamp | Kinnairds Wetland | Moodie Swamp | EPBC | FFG |
|---------------------------|--|-------------|-------------------|--------------|-----------------------|-----------------------|
| River Swamp Wallaby-grass | <i>Amphibromus fluitans</i> | Y | | | Vulnerable | |
| Winged Water-starwort | <i>Callitriche umbonata</i> | Y | Y | Y | | Endangered |
| Riverine Bitter-cress | <i>Cardamine moirensis</i> | | Y | Y | | Endangered |
| Small-flower Mud-mat | <i>Glossostigma cleistanthum</i> | | Y | | | Endangered |
| Dwarf Brooklime | <i>Gratiola pumilo</i> | | | Y | | Endangered |
| Smooth minuria | <i>Minuria integerrima</i> | Y | | | | Vulnerable |
| Slender Water-milfoil | <i>Myriophyllum gracile var. lineare</i> | | Y | Y | | Endangered |
| Rigid Water-milfoil | <i>Myriophyllum porcatum</i> | | Y | Y | Critically Endangered | Critically Endangered |
| Water Nymph | <i>Najas tenuifolia</i> | Y | | | | Endangered |
| Wavy Marshwort | <i>Nymphoides crenanta</i> | | | Y | | Endangered |
| Floodplain Fireweed | <i>Senecio campylocarpus</i> | Y | | Y | | Endangered |