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# **Black Swamp** Environmental Water Management Plan

2023

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# Summary

Black Swamp's Environmental Water Management Plan 2011 (2011 Plan) has been updated to reflect the changes at Black Swamp over the past 15 years since environmental water was first delivered in 2008. The Black Swamp Environmental Water Management Plan 2023 (the Plan) objectives and targets have been updated from the 2011 Plan to better reflect alignment to the Basin Plan 2012 (Cth 2012) and the Victorian Murray Long-Term Watering Plan (DELWP 2021). The response of the swamp from delivery of environmental water over the past 15 years is documented, indicating a positive increase in flora and fauna diversity at the site and an increase in the index of wetland condition scoring (DELWP 2020).

Black Swamp is a 16-hectare, intermittent river red gum wetland located on Nine Mile Creek near Wunghnu in Victoria. Of the 3,600 wetlands within the Goulburn Broken catchment, Black Swamp is situated in the Broken catchment where only three wetlands can currently receive environmental water. Its availability to receive environmental water via a link channel to Nine Mile Creek makes this site an important refuge for fauna. It is one of the only wetlands within the Goulburn Broken catchment which has a significant sized population of the Environment Protection Biodiversity Act 1999 (EPBC Act; Cth 1999) vulnerably listed River Swamp Wallaby-grass (*Amphibromus fluitans*). Black Swamp is an important gathering place for the Yorta Yorta People with evidence of clay balls and oven mounds being recorded at the site. The wetland still provides resources for Yorta Yorta People who maintain a strong connection to their traditional country. The wetland also provides social and economic value to the local community who benefit from visitors to the site for recreational activities such as birdwatching, camping and duck hunting.

Consultation was undertaken with the Yorta Yorta People to align their use of the site and their cultural values with environmental water values. A draft of this plan was also sent to the Goulburn Broken Environmental Water Wetland Advisory Group for comment which includes the Yorta Yorta People, community members and land and water managers. Consultation to update objectives and targets with the Goulburn Broken Scientific Technical Reference Committee and Yorta Yorta Nation Aboriginal Corporation (YYNAC) also occurred.

Black Swamp has diverse cultural and environmental values at the site that are wetland-dependent, including threatened Ecological Vegetation Classes (EVCs), EPBC Act vulnerably listed River Swamp Wallaby-grass and the waterbirds and frogs that depend on the site for feeding and breeding. Threats to the environmental values at the site include an altered water regime, pest species and climate change.

Ecological objectives and management objectives were first developed for Black Swamp in 2011 as part of the Black Swamp Environmental Water Management Plan (GBCMA, 2011). Building upon the changes from 2008-2023 at the site and to align with Basin Plan (2012) and Victorian Murray Long-term Watering Plan (2021) these objectives have been updated (Table 1).

**The long-term management goal for Black Swamp Environmental Water Management Plan is to:**

*“Maintain and improve the biological values, functioning and resilience of Black Swamp by providing a more natural wetting and drying regime.”*

This plan is linked to the Goulburn Broken Catchment Management Authority (Goulburn Broken CMA) Waterway Strategy (GBCMA 2014) goals, they are;

- Maintaining or improving the resilience of the region’s waterways.
- Wetlands with recognised significance are maintained or improved.
- Maintain or improve waterways of high community value.

Consistent with the long-term management goal and the ecological objectives (Table 1), the water regime for Black Swamp is for flooding to occur three to seven in ten years, in late autumn-spring, and drying out within a year.

Delivery of environmental water to Black Swamp can be constrained by:

- **Flow volume** – flow in Nine Mile Creek needs to be greater than 100ML/day before water enters the wetland.
- **Flow duration** – flow in Nine Mile Creek needs to be greater than 100ML/day long enough for the required volume of water to enter the wetland.

- **Irrigation demands** – Black Swamp does not have a delivery share; therefore, environmental water can only be delivered when there is spare capacity to carry the water in Nine Mile Creek.

Risks can present in many forms including climate and environmental, community, management, cultural and legal risks. Risks associated with the delivery of environmental water are presented in this Plan. Risk identification and assessments are undertaken annually at a formal workshop with the Victorian Environmental Water Holder (VEWH) during the development of Seasonal Watering Proposal and including any cultural risks pertaining to Yorta Yorta cultural values.

The Plan details key environmental water management knowledge gaps including, the effect of groundwater on the wetland, the flood regime tolerances of water-dependent Ecological Vegetation Classes and their associated flora species such as the EPBC Act vulnerably listed River Swamp Wallaby-grass.

**Table 1: Updated ecological objectives and targets for Black Swamp EWMP 2022**

No.	Objective	Target
BS1	Maintain the presence of water-dependent nationally threatened species recorded at Black Swamp by 2030.	Protect and restore biodiversity that is wetland-dependent, including supporting life cycles of threatened species at Black Swamp by 2030: <ul style="list-style-type: none"> <li>• Maintain presence of Australasian bittern (<i>Botaurus poiciloptilus</i>) in 70% of targeted surveys undertaken.</li> <li>• Maintain presence of listed plant species including River Swamp Wallaby-grass (<i>A.fluitans</i>) in 70% of surveys undertaken.</li> </ul>
	Maintain the presence of six state listed threatened waterbird species at Black Swamp by 2030.	Continue to support the presence of <i>Flora and Fauna Guarantee Act 1988 (Vic)</i> listed waterbirds in three out of five targeted surveys including: <ol style="list-style-type: none"> <li>1. Australasian bittern (<i>B. poiciloptilus</i>)</li> <li>2. Australian little bittern (<i>Ixobrychus dubius</i>)</li> <li>3. Baillon’s crane (<i>Porzana pusilla</i>)</li> <li>4. Eastern great egret (<i>Ardea alba modesta</i>)</li> <li>5. Plumed egret (<i>Ardea intermedia plumifera</i>)</li> <li>6. White bellied sea eagle (<i>Haliaeetus leucogaster</i>)</li> </ol>

No.	Objective	Target
<b>BS2</b>	Improve diversity of native water-dependent flora species consistent with Red Gum Swamp EVC 292 benchmarks at Black Swamp by 2030.	<p>Improve condition of water-dependent native vegetation at Black Swamp by 2030:</p> <ul style="list-style-type: none"> <li>• Red Gum Swamp EVC 292 with 5-10% cover of river red gum trees, at least two species of medium to large sedges with &gt;10% cover, at least three species of medium to large grasses with &gt;10% cover in zone where dominant, and greater than eight aquatic herb species with &gt;10% cover.</li> </ul>
<b>BS3</b>	By 2030, support waterbird breeding and feeding at Black Swamp at least five times in ten years.	<p>Protect and restore ecosystem functions of water-dependent ecosystems that support successful non-colonial nesting of waterbird species at Black Swamp providing conditions for breeding and fledging at least five times in ten years:</p> <ul style="list-style-type: none"> <li>• As a minimum at least seven species recorded breeding at Black Swamp over any ten-year assessment period: <ol style="list-style-type: none"> <li>1. Australian shelduck (<i>Tadorna tadornides</i>)</li> <li>2. Australasian reed warbler (<i>Acrocephalus stentoreus</i>)</li> <li>3. Australian wood duck (<i>Chenonetta jubata</i>)</li> <li>4. Black swans (<i>Cygnus atratus</i>)</li> <li>5. Grey teal (<i>Anas gracilis</i>)</li> <li>6. Pacific black duck (<i>Anas superciliosa</i>)</li> <li>7. Purple swamphen (<i>Porphyrio porphyrio</i>).</li> </ol> </li> </ul> <p>Protect and restore ecosystem functions at Black Swamp that support the creation of vital habitat for waterbird feeding habitat guilds on a regular basis, including during drought. Target waterbird feeding habitat guilds are densely vegetated habitat and shallow water &lt;0.5m habitat as per Jaensch (Jaensch, 2002).</p>
<b>BS4</b>	Improve breeding of frogs at Black Swamp to 80% of years in which water is present by 2030.	<p>Maintain breeding of frogs at Black Swamp in 80% of years in which water is present, including:</p> <ol style="list-style-type: none"> <li>1. Barking marsh frog (<i>Limnodynastes fletcheri</i>)</li> <li>2. Common froglet (<i>Crinia signifera</i>)</li> <li>3. Peron's tree frog (<i>Litoria peronii</i>)</li> <li>4. Plains froglet (<i>Crinia parinsignifera</i>)</li> <li>5. Pobblebonk (<i>Limnodynastes dumerilii</i>)</li> <li>6. Spotted marsh frog (<i>Limnodynastes tasmaniensis</i>).</li> </ol>
<b>BS5</b>	Provide refugia to support the long-term survival and resilience of water-dependent biota at Black Swamp by 2030.	Maintain Black Swamp at least 50% full over summer months during prolonged dry periods to provide a refugium to support the long-term survival and resilience of populations of waterbirds and other water-dependent biota, to allow for subsequent recolonisation beyond Black Swamp.
<b>BS6</b>	Reduce the cover and diversity of exotic water-dependent flora species at Black Swamp by 2030.	Reduced diversity and cover of target invasive aquatic plant species, especially aster-weed ( <i>Aster subulatus</i> ), water couch ( <i>Paspalum distichum</i> ) and arrowhead ( <i>Sagittaria platyphylla</i> ) which is classified as a Weed of National Significance (WoNS), by 30% at Black Swamp by 2030 compared to benchmark 2008-2011.

# Acknowledgements

The Goulburn Broken CMA respects the Yorta Yorta People and acknowledge the intrinsic connection they have to their country on which Black Swamp is located. We recognise the diversity of their culture and the deep connections they have with Victoria's lands and waters. We value our unique partnership with Yorta Yorta for the health of their people and their traditional country. We respect Yorta Yorta Elders, their ancestors and acknowledge and recognise the Yorta Yorta People's embedded cultural connections, their bloodlines, their cultural obligations, rights and responsibilities to care for their traditional lands and waters and interact with their country for the purposes of life and resources. As valued partners Yorta Yorta Nation Aboriginal Corporation have been actively involved in the update of the Black Swamp Environmental Water Management Plan (GBCMA 2023) to ensure Yorta Yorta People's cultural connections, and their values of Black Swamp are recognised and aligned with their cultural protocols and environmental water objectives and targets.

Thanks especially to Sonia Cooper, without her cultural guidance and knowledge for the Yorta Yorta People, history of the landscape and her amazing cultural insight, this plan would not be what it is today.

Acknowledgement also goes to the team at Wetland Revival Trust and Water Technology for their consistent data collection within the Goulburn Broken Catchment wetlands and reports developed.

Thank you to members of the Goulburn Broken Scientific Technical Reference Committee especially Rhonda Butcher, Goulburn Broken Environmental Water Wetlands Advisory Group and numerous individuals for their input and development of the plan.

## ▼ Yellow-billed Spoonbill at Black Swamp

*Photo: J Geddes, GB CMA*



# Abbreviations and acronyms

<b>ACHLMA</b>	Aboriginal Cultural Heritage Land Management Agreement
<b>Basin Plan</b>	Murray Darling Basin Plan 2012 (Cth)
<b>BCS</b>	Bioregional Conservation Status
<b>BioEVC</b>	A combination of EVC and Bioregion to determine BCS
<b>CAMBA</b>	China Australia Migratory Bird Agreemen
<b>CMA</b>	Catchment Management Authority
<b>DEECA</b>	Department of Energy, Environment and Climate Action
<b>DELWP</b>	Department of Environment, Land and Water Planning
<b>DSE</b>	Department of Sustainability and Environment
<b>EPBC Act</b>	<i>Environment Protection Biodiversity Act 1999 (Cth)</i>
<b>EVC</b>	Ecological Vegetation Community
<b>EWMP</b>	Environmental Water Management Plan
<b>EWR</b>	Environmental Water Reserve
<b>FFG Act</b>	<i>Flora and Fauna Guarantee Act 1988 (Vic)</i>
<b>GB CMA</b>	Goulburn Broken Catchment Management Authority
<b>GB EWWAG</b>	Goulburn Broken Environmental Water Wetland Advisory Group
<b>GB STRC</b>	Goulburn Broken Scientific Technical Reference Committee
<b>GMID</b>	Goulburn-Murray Irrigation District
<b>GMW</b>	Goulburn-Murray Water
<b>IWC</b>	Index of Wetland Condition
<b>JAMBA</b>	Japan Australia Migratory Birds Agreement
<b>ML</b>	Megalitre (one million litres)
<b>MSC</b>	Moira Shire Council
<b>NVIRP</b>	Northern Victoria Irrigation Renewal Project
<b>PV</b>	Parks Victoria
<b>PEF</b>	Priority Ecosystem Functions
<b>PoE</b>	Probability of Exceedance
<b>RAP</b>	Registered Aboriginal Party
<b>RWS</b>	Regional Waterway Strategy
<b>TEK</b>	Traditional Ecological Knowledge
<b>VEWH</b>	Victorian Environmental Water Holder
<b>VWMS</b>	Victorian Waterway Management Strategy
<b>WetMAP</b>	Wetland Monitoring and Assessment Program
<b>WoNS</b>	Weeds of National Significance
<b>YYNAC</b>	Yorta Yorta Nation Aboriginal Corporation

# Relevant plans and legislation

International treaties, conventions, and initiatives	Japan Australia Migratory Birds Agreement (JAMBA) 1974
	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979
	China Australia Migratory Birds Agreement (CAMBA) 1986
Commonwealth legislation and policy	<i>Australian Heritage Commission Act 1975</i> (Register of the National Estate)
	<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i> (Part IIA)
	<i>Native Title Act 1993</i>
	Wetlands Policy of the Commonwealth Government of Australia 1997
	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)
	<i>Water Act 2007</i> subparagraph 44(3)(b)(i) Basin Plan 2012
	A Framework for Determining Commonwealth Environmental Watering Actions 2009
Victorian legislation	<i>Aboriginal Heritage Act 2006</i>
	<i>Catchment and Land Protection Act 1994</i> (CaLP Act)
	<i>Water Act 1989</i> (Vic)
	<i>Flora and Fauna Guarantee Act 1988</i> (FFG Act)
	State Environment Protection Policy (Waters of Victoria) 2003



◀ Murray Darling Basin Boundary

# 1. Introduction

*Environmental water management in Victoria is now firmly established with water recovery enabling significant volumes of water being returned to the environment. The increased environmental water availability has provided opportunities to protect, restore and reinstate high value ecosystems throughout Victoria.*

Environmental watering in Victoria has historically been supported by management plans such as this one, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and assist managers to evaluate how well those assets respond to the water they receive or what could be done better.

Environmental water in Victoria is managed as an integral part of the Victorian Waterway Management Program, with the state-level Victorian Waterway Management Strategy 2013 (VWMS; DEPI 2013) providing the overarching framework for environmental water management. Regional Waterway Strategies (RWSs) drive the implementation of the VWMS at the regional level. Information from the region's RWS is a key input to environmental water planning arrangements, including the selection of eligible assets to receive environmental water. Environmental water management plans (EWMPs) are site-specific plans developed for those assets deemed a priority to receive environmental water through the RWS development process.

In the Murray-Darling Basin, environmental water management is further underpinned by the Basin Plan 2012 (Cth 2012) and the associated Basin-wide environmental watering strategy (MDBA 2019). In accordance with Basin Plan requirements, Victoria has also developed relevant water resource plans and long-term watering plans (DELWP 2021).

Victoria's Catchment Management Authorities (CMAs), Melbourne Water, Department of Energy, Environment and Climate Action (DEECA – previously Department of Environment, Land, Water and Planning (DELWP)) the Victorian Environmental Water Holder (VEWH) and Traditional Owner groups have worked together to develop Environmental Water Management Plans for most watered assets throughout Victoria. These plans are continually updated through an adaptive management process.



#### ▲ Water Primrose at Black Swamp

*Photo: D Cook, Wetlands Revival Trust*

A primary purpose of the plans is to provide a consistent set of documents that support Seasonal Watering Proposals to be submitted by asset managers to the VEWH annually. The supporting information includes:

- Lead management agencies and their management responsibilities.
- The water-dependent environmental, social, and economic values of the asset.
- The asset's environmental condition and threats.
- Environmental objectives and intended watering regime.
- Contributions from Traditional Owner groups (included in an EWMP with free, prior, and informed consent) that may include information about cultural values, management goals, environmental and cultural objectives and intended watering regime.
- Opportunities for improved water delivery, efficiency or capacity through structural works or other measures.
- Scientific knowledge gaps and recommendations for future work.

This Plan establishes priorities for the use of environmental water at Black Swamp within the Broken catchment described in section 2.1 Catchment setting. This revision builds on iterations of the 2011 Plan and has been revised to reflect upon learnings over the past 15 years of water delivery to the site and improve alignment of Black Swamp objectives to the Basin Plan's Environmental Watering Plan Framework and Victoria's Long-term Watering Plans.

The 2011 Plan has been used to guide water delivery to the site for the past 12 years. Monitoring of environmental water delivered to Black Swamp has improved Goulburn Broken CMA understanding of ecological and hydrological needs and responses, and operational conditions that are to be considered at the time of delivery.

The revision of the 2011 Plan has been coordinated by Goulburn Broken CMA in consultation with DEECA guidelines to ensure a consistent approach to planning and management of wetlands across Victoria.

## 1.1 Consultation

The revision of the 2011 Plan was undertaken by Goulburn Broken CMA with input from Yorta Yorta Nation Aboriginal Corporation, the Goulburn Broken Scientific Technical Reference Committee (GB STRC), and the Goulburn Broken Environmental Water Wetland Advisory Group (GB EWWAG). Consultation with Yorta Yorta included online meetings, on-site field inspections, phone calls and emails discussing the alignment of cultural and environmental water objectives. Consultation with the GB STRC Group and GB EWWAG largely involved online meetings and email communication.

The GB STRC assisted with the alignment of objectives to the Basin Plan and Victorian Long-term Watering Plans.

The GB EWWAG consists of Yorta Yorta Nation Aboriginal Corporation members, community members and land and water managers who were consulted on the draft plan. Consultation was held with DELWP regarding field survey data to feed into flora and fauna sections of this plan. VEWH were consulted on water allocation and available water sources. Table 2 indicates the level of engagement using the IAP2 Public Participation Spectrum (IAP2 2018) with each affiliated group.

**Table 2: Engagement undertaken in development Black Swamp EWMP**

Category	Who	IAP2 level of engagement	Engaged on Black Swamp EWMP	Engagement methods	Engagement Purpose
<b>Government Agencies</b>	Delivery Partners	Collaborate	Goulburn-Murray Water (River Operations Planning, Diversions) VEWH Parks Victoria DEECA	Formal advisory group (GB EWWAG) Direct engagement Review of draft proposal	Seek input into the development of the proposal. Ensure program partners understand the watering proposed and intended outcomes.
<b>Traditional Owners</b>	Yorta Yorta People	Collaborate	Yorta Yorta Nation Aboriginal Corporation	Formal advisory group (GB EWWAG) Site visits Meetings	Seek input into the development of the EWMP by reviewing document, providing information, and aligning cultural outcomes and objectives.
<b>Recreational Users</b>	Field and Game Australia Local fishing clubs	Consult	Field and Game Trellys Fishing and Hunting	Formal advisory group (GB EWWAG) Direct engagement	Ensure understanding of the EWMP and intended outcomes. Review EWMP and provide feedback/ input.
<b>Community Groups</b>	Environment Groups	Consult	Goulburn Murray Landcare Network Goulburn Valley Environment Group Turtles Australia	Formal advisory group (GB EWWAG) Direct	Ensure understanding of the EWMP and intended outcomes. Review EWMP and provide feedback/ input.
<b>Technical experts</b>	Scientists and Consultants	Collaborate	Research Scientists from Arthur Rylah Institute Wetlands Trust Water's Edge Consulting	Formal advisory group (GB STRC) Direct engagement	Seek input into the development of the EWMP and ecological and hydrological objectives. Review EWMP and provide feedback/input.

## 1.2 The Yorta Yorta People

Consultation and involvement of the Yorta Yorta People when developing this Plan was undertaken with Yorta Yorta Nation Aboriginal Corporation and is imperative to the conservation and protection of cultural sites, connection to country and establishing strong linkages.

Yorta Yorta Nation Aboriginal Corporation have worked closely with Goulburn Broken CMA in the development of this Plan via online meetings, on-site field inspections and email communication. Alignment of cultural objectives with environmental watering objectives for Black Swamp will begin the first steps to healing country for Yorta Yorta People (section 5.3).

Yorta Yorta Nation Aboriginal Corporation is the representative body that provides the interface between government and the Yorta Yorta People and is a Victorian Registered Aboriginal Party (RAP) under the *Aboriginal Heritage Act 2006* (Vic 2006) with decision making responsibilities for protecting Aboriginal cultural heritage, and other matters within the RAP area.

Yorta Yorta Nation Aboriginal Corporation and Goulburn Broken CMA have established an Aboriginal Cultural Heritage Land Management Agreement (ACHLMA). This agreement provides a framework for protecting and managing Aboriginal cultural heritage during ongoing, routine land management activities within a RAP area including works to assist with environmental water releases to Black Swamp.

Yorta Yorta lands lie on both sides of the Murray River from Cohuna in Victoria to Howlong in New South Wales. They include towns such as Echuca, Shepparton, Benalla, Corowa and Wangaratta and extend northwards to just south of Deniliquin (Figure 1). The people of the Yorta Yorta Nation are comprised of eight different clan groups, where the Yorta Yorta language is spoken commonly by all the Yorta Yorta clans which make up Yorta Yorta Nation. Yorta Yorta Nation Aboriginal Corporation list the following objectives and outcomes in Table 3 for their involvement in environmental water in Traditional Owner objectives and outcomes: Compilation of contributions to Victoria's water resource plans (DELWP 2019).

**Figure 1: Yorta Yorta Country**



**Table 3: Yorta Yorta objectives and outcomes for water management**

Objective	Outcome
To look after country through land and water management to restore and maintain our wetlands, rivers, waterways, tributaries, and lagoons which in turn look after our flora and fauna that make up cultural lore.	Increase awareness, understanding, respect and protection of Yorta Yorta interests and custodianship. Healthy country and economic outcomes for Yorta Yorta people.
To have decision making in the water planning process, water sharing and distribution.	Equal influence 'at the table' with other representatives from the water industry. Increased integration across the industry.
To develop a cultural flow that will complement the current water management process and have input to the current water flows that goes through country.	Watering country for healthy country and achieving economic outcomes for Yorta Yorta people.
To build Traditional Ecological Knowledge (TEK) into strategies where appropriate e.g., river red gum thinning, protection of wetlands, links with cultural lore, bring back native animals and plants etc. and involve Elders onsite to discuss TEK.	To build Traditional Ecological Knowledge (TEK) into strategies where appropriate e.g., river red gum thinning, protection of wetlands, links with cultural lore, bring back native animals and plants etc. and involve Elders onsite to discuss TEK. "Bring people back, bring Country back." It will provide a better living culture, better caring for Country and better outcomes for Country.

\* TEK is Traditional Ecological Knowledge is the knowledge base that has been handed down to the Yorta Yorta People and has direct contact with their cultural environment.

Black Swamp supports a diverse range of culturally significant plants and animals used for food, medicine, clothing and tools including multiple varieties of Nardoo (food source), native grasses, old man Weed (medicinal) and weaving sedges/rushes (Appendix 1). Evidence of cooking mounds and clay balls are present around the perimeter of the wetland, indicating it was a significant occupation, gathering place and source of food for Yorta Yorta people.

Yorta Yorta Whole-of-Country Plan 2021-2030 (Yorta Yorta Nation Aboriginal Corporation WOC Plan) states the following actions in Table 4. These are taken from section 4.2, pages 26 and 27 of the Yorta Yorta Nation Aboriginal Corporation WOC Plan to pursue an inherent right to water entitlements that are legally and beneficially owned by Yorta Yorta of a sufficient quantity and quality and which are relevant to this plan (YYNAC 2021).

**Table 4: Yorta Yorta Whole-of-Country Plan for water management that may be relevant to this plan**

Walla – Water (page 26 and 27)	
<b>Pursue our inherent right to water entitlements that are legally and beneficially owned by Yorta Yorta of a sufficient quantity and quality to improve our spiritual, cultural, environmental, social and economic needs.</b>	
Actions	
<b>WW12</b>	Seek water policies and operational flows that: <ul style="list-style-type: none"> <li>a. achieve healthier Country and better outcomes for ecosystems, and native plants and animals; and</li> <li>b. recognise and deliver legal water entitlements that meet broader Yorta Yorta cultural, social and economic needs.</li> </ul>
<b>WW13</b>	Ensure water rights are negotiated in expanded management rights in co-management, joint management, treaty and other processes.
<b>WW15</b>	Watering country for healthy country and achieving economic outcomes for Yorta Yorta people.
<b>WW18</b>	Support government policies to allow waterways and floodplain wetlands to flood naturally, and the removal or managed weathering away of levees and constructed barriers.

# 2. Asset overview

## 2.1 Catchment setting

Black Swamp is located on Nine Mile Creek floodplain within the Broken catchment (Figure 2). Broken, Boosey and Nine Mile Creeks are the key waterways in the Broken catchment and have a combined total length of approximately 450km. Broken Creek and its associated floodplain is listed in *A Directory of Important Wetlands in Australia* (EA 2001) and stretches of Broken and Nine Mile Creeks have been reserved as State Park and Natural Features Reserve.

The Broken catchment is 772,386 hectares or 3.4 per cent of Victoria's total area. The main waterway of the Broken catchment is the Broken River which is a tributary of the Goulburn River where they confluence at Shepparton. The Broken catchment also includes Broken Creek that diverges from the Broken River west of Benalla township and flows north-west into the Murray River. Nine Mile Creek is an ancient course of the Broken River palaeovalley (Figure 3) which began to form one hundred million years ago. Due to erosion and sediment deposits the palaeovalley backfilled and the Broken River changed course (Tickell 1989). Nine Mile Creek then became an anabranch of the Broken Creek, which eventually became channelised. Nine Mile Creek today is a highly regulated system in which a link channel connects Black Swamp to the creek.

Most of the Broken catchment has been cleared for agriculture which supports grazing in the south, and mixed cereal and livestock farming in the central region. A large part of the northern section of the Broken catchment is within the Goulburn- Murray Irrigation District (GMID), with irrigation for fruit growing, dairy and livestock production. Drainage, land forming, and river regulation have significantly reduced the number and area of wetland habitats.

Therefore, the remnant vegetation and wetlands fringing Broken, Boosey and Nine Mile creeks form an important corridor in the Broken catchment and are a stronghold for native flora and fauna.

Within the Broken catchment only three wetlands currently receive environmental water. These are Black Swamp, Kinnairds Wetland and Moodie Swamp. These sites have been prioritised due to their ecological values, significance to the community and Yorta Yorta People. In addition, these sites 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 Yorta Yorta Nation Aboriginal Corporation and land manager approvals are met.

▼ Swans nest at Black Swamp in 2014  
Photo: J Geddes, GB CMA



Figure 2: Broken catchment indicating Black Swamp on Nine Mile Creek

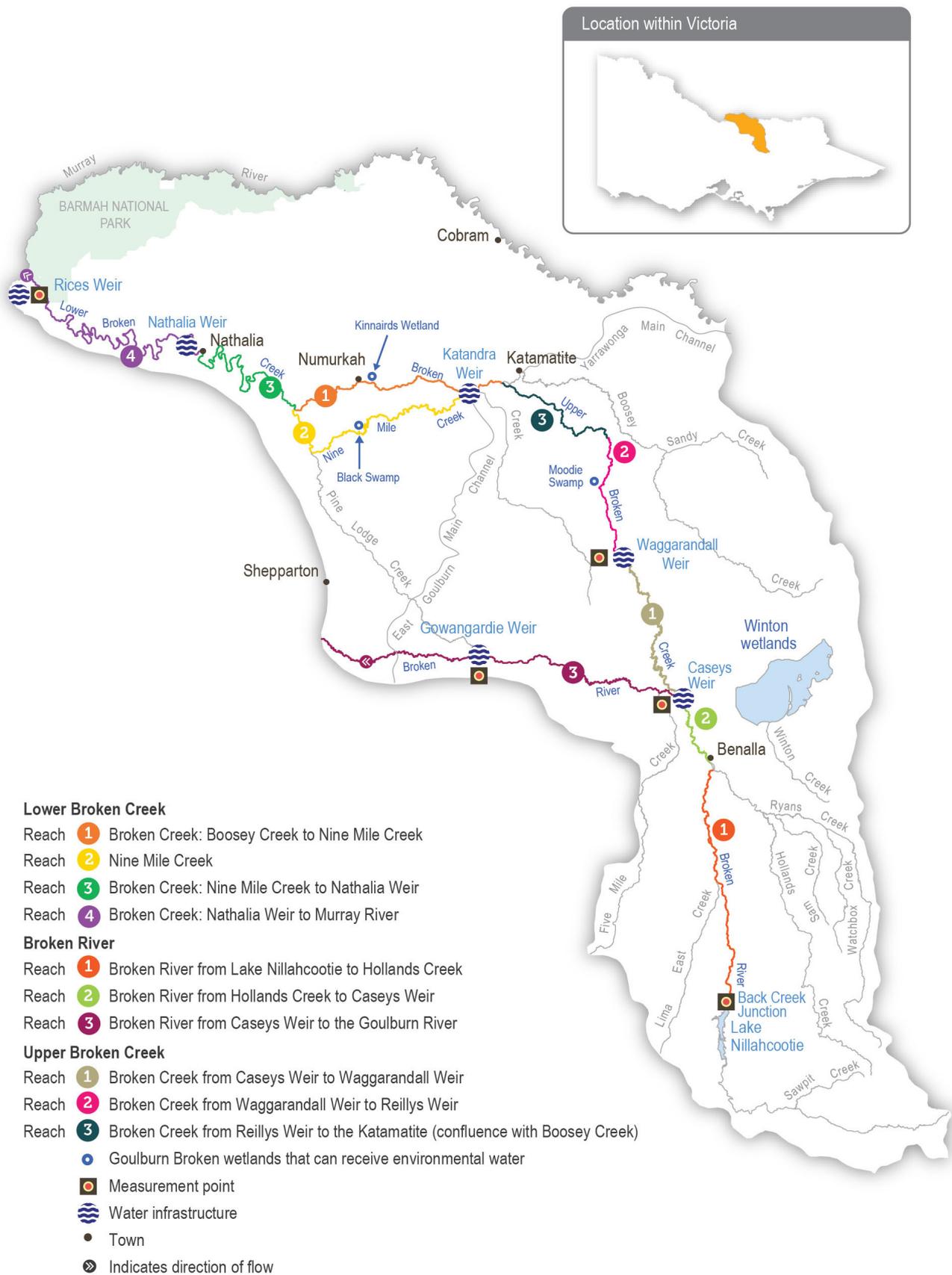
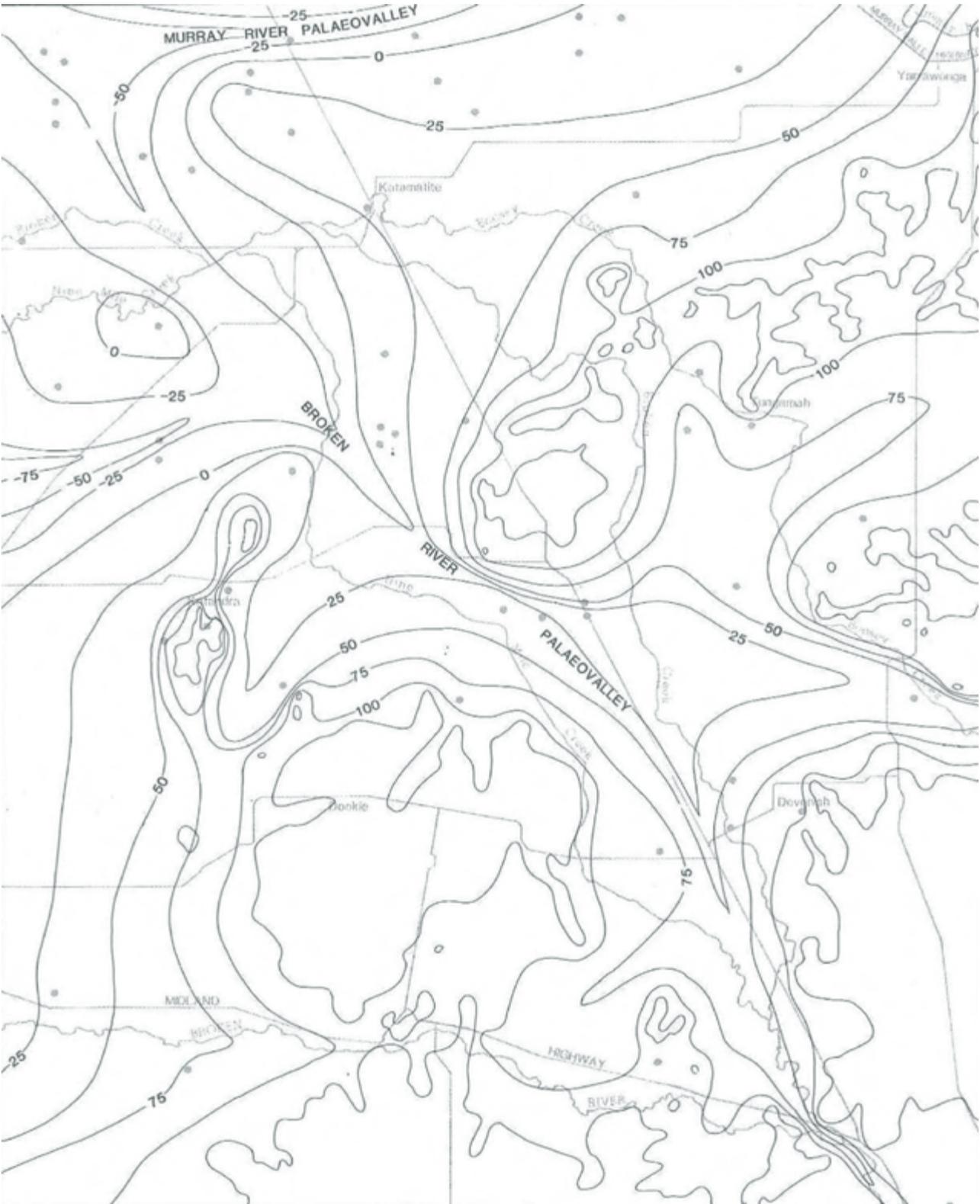


Figure 3: Broken River Palaeovalley



Extracted from Tickell, 1989

## 2.2

# Land status and management

Black Swamp is located within the Black Swamp Wildlife Reserve managed by Parks Victoria. A range of management agencies are responsible for ensuring that management of the site and environmental water delivery complies with a broad range of legislative requirements.

Lead management agencies and their key responsibilities are summarised in Table 5. The successful management of the site therefore relies on effective cooperation and partnership between the government agencies, Yorta Yorta Nation Aboriginal Corporation and the broader community.

**Table 5: Lead agencies and their key site responsibilities**

Agency	Responsibility
<b>Yorta Yorta Nation Aboriginal Corporation (YYNAC)</b>	Yorta Yorta Nation Aboriginal Corporation is the representative body that provides the interface between government and the Yorta Yorta People. Foremost the Yorta Yorta People are the Traditional Owners of the areas within this Plan, namely Black Swamp. Yorta Yorta Nation Aboriginal Corporation is also a Victorian Registered Aboriginal Party (RAP) under the <i>Aboriginal Heritage Act 2006</i> (Vic) (AHA) this occurred in 2007. Yorta Yorta Nation Aboriginal Corporation have decision making responsibilities that are recognised by the State of Victoria for protecting their traditional knowledge referred to in the AHA as Aboriginal cultural heritage, and other matters within the RAP area. Yorta Yorta Nation Aboriginal Corporation collaborate with the Goulburn Broken CMA regarding environmental water delivery to wetlands within Yorta Yorta Country that sits within the basin.
<b>Department of Energy, Environment and Climate Action (DECCA)</b>	Provide financial, policy and strategic support for the management of public and private land. Management of flora and fauna, State Forest and public land water frontage. Management of hunting and domestic stock licensing on public land.
<b>Goulburn Broken Catchment Management Authority (Goulburn Broken CMA)</b>	Implementation of the Goulburn Broken Regional Catchment Strategy 2021-27 (GBCMA 2021). Works on waterways, regional drainage and floodplain management, and coordinating Commonwealth and State natural resource management investment. Determining the environmental water requirements of wetlands and streams, developing, and submitting Seasonal Watering Proposals to VEWH for consideration, and managing the delivery of environmental water in accordance with VEWH's watering plan.
<b>Goulburn-Murray Water (GMW)</b>	Manages water related services including storage, delivery and drainage systems across Northern Victoria.
<b>Murray-Darling Basin Authority (MDBA)</b>	The Murray-Darling Basin Authority's principal aim is to manage the Basin's water resources in the national interest.
<b>Moira Shire Council (MSC)</b>	Regulate local development through the planning scheme, on-ground works, and management of local roads and urban drainage.
<b>Parks Victoria (PV)</b>	Management of the site on behalf of DECCA.
<b>Victorian Environmental Water Holder (VEWH)</b>	Management of environmental water entitlements on behalf of the Minister for Environment as of July 2011. Development of Seasonal Watering Plans derived from CMA's Seasonal Watering Proposals.

## 2.3

### Asset characteristics

Until 2014 wetlands in Victoria were classified using a system developed by Corrick and Norman which included information on water depth, permanency and salinity (Corrick and Norman 1980). Wetlands throughout Victoria were mapped and classified between 1975 and 1994 and developed into spatial layers (DSE 2007). Black Swamp was classified as a shallow freshwater marsh in the Department of Sustainability and Environment (DSE) wetlands 1994 layer.

In 2014, a new classification framework for Victoria was developed and based on the Australian National Aquatic Ecosystem Classification Framework (AET 2012). Under this classification Black Swamp is classified as temporary freshwater wetland.

Black Swamp has an approximate depth of 0.5m and has a calculated capacity of approximately 80ML. Black Swamp is situated in the Victorian Riverina bioregion (section 3.1.2.3) and is located within the Black Swamp Wildlife Reserve and the surrounding Nine Mile Creek floodplain is reserved as State Park.

The wetland is managed by Parks Victoria and is part of a larger 70-hectare wetland complex (Table 6). Black Swamp is surrounded by irrigated agricultural properties to the north, Purdie's Swamp to the west and Nine Mile Creek to the southeast.

**Table 6: Black Swamp site characteristics**

Characteristics	Description
<b>Name</b>	Black Swamp
<b>Traditional Owners</b>	The Yorta Yorta People
<b>Mapping Id</b>	7925607991 (old); 63203 (new)
<b>Area (hectares)</b>	16.5
<b>Bioregion</b>	Victorian Riverina
<b>Conservation Status</b>	Bioregionally Significant*
<b>Land Status</b>	Natural Features Reserve – Wildlife Reserve
<b>Land Manager</b>	Parks Victoria
<b>Surrounding Land Use</b>	Irrigated Agriculture/ Conservation area
<b>Water Supply</b>	Nine Mile Creek
<b>1788 Wetland Category</b>	Shallow freshwater marsh
<b>1994 Wetland Category</b>	Shallow freshwater marsh
<b>2014 Wetland Category</b>	Temporary freshwater swamp
<b>Wetland Capacity (ML)</b>	80ML (updated from 53ML in original EWMP)
<b>Wetland depth at Capacity (mm)</b>	Varies to 500mm

*Note: Bioregional Significance is defined by the National Land and Water Audit (Cth 2002) which established a national framework for identifying biodiversity assets of bioregional significance.*

## 2.4 Environmental water sources

The Environmental Water Reserve (EWR) is the legally recognised amount of water set aside to meet environmental needs. The reserve includes minimum river flows, unregulated flows, and specific environmental entitlements held in storages. Environmental entitlements can be called out of storage when needed and delivered to wetlands or streams to protect their environmental values and health.

Environmental entitlements are held by the Minister for the Environment and Climate Action, who delegates management to the Victorian Environmental Water Holder.

Environmental Water for Black Swamp can be sourced from the water entitlements and their agencies listed in Table 7. The amount of water available for use depends upon volumes acquired and seasonal water allocations.

**Table 7: Environmental Water Entitlements**

System	Entitlement	Volume (ML)	Class of entitlement
Murray	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999	45,267	High
		8,523	Low
		49,000	Unregulated
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999 – Barmah-Millewa Forest Environmental Water Allocation	50,000	High
		25,000	Low
	Bulk Entitlement (River Murray – Flora and Fauna) Conversion Order 1999 – Living Murray	9,589	High
		101,850	Low
		34,300	Unregulated
	Environmental Entitlement (River Murray – NVIRP Stage 1) 2012	1,155 <sup>1</sup>	High
	Water shares – Snowy Environmental Reserve	14,671	High
6,423		Low	
Goulburn (can be traded into Murray account if required)	Goulburn River Environmental Entitlement 2010	26,555	High
		5,792	Low
	Environmental Entitlement (Goulburn System – Living Murray) 2007	39,625	High
		156,980	Low
	Environmental Entitlement (Goulburn System – NVIRP Stage 1) 2012	1,398 <sup>1</sup>	High
	Water Shares – Snowy River Environmental Reserve	8,321	High
17,852		Low	
Broken	Water shares	90	High
		19	Low

<sup>1</sup> This entitlement volume is the mitigation water savings from the Goulburn-Murray Water Connections Project Stage 1, as verified in the latest audit.

Ref: VEWH – How much water is available?

## 2.5

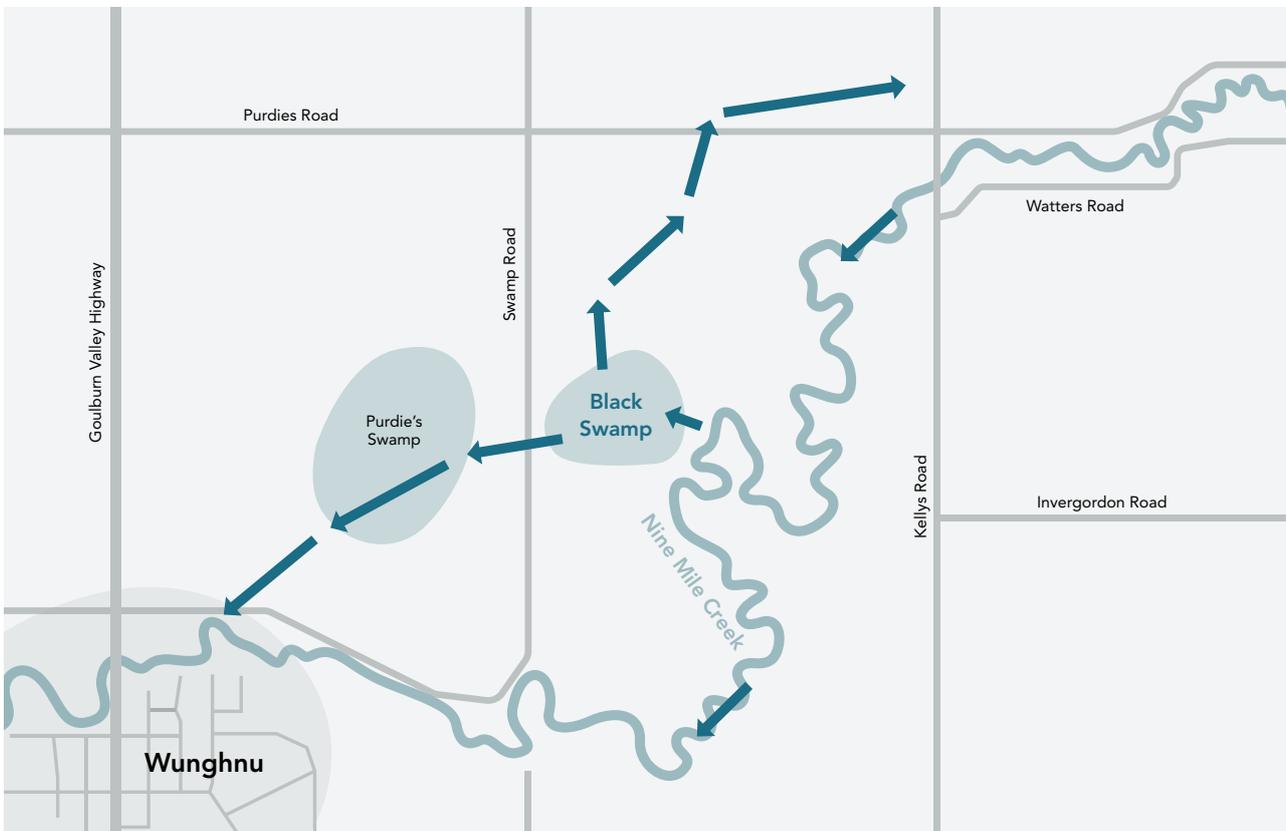
# Hydrological and system operations

Wetland hydrology is the most important determinant in the establishment and maintenance of wetland types and processes. It affects the chemical and physical aspects of the wetland which in turn affects the type of flora and fauna that the wetland supports (DSE 2005). A wetland's hydrology is determined by surface and groundwater inflows and outflows in addition to precipitation and evapotranspiration (Mitsch and Gosselink 1993). Duration, frequency, seasonality (timing) and depth are the main components of a wetland's hydrological regime.

## PRE-REGULATION

Under natural conditions, Black Swamp would have received inflows from Nine Mile Creek to its east. When the wetland filled with water then flowed to the west into Purdie's Swamp before returning to Nine Mile Creek (Figure 4). The wetland would have been inundated most years during late winter and spring. Given the shallow depth of the wetland it would have also dried out most years over the summer-autumn period. Groundwater is unlikely to have influenced Black Swamp as it is located within a 5-10m depth to water table. This is dominated by a series of clays, silts of low permeability and isolated lenses of sands and gravels (GMW 2015). Groundwater levels and flow vary considerably on a local scale, the location of Black Swamp has limited connectivity to groundwater with the water table within Nine Mile Creek floodplain situated at >3m depth.

Figure 4: Arrows indicate flow path of water into and out of Black Swamp



## POST-REGULATION

The natural hydrological regime of the wetland has been significantly altered since European settlement. The effect of groundwater on the system is classified as low on the Victorian Wetlands Inventory database (DELWP 2022). Historical occurrences of note are listed below.

### 1960s

In 1961, Nine Mile Creek was used for irrigation supply and drainage outfalls. This changed the hydrology of the creek from being seasonally dry over summer and autumn to having high flows maintained in the creek to supply water for irrigation, stock and domestic use. This increase in creek flows resulted in prolonged/ near permanent inundation of Black Swamp due to the regulated flow level in the creek being higher than the commence-to-fill level of the wetland. River red gums (*Eucalyptus camaldulensis*) within the wetland body of Black Swamp and Grey Box (*Eucalyptus microcarpa*) on the surrounding floodplain died because of water logging. Between 1963-64 the creek was dredged to increase capacity; this reduced water levels and Black Swamp was no longer permanently inundated.

### 1970s

A link channel was constructed between Black Swamp and Nine Mile Creek in 1971. This resulted in more regular, unseasonal, and prolonged flooding of the wetland.

This change to the natural hydrology of the wetland reduced the diversity and abundance of biota by favouring species adapted to permanent inundation including cumbungi (*Typha spp*) species and Common Carp (*Cyprinus carpio*).

### 1980s

Site temporarily reserved for the management of Wildlife – Wildlife Reserve.

### 1990s

In 1992, an adjustable regulator was fitted on the link channel to have the ability to deliver a more desirable water regime to the wetland. This was never fully implemented, and the operation of the structure was ad hoc. The structure was regularly tampered with to allow water into the wetland for duck hunting season.

### 2000s

To restore a more natural hydrological regime in the wetland the existing drop bars in the regulator at Black Swamp were replaced in 2008 by Goulburn Broken CMA with a new head and discharge gate to regulate flows more effectively into the wetland complex and reduce the illegal manipulation of the structure. The first environmental water delivery occurred in May 2008 with 90ML of environmental water pumped into the wetland from Nine Mile Creek.



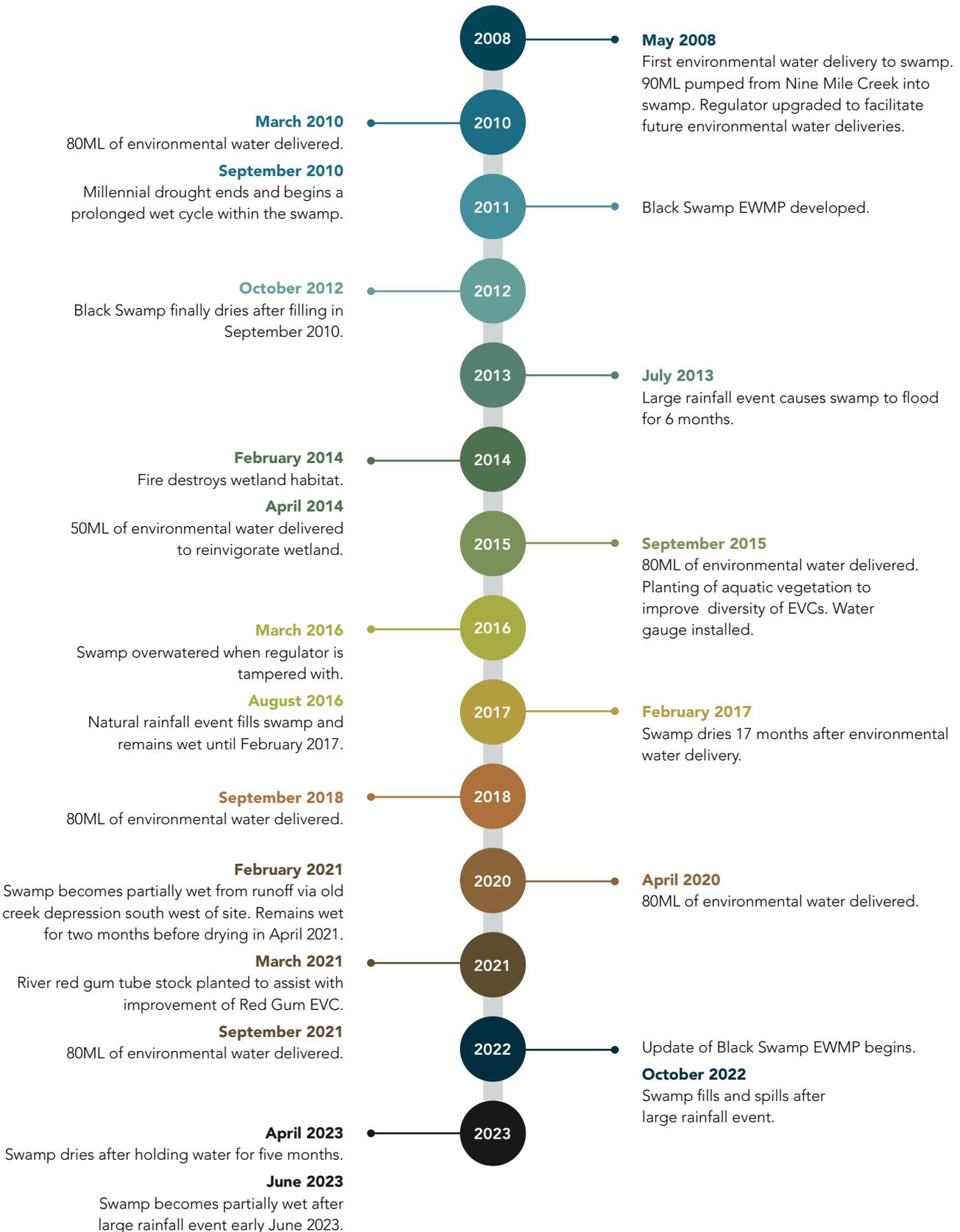
▲ Pumping the first environmental water delivery into Black Swamp 2008

Photo: K Ward, GB CMA

## ENVIRONMENTAL WATER

Environmental water was first pumped into Black Swamp in May 2008. Figure 5 presents a timeline of watering and events at Black Swamp since 2008.

**Figure 5: Black Swamp timeline since environmental water delivery began in 2008**





▲ **Black Swamp the day after it was burnt, 10th February 2014**  
 Photo: J Geddes, GB CMA

### 2010s

The first environmental water delivery to Black Swamp via Nine Mile Creek using the link channel occurs in 2010. For this to occur, Nine Mile Creek must be running at a capacity of approximately 100ML/d to push water into the link channel and wetland. On the 9th of February 2014, wildfire destroys standing dead river red gums which provided important habitat for birds and small mammals.

Many young river red gums in the bed of the wetland were burnt during the fire. Most of the wetland dependent species were dormant as the wetland was experiencing a dry phase during the fire and regenerated readily from rhizomes and the seedbank.

Small, isolated patches of cumbungi (*Typha sp*) were also burnt, but quickly began to regenerate after the fire.

Terrestrial vegetation surrounding the wetland was severely burnt, which had a detrimental effect on fauna that relies on this vegetation for food and shelter.

In April 2014, 50ML of environmental water was delivered to the wetland to assist vegetation regeneration. The EPBC Act vulnerably listed River Swamp Wallaby-grass grew prolifically in the wetland during the watering and over 21 swan nests were recorded at the site.



▲ **Cumbungi reshoots days after fire razes Black Swamp**  
 Photo: J Geddes, GB CMA



▲ **Aerial view of Black Swamp receiving environmental water after 2014 fire**  
 Photo: K Ward, GB CMA

Environmental water was delivered in September 2015. The watering assisted with the regeneration of wetland-dependent species that favour spring watering. Water Nymph (*Najas tenuifolia*) was recorded at the wetland for the first time in February 2016 and is listed as endangered under the FFG Act. Magpie Geese (*Anseranas semipalmata*) were also recorded at the wetland for the first time in 2015 and 2016. Magpie Geese are listed under the cFFG Act as vulnerable.

The delivery regulator was tampered with in October 2015. This increased water levels in the wetland impacting the health of emergent aquatic vegetation. The regulator was closed late October, only to be tampered with again in early March 2016. The wetland had begun to drawdown in February 2016 and would have dried by March. Emergent aquatic vegetation died, and the wetland became mostly open water.

The wetland naturally filled in August 2016 after a large rainfall event and remained wet until February 2017. The wetland was dry until September 2018 when 80ML of environmental water was delivered to the site.

## 2020s

COVID-19 impacted monitoring of environmental watering events within Victoria in 2020 and 2021. Black Swamp received 80ML of environmental water in April 2020 and due to environmental water deliveries not being considered as compulsory work, monitoring of the site was limited. The image below (left) was taken in May 2020 by Goulburn-Murray Water staff which shows water ponding a month after delivery. The wetland only held water for three months in 2020. This was unlikely to be long enough for some aquatic plants to flower and set seed.

A total of 90ML of environmental water was delivered to Black Swamp in September 2021. The delivery was staggered (45ML delivered twice within a four-week period) to ensure newly planted river red gum tube-stock were not drowned (section 3.1.2.3). River red gums responded well to the watering as did the EPBC Act vulnerably listed River Swamp Wallaby-grass.



▲ **Black Swamp one month after 80ML environmental water delivery in April 2020**  
Photo: J Geddes, GB CMA



▲ **Black Swamp September 2021**  
Photo: J Geddes, GB CMA

# 3. Water-dependent values

## 3.1 Environmental values

Black Swamp is classified as a Bioregionally significant site in the National Land and Water Audit 2002 (Cth 2002). It is a significant site in the Goulburn Broken catchment as it is one of only nine wetlands that can receive water from 3,600 wetlands that have been mapped within the catchment. The wetland has a significant sized population of the EPBC Act vulnerable listed River Swamp Wallaby-grass (page 33) and provides refuge in dry to extremely dry years. Its vegetation classes are classified as vulnerable and depleted (section 3.1.2.5).

▼ **Baillon's crane hide amongst the cumbungi at Black Swamp**  
*Photo: S Wilson, GB CMA*

### 3.1.1 ECOSYSTEM TYPE

Black Swamp is classified as temporary freshwater swamp within the 2014 Victorian wetland classification system, pre-European classification suggests the wetland would have been a shallow freshwater marsh.

The wetland regime categories adopted in the Victorian wetland classification framework indicate that Black Swamp is classified as a palustrine ecosystem that is periodically inundated, infrequently holding water greater than one month on average and is wet three to less than eight years in ten (Table 8, bold font).

Black Swamp is not listed on the Groundwater Dependent Ecosystem Atlas (BOM 2017). The neighbouring Purdie's Swamp is listed as a low potential groundwater-dependant ecosystem on an alluvial plain. However, the Victorian Wetland Inventory Edit Tool indicates that the likelihood Black Swamp receives water from groundwater flows is low (DELWP 2022).



**Table 8: Water regime categories adopted in the Victorian wetland classification framework**

Wetland system	Water regime category	Category description	Water regime subcategory	Subcategory description	
				Frequency of inundation	Duration of inundation
Lacustrine and palustrine	Permanent	Inundated constantly, rarely drying completely.		Constant, annual, or less frequently but before usually wetland dries.	Never dries or dries rarely (i.e., holds water at least 8 years in every 10), but levels may fluctuate within or between years.
	Periodically inundated	Inundated annually to infrequently, holding water for at least one month to more than one year before drying.	Seasonal	Annual or near annual inundation (i.e., holds water at least eight years in every ten).	Holds water one to eight months then dries.
			Intermittent	Infrequent, holds water, on average, three to less than eight years in every ten.	Holds water greater than one month to greater than one year then dries.
			Episodic	Infrequent, holds water, on average, less than three years in every ten.	Holds water greater than one month to greater than one year then dries.
Unknown	Water regime category unable to be determined				

### 3.1.2 FLORA AND FAUNA VALUES

Black Swamp Wildlife Reserve provides habitat for a wide variety of dependent and terrestrial fauna species. The fauna population has increased at the site since monitoring and environmental water delivery began in 2008. A total of 140 fauna species were recorded at the site between 2008 and 2010. This has now increased to 161 species in 2022 (Table 9). Noting that fauna numbers fluctuate depending on water availability within the broader landscape. Numerous water birds use Black Swamp as a breeding and feeding site.

Birds that have been recorded breeding at Black Swamp include Australian shelduck (*Tadorna tadornides*), Australasian reed warbler (*Acrocephalus stentoreus*), Australian wood duck (*Chenonetta jubata*), black swans (*Cygnus atratus*), grey teal (*Anas gracilis*), Pacific black duck (*Anas superciliosa*) and purple swamphens (*Porphyrio porphyrio*). Bitterns, crakes, egrets, ibis, herons, and spoonbills also utilise the wetland as a roosting and feeding site. Plumed whistling duck (*Dendrocygna eytoni*) were first recorded at the site in 2015 and the FFG Act listed freckled duck (*Stictonetta naevosa*) in 2016.

**Table 9: Fauna count comparison at Black Swamp between 2008-2022**

Species type	2008-2010 count	2011-2022 count	Change
Terrestrial birds	67	81	14
Wetland birds	40	43	3
Amphibians	6	7	1
Reptiles	6	6	0
Aquatic insects	9	12	3
Mammals	10	10	0
Fish	2	2	0
<b>Total</b>	<b>140</b>	<b>161</b>	<b>21</b>

### 3.1.2.2 FAUNA THREATENED STATUS

Species are classified by their threatened status. Most species found at Black Swamp do not have a threatened status, meaning their position in the landscape and their population numbers are not currently threatened nationally or in Victoria.

There are two primary lists of threatened species which are enshrined in legislation that relate to Victoria, they are:

- *Victorian Flora and Fauna Guarantee Act 1988 (Vic)* and;
- *Environment Protection and Biodiversity Conservation Act 1999 (Cth)*.

The *Flora and Fauna Guarantee Act 1988* (FFG Act) is the Victorian legislation that provides for the conservation of biodiversity and the management of associated potentially threatening processes (DELWP 2022). Previously, Victoria had multiple lists of threatened species – those listed under the FFG Act, and non-statutory lists, called the Victorian Threatened Species Advisory Lists.

Recent amendments to the FFG Act have removed duplication by establishing a single comprehensive list of threatened flora and fauna species. This will continue to be known as the *Flora and Fauna Guarantee Act 1988 – Threatened List* (DELWP 2022). With the new comprehensive list now in effect, the advisory lists have been revoked. Black Swamp has three species listed under the EPBC Act and twelve species that are listed under the FFG Act (Table 10), with nine of these being wetland dependent. Three species are listed under international agreements (Relevant plans and Legislation and Appendix 2).

Pest animals that pose major a threat to Black Swamp include carp (*Cyprinus carpio*) and goldfish (*Carassius auratus*) as they compete with native fish for food, decrease water quality by foraging on the bottom of the wetland causing water to become turbid, can reproduce in large numbers and feed on native fish (section 4.2).

**Table 10: Conservation status of fauna species recorded at Black Swamp**

Common Name	Scientific Name	Type	International Agreements	EPBC	FFG
Australasian bittern	<i>Botaurus poiciloptilus</i>	B		EN	CE
Australasian shoveler	<i>Anas rhynchotus</i>	B			Vu
Australian little bittern	<i>Ixobrychus dubius</i>	B			En
Brown Treecreeper	<i>Climacteris picumnus victoriae</i>	B		VU	
Bush Stone-curlew	<i>Burhinus grallarius</i>	B			CE
Eastern great egret	<i>Ardea modesta</i>	B			Vu
Freckled duck	<i>Stictonetta naevosa</i>	B			En
Glossy Ibis	<i>Plegadis falcinellus</i>	B	B		
Hardhead	<i>Aythya australis</i>	B			Vu
Lace monitor	<i>Varanus varius</i>	R			En
Magpie goose	<i>Anseranas semipalmata</i>	B			Vu
Plumed Egret	<i>Ardea intermedia plumifera</i>	B			CE
Rainbow Bee-eater	<i>Merops ornatus</i>	B	J		
Superb Parrot	<i>Polytelis swainsonii</i>	B		VU	En
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	B	C		En

#### Legend

Type: Bird, Reptile International: Bonn (B), CAMBA (C), JAMBA (J)

EPBC Act: Listed as Endangered (EN), Vulnerable (VU)

Flora and Fauna Guarantee Act 1988: Listed as Critically Endangered (CE), Endangered (En), Vulnerable (Vu)



Glenelg Hopkins  
  
 CMA

## CASE STUDY

# Australasian Bittern

Black Swamp is home to the Australasian Bittern (*Botaurus poiciloptilus*).

Australasian Bittern is listed as endangered under the EPBC Act (1999) and critically endangered under the FFG Act (1988).

The Australasian Bittern is a secretive bird that habits densely vegetated wetlands, floodplains, creeks and estuaries. They are mostly mottled brown colour with a darker back and pale buff coloured underside.

Also known as the Bunyip bird, they have a distinct booming call and are usually heard and not seen. If exposed, they will stand motionless with their neck and bill pointed skywards.

Australasian Bitterns feed on aquatic animals such as frogs and freshwater crustaceans.

Growth can be to 75cm with a wingspan over 1m.

Australasian Bittern can be confused with juvenile Nankeen night-heron (*Nycticorax caledonicus*). To identify the difference between the two species, the Australasian Bittern is larger, with streaked underparts and does not have a black crown like the juvenile Nankeen night-heron.

Threats to Australasian Bittern include:

- Loss of habitat caused by grazing animals.
- Predator species such as foxes and cats.
- Altered watering regime to habitat.
- Salinisation of habitat.
- Invasive weeds.
- Shooting and hunting.

▲ After weeks of careful observations, the Bittern Recovery team discovered an Australasian Bittern nest with 3 fluffy chicks. These chicks are around four days old here. Disturbance to the nest was in accordance to the strict ethics permit for the field work. This photo was taken while the mother was off the nest to forage. The team monitored her flight and exited the swamp before she came back to the nest. The Bittern has continued her foraging trips as before.

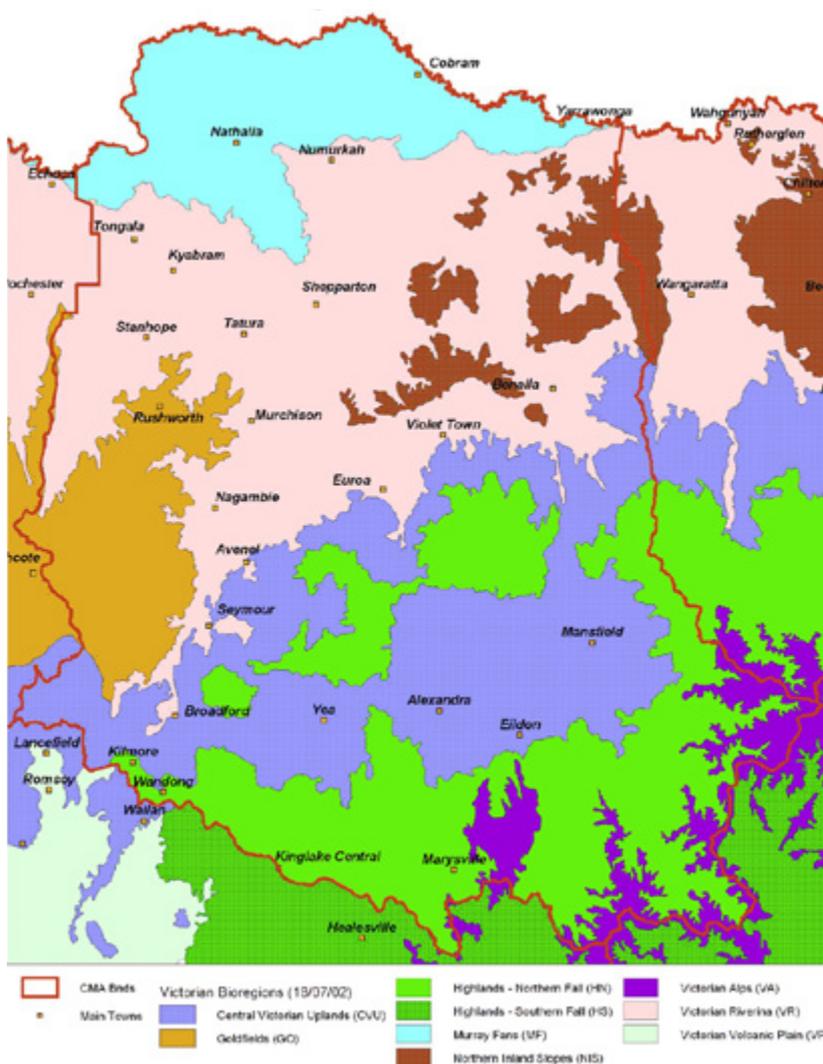
Photo: J Hendriks, Glenelg Hopkins CMA

### 3.1.2.3 FLORA – BIOREGIONS AND ECOLOGICAL VEGETATION CLASSES

Black Swamp is situated in the Victorian Riverina bioregion (Figure 6). Bioregions are a landscape-scale approach to classifying the environment using a range of attributes such as climate, geomorphology, geology, soils, and vegetation. Victorian Riverina, located north of the Great Dividing Range in Victoria, is characterised by flat to gently undulating landscape on recent unconsolidated sediments with evidence of former stream channels and wide floodplain areas associated with major river systems and prior streams.

Alluvium deposits from the Cainozoic period (65 million years – present day) gave rise to the red brown earths and texture contrast soils (Chromosols and Sodosols) which dominate the Riverine Plain. Annual average rainfall for the region ranges from 360-672mm per annum. The average annual minimum and maximum temperature range is from 3 to 9°C and 15 to 21°C respectively. The vegetation is dominated by Plains Grassy Woodland, Plains Grassland, Pine Box Woodland/Riverina Plains Grassy Woodland Mosaic, Riverine Grassy Woodland/Riverine Sedgy Forest/Wetland Mosaic, Plains Grassy Woodland/Gilgai Plains Woodland/Wetland Mosaic, Grassy Woodland and Wetland Formation ecosystems. The Victorian Riverina bioregion is associated with the eight river basin tributaries of the Murray River draining north, west, and southwest from the Great Dividing Range of eastern Australia (DELWP 2022).

Figure 6: Bioregions of the Goulburn Broken CMA



**Table 11: Conservation status of Ecological Vegetation classes recorded at Black Swamp**

EVC number	EVC Name	Bioregional Conservation Status
292	Red Gum Swamp	Vulnerable
821	Tall Marsh	Depleted
306	Aquatic Grassy Wetland	Not yet assigned
815	Riverine Swampy Woodland	Vulnerable
803	Plains Woodland	Endangered

A hierarchical system of classification of vegetation communities has been developed in Victoria over the past decade to classify vegetation into units that are both ecologically meaningful and useful for vegetation managers. The classification that has been adopted in Victoria is Ecological Vegetation Classes (EVCs), which are defined by a combination of floristics, lifeform, position in the landscape and an inferred fidelity to environments. Each EVC includes a collection of floristic communities, which occur across a biogeographic range, and although differing in species, have similar habitat and ecological processes operating. Approximately 300 EVCs have been described for Victoria. The combination of EVC and bioregion (BioEVC) is used to determine the bioregional conservation status (BCS) of an EVC. This is a measure of the current extent and quality for each EVC, when compared to its original (pre-1750) extent and condition. On this basis a BioEVC will have a BCS of endangered, vulnerable, depleted, least concern or rare (DELWP 2022).

Dominant EVCs within Black Swamp include Red Gum Swamp, Aquatic Grassy Wetland and Tall Marsh. Within this bioregion the EVC Red Gum Swamp has a vulnerable conservation status, the EVC Tall Marsh has a depleted conservation status and the EVC Aquatic Grassy Wetland has not yet been assigned a conservation status (Table 11). Terrestrial EVCs surrounding Black Swamp include the vulnerable Riverine Swampy Woodland and endangered Plains Woodland.

Before the introduction of environmental water in 2008, Black Swamp experienced regular, unseasonal, and prolonged flooding due to the regulation of Nine Mile Creek to supply water for irrigation, stock, and domestic use. As a result, the mature river red gums that once covered the wetland died. In addition, the composition, structure, and diversity of the understorey was modified by the establishment of flora species adapted to more permanent inundation including cumbungi (*Typha orientalis*) and giant rush (*Juncus ingens*).

#### ▼ Tall Marsh EVC

Photo: D Cook, Wetlands Revival Trust





▲ Drought employment crew planting river red gum tube stock at Black Swamp to assist with re-establishment of Red Gum EVC

Photo: M Geddes, GB CMA Drought Employment Crew

Currently, only a fringe of the original Red Gum Swamp EVC exists around the edge of the wetland dominated by river red gum, common Swamp Wallaby-grass (*Amphibromus nervosus*), common spike-rush (*Eleocharis acuta*), rush sedge (*Carex tereticaulis*), red pondweed (*Potamogeton cheesemaniae*), southern cane-grass (*Eragrostis infecunda*) and common nardoo (*Marselia drummondii*) (Cook, Bayes et al. 2009).

The EVCs Aquatic Grassy Wetland and Tall Marsh have also been recorded in the site and have established over the main body of the wetland under the altered hydrological regime. Aquatic Grassy Wetland is dominated by the indicator species River Swamp Wallaby-grass and Common Swamp Wallaby-grass, and the EVC Tall Marsh is dominated by the indicator species cumbungi and giant rush. However, a variety of native wetland-dependent species are common across both EVCs including Pacific azolla (*Azolla filiculoides*), water primrose (*Ludwigia peploides subsp. montevidensis*), red milfoil (*Myriophyllum verrucosum*) and pale knotweed (*Persicaria lapathifolia*) (Cook, Bayes et al. 2009).

Since 2008, Goulburn Broken CMA with the cooperation of Parks Victoria, Goulburn-Murray Water and Yorta Yorta Nation Aboriginal Corporation have attempted to restore a more natural hydrological regime to Black Swamp by upgrading its regulating structure and managing the delivery of environmental water to the site. This has increased the abundance, distribution, and diversity of native wetland-dependent species. In the long term, reinstating a more natural hydrological regime will encourage the restoration of the original Red Gum Swamp EVC and reduce the abundance and distribution of weeds. A drought employment crew were employed to plant river red gum tube stock in March 2021, which will assist with the re-establishment of the Red Gum EVC after the 2014 fire destroyed immature trees within the wetland body.

Terrestrial EVCs at Black Swamp include Riverine Swampy Woodland and Plains Woodland. These EVCs provide important habitat for terrestrial fauna species. These fauna benefit during environmental water delivery as the water provides both a water source and food source for terrestrial species.

### 3.1.2.4 FLORA – SPECIES LISTINGS AND SIGNIFICANCE

A total of 269 flora species have been recorded at Black Swamp since 2011. Flora surveys between 2008 and 2010 recorded a total of 180 species and a further eighty-nine species were recorded between 2011 and 2022 (Table 12). Of the 269 species recorded ninety-seven are native wetland-dependent species, ninety-nine are native terrestrial species and seventy-three are introduced species.

Of the introduced species arrowhead (*Sagittaria platyphylla*) poses the greatest risk to the site due to its ability outcompete native wetland-dependent species. Arrowhead is classified as a Weed of National Significance however is not listed in Victoria. Arrowhead once dominated large areas of Black Swamp but is no longer found in the main body. The last recording of arrowhead within the main body of the wetland was four small populations recorded in 2016. Recent surveys indicate it is no longer present in the wetland body. Arrowhead still poses a threat to Black Swamp as it is present in Nine Mile Creek.

**Table 12: Flora count comparison between 2008 and 2022**

Species type	2008-2010 count	2011-2022 count	Change
Native Terrestrial plants	66	99	33
Native wetland-dependent plants	63	97	34
Introduced terrestrial plants	36	52	16
Introduced wetland-dependent plants	15	21	6
<b>Total</b>	<b>180</b>	<b>269</b>	<b>89</b>

#### ▼ Lace monitor at Black Swamp

Photo: J Geddes, GB CMA



### 3.1.2.5 FLORA THREATENED STATUS

Flora species are classified by their threatened status. Most flora species found at Black Swamp do not have a threatened status, meaning their position in the landscape and their population numbers are not currently under threat either nationally or in Victoria (section 3.1.2.2). Threatened flora species numbers have also increased at Black Swamp with ten species being recorded at the site in 2023 compared to six in 2010 (Table 13).

Changes to some of the threatened species at Black Swamp include the addition of the Cut-leaf Burr-daisy (*Calotis anthemoides*). This species has since been identified as threatened on the 2022 FFG Act species list. In the 2011 Plan, Bluish raspwort (*Haloragis glauca f. glauca*) was identified as a threatened species on the 2005 DSE Advisory list of rare or threatened plants but has since been removed from the 2022 FFG Act species list.

**Table 13: Conservation Status of Flora species recorded at Black Swamp**

Common Name	Scientific Name	Species type	EPBC Status	FFG Status
Buloke	<i>Allocasuarina luehmannii</i>	Terrestrial		CE
Cut-leaf Burr-daisy	<i>Calotis anthemoides</i>	Terrestrial		CE
Groundsel	<i>Senecia campylocarpus</i>	Terrestrial		En
Riverina bitter-cress	<i>Cardamine moirensis</i>	Aquatic		En
River swamp Wallaby-grass	<i>Amphibromus fluitans</i>	Aquatic	V	
Slender water-ribbons	<i>Cycnogeton dubium</i>	Aquatic		En
Smooth minuria	<i>Minuria integrima</i>	Terrestrial		Vu
Waterbush	<i>Myoporum montanum</i>	Terrestrial		En
Water nymph	<i>Najas tenuifolia</i>	Aquatic		En
Winged water starwort	<i>Callitriche umbonata</i>	Aquatic		En

#### Legend

EPBC Status: Vulnerable (V)

FFG Status: Critically Endangered (CE), Endangered (En), Vulnerable (Vu)



## CASE STUDY

# River Swamp Wallaby-grass

Black Swamp is one of the only swamps within the Broken catchment that has a significant population of River Swamp Wallaby-grass (*Amphibromus fluitans*).

River Swamp Wallaby-grass is listed as vulnerable under the EPBC Act (1999) and is usually found in wetlands.

The plant flowers between October and March and usually begins fruiting in December.

River Swamp Wallaby-grass grows to approximately 80cm.

Autumn watering at Black Swamp encourages the growth of River Swamp Wallaby-grass which is prolific within the swamp by spring.

Threats to River Swamp Wallaby-grass include:

- Grazing
- Invasion of exotic plant species
- Human-induced disturbance
- Altered watering regime.

## 3.2 Ecological condition

Rakali consulting has been monitoring the condition of Black Swamp since environmental watering began in 2008. A report written by the consulting company in 2018 describes progress against the ecological objectives established for the wetland in the 2011 Plan and recommendations to help achieve them. These are summarised in Table 14. Mitigation actions have been undertaken since the progress report was developed in 2018.

These include:

- Replanting 200 river red gum saplings within body of wetland to assist with the re-establishment of the Red Gum EVC.
  - Drying of wetland to ensure exotic species do not establish in the wetland body.
- Autumn watering in 2020 to re-establish River Swamp Wallaby-grass within wetland.
  - Autumn watering to assist with the re-establishment of medium to large sedges within the wetland.

Flora and fauna numbers at Black Swamp have increased since the first delivery of environmental water in 2008, thus indicating a positive change in the ecological condition of the site. With continuous monitoring, delivery of environmental watering and re-introduction of aquatic plant species to promote EVC health, Black Swamp's ecological condition should continue to improve.

### ▼ Nardoo emerges during environmental watering in 2020

Photo: C Ryan, GMW



**Table 14: 2011 ecological objectives and their review in 2018**

2011 Ecological objectives	Discussion and recommendations from 2018	Actions since 2018
<p><b>Red gum canopy:</b> Cover of 5-10% across the entire wetland</p>	<p>The cover of river red gums is &lt;1% across the wetland, significantly below the 5-10% target.</p> <p>At the current rate of regeneration, it will take many years for the target of 5-10% canopy cover across the entire wetland to be reached. Some river red gum saplings planted by Goulburn Broken CMA in the deeper parts of the wetland are becoming well established.</p> <p>Additional planting of 200 river red gum seedlings as this wetland next draws down would greatly accelerate the regeneration of the tree canopy.</p> <p>River red gum canopy regeneration is reliant upon a drying cycle long enough for river red gum saplings to reach between a metre and metre and a half in height before the they are inundated for a prolonged period, particularly during the warmer months (October to May).</p>	<p>200 river red gums seedlings planted in 2021.</p>
<p><b>Sedgy understorey:</b> Medium to large sedges: aim to have at least two species and &gt;10% cover: e.g., <i>Eleocharis acuta</i>; <i>Carex tereticaulis</i></p>	<p>Two species of sedges were present, however at significantly below the target 10% cover.</p> <p>The development of the cover of native sedges, grasses and aquatic herbs in shallow wetland areas is reliant on an adequate period of inundation, which drowns out terrestrial weeds and provides enough time for the rhizomes and stems of these species to fully develop and spread.</p> <p>When these wetlands are watered in spring and a hot dry summer occurs these lifeforms will not have enough time to develop. Watering in autumn can increase the amount of time a wetland is inundated for and assist in the control of summer-growing wetland weeds including barnyard grass (<i>Echinochloa crus-galli</i>) and narrow-leaf water plantain (<i>Alisma lanceolata</i>) and weeds that grow following water draw-down including aster-weed (<i>Symphotrichum subulatum</i>).</p> <p>It is recommended that the next few environmental watering events for these wetlands are planned for autumn, with follow up monitoring conducted to determine whether this assists in meeting cover benchmarks.</p>	<p>Autumn watering occurred in 2020.</p>
<p><b>Grassy understorey:</b> Medium to large grasses: aim to have at least three species and &gt;10% cover around verges and bed: <i>Amphibromus sp</i>; <i>Eragrostis infecunda</i>; <i>Lachnagrostis filifolia s.l</i>; <i>Poa fordeana</i>; <i>Walwhalleya proluta</i></p>	<p>Three species of grasses were present at well above the target 10% cover.</p> <p>Prolonged warm season flooding over summer 2015-16 had a significant impact on river swamp Wallaby grass significantly reducing its cover. The last watering has allowed this species to recover, and it is now once again dominant across most of the wetland.</p>	

2011 Ecological objectives	Discussion and recommendations from 2018	Actions since 2018
<p><b>Aquatic or mudflat Herbs</b> (aim to have &gt;8 species and &gt;10% cover) e.g.</p> <p><b>Wet Phase:</b> <i>Marsilea drummondii</i>; <i>Myriophyllum sp.</i>; <i>Najas tenuifolia</i>; <i>Marsilea costulifera</i>; <i>Ludwigia peploides</i>; <i>Potamogeton cheesemanii</i>; <i>Damasonium minus</i>; <i>Cycnogeton (Triglochin) sp.</i></p> <p>Dry phase: <i>Centipeda cunninghamii</i>; <i>Persicaria sp.</i>; <i>Dysphania pumilio</i>; <i>Senecio sp.</i></p>	<p>Most aquatic understory herbs that responded well to inundation in spring 2016 were either absent or very sparse during the current monitoring period, including swamp lily (<i>Ottelia ovalifolia</i>), waterwort (<i>Elatine gratioloides</i>), red water milfoil (<i>Myriophyllum verrucosum</i>), Eel grass (<i>Vallisneria australis</i>), water nymph (<i>Najas tenuifolia</i>), blunt pondweed (<i>Potamogeton ochreatus</i>) and red pondweed (<i>Potamogeton cheesemanii</i>). This was probably because the duration of inundation was too short to allow the extensive growth of aquatic herbs.</p>	<p>Dry phase between 2021 and naturally flooding event in 2022.</p>
<p><b>Reduce the cover and diversity of exotic flora species</b></p>	<p>The wetland drying over the very hot, dry summer of 2018-19 assisted in reducing the cover of summer-growing weeds and invasive native plants including water couch (<i>*Paspalum distichum</i>), arrowhead (<i>*Sagittaria platyphylla</i>) and broad-leaf cumbungi (<i>Typha orientalis</i>).</p>	
<p><b>To provide opportunities for waterbirds that utilise the site for breeding and feeding</b></p>	<p>Delivery of environmental water to Black Swamp attracted a moderate diversity but mostly low abundance of waterbirds, including white-faced heron (<i>Egretta novaehollandiae</i>), white-necked heron (<i>Ardea pacifica</i>), yellow-billed spoonbill (<i>Platalea flavipes</i>), Australian white ibis (<i>Threskiornis molucca</i>), eastern great egret (<i>Ardea modesta</i>), Pacific black duck (<i>Anas superciliosa</i>), grey teal (<i>Anas gracilis</i>) and Australian spotted crake (<i>Porzana fluminea</i>).</p>	<p>Continuation of deliveries assists with bird breeding events.</p>
<p><b>To provide opportunities for native frog breeding</b></p>	<p>Environmental water triggered breeding of at least five species of frog.</p>	<p>Frog populations responded well to water deliveries in 2020 and 2021.</p>

▼ **Black Swan cygnet with eggs in nest at Black Swamp**  
Photo: GB CMA stock image



### 3.3

## Shared benefits

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 Traditional Owner benefits in delivering environmental water. Environmental watering of wetlands increases opportunities and visitation of wetlands for community events, bird watching, picnicking, photography, walking and camping. Wetlands provide resources for Traditional Owners for food, medicinal and traditional activities.

**Table 15: Shared benefits for Black Swamp**

Wetland	Beneficiary	Connection to wetland	Value	How have these benefits been considered for this EWMP?
<b>Black Swamp</b>	Yorta Yorta People Bird watchers Photographers	Cultural connection to country and wetland.  Recreation and tourism play an important role in the Moira Shire Council region. Tourism is the seventh largest contributor to economic output with an estimated \$90 million for the local community.	Environmental watering provides food, medicine and materials.  Environmental watering provides an opportunity for all visitors and locals to enjoy a valued site that is culturally diverse, ecologically protected, and who can in return value the site by ensuring native plant and animal species is protected. Opportunities for activities such as bird watching, and photography.	Environmental watering will provide a connection to country for Yorta Yorta People along with provisions and may assist with healing of country.  Environmental watering will provide for passive recreational activities such as bird watching and photography through increased communications around planned delivery via social media, radio and local newspaper notifications. Goulburn Broken CMA is constantly revising its communications strategy to expand networks to capture new audiences.

### 3.4

## Yorta Yorta cultural values

Black Swamp is a highly valued site for the Yorta Yorta People with evidence of oven mounds and clay balls adjoining the wetland edge. In its current condition, Black Swamp provides plant species for medicines, food and materials, fauna species for food and materials and a place of healing. Plants used traditionally for weaving are present within Black Swamp. These values have been written into cultural objectives and aligned with environmental watering values (section 5.3).

### 3.5

## Recreational values

Activities enjoyed by visitors to the site include bird watching, picnicking, bike riding and walking. Camping is a low-level activity at the wetland. Recreational hunting of ducks, quails and other game species in season is permitted at the site by licensed game shooters, however environmental water is not delivered for the purpose of hunting.

# 4. Current condition

The condition of Black Swamp was assessed in March 2023 using the Index of Wetland Condition (IWC). The IWC defines wetland condition as the state of the biological, physical, and chemical components of the wetland ecosystem and their interactions (DELWP 2020). Three IWC assessments have been completed at Black Swamp in 2006, 2009 and 2023.

The IWC has six sub-indices based on the catchment of the wetland and its fundamental characteristics: physical form, hydrology, water properties, soils, and biota (Appendix 3). Each sub-index is given a score between 0 and 20 based on the assessment of several measures. The overall IWC score is not a simple summation of the sub-index scores. A formula is used that weights each sub-index according to the contribution it makes to the overall condition of the wetland. The wetland hydrology sub-index for example contributes more to the overall score than the soils sub-index.

The 2006 IWC assessment is difficult to compare to 2009 and 2023 due to different scoring and survey techniques. It has been added to this report due to observations of the site which can be compared to 2009 and 2023 surveys.

The overall score for 2009 IWC assessment was six out of ten, classing the site in moderate condition. Sub-indices hydrology and biota were in very poor and poor condition respectively. Hydrology was very poor due to the significant impact the regulation of Nine Mile Creek has had on the natural wetting and drying cycle of Black Swamp. The regulation of Nine Mile Creek significantly modified the wetland dependent species (section 3.1.2.3) and the Red Gum Swamp EVC that once dominated the site was largely lost.

Water Technology undertook the 2023 IWC assessment at Black Swamp (Table 16) and made the following observations (Water Technology 2023):

## **Wetland Catchment**

The surrounding wetland buffer and surrounding land use was assessed around the existing wetland, not the original mapped wetland margin. This sub-index identified a wide buffer and low land-use intensity within the adjacent reserve that surrounded about 70% of the wetland margin. This score is relatively consistent with previous assessments.

## **Physical Form**

This sub-index has a reduced score due to the approximately 30% reduction in the original wetland area and a small area of change in bathymetry where the wetland had been excavated to create the levee on the north-west side. The 2023 score was consistent with the 2006 score.

## **Hydrology**

This sub-index was scored highly in 2023 as it is believed that the manipulated inflows from the delivery of environmental water are now more closely replicating the natural water regime (frequency, duration and timing). This score has shown improvement over previous assessments.

## **Water Properties**

This score was downgraded slightly as it is assumed that the surrounding agricultural land causes low level enrichment to the wetland, as was evident in the algal presence within the excavated channel on the north-west side.

## **Soils**

There was no notable soil disturbance observed within the wetland and this was consistent with previous assessments.

## **Biota**

This score fell between the two previous assessments. The fringing Riverine Swampy Woodland scored highly, while the Red Gum Swamp which occupies most of the wetland, is in recovery phase and is expected to improve if/as scattered tree cover returns.

The whole of wetland score increased in 2023 due to the improvements in the Hydrology and Biota subindex scores.

**Table 16: Comparison of IWC assessment scores and condition**

IWC sub-index	Score 2006	Score 2010	2010 Condition category	Score 2023	2023 Condition category
<b>Wetland catchment</b>	14/20	11/20	Moderate	11.5/20	Good
<b>Physical form</b>	16/20	20/20	Excellent	15.7/20	Good
<b>Hydrology</b>	10/20	0/20	Very poor	20/20	Excellent
<b>Water properties</b>	20/20	20/20	Excellent	17/20	Excellent
<b>Soils</b>	20/20	20/20	Excellent	20/20	Excellent
<b>Biota</b>	18/20	10.5/20	Poor	13.48/20	Moderate
<b>Overall IWC Score</b>		<b>6/10</b>	<b>Moderate</b>	<b>8/10</b>	<b>Good</b>

## 4.1 Trajectory of change

The addition of environmental water to Black Swamp since 2008 has seen progressive improvement of flora and fauna assets at the site (section 3.1.2). Due to the relatively small size of Black Swamp, its future environmental water availability and the introduction of a more natural hydrological regime, increased abundance, distribution, and diversity of native wetland dependent species in the site has occurred. Continuation of a more natural hydrological regime is expected to restore the Red Gum Swamp EVC in the long-term (Cook, Bayes et al. 2009). The replanting of 200 river red gum saplings and other aquatic herbs since 2015 have also increased diversity and have assisted with improving EVCs at the site.

Despite impacts of climate change on Black Swamp, environmental water may assist with decreasing the predicted long-term dry phases at the site (section 4.2).

If a “do nothing” approach was to occur at Black Swamp, it would be detrimental to the diversity and ecology of the site. Natural inflows into the swamp would only occur during extremely large rainfall events, with smaller events possibly only wetting the mid-section of the swamp. Invasive weed species such as arrowhead would become prolific in the swamp due to the shallow flooding, along with cumbungi. Large stands of cumbungi would form across the swamp bed and outcompete other aquatic plant species.

▼ **Large stands of dry cumbungi at Black Swamp in 2007**

*Photo: J Geddes, GB CMA*



## 4.2 Managing risks and threats

The key threats to the values of Black Swamp are outlined below and in Table 17. These threats result from activities in the wetland, on adjoining land and in the surrounding catchment. To address these threats and the impacts an integrated approach is required.

Potentially threatening processes identified in the FFG Act (DELWP 2022) relevant to Black Swamp and its surrounding area include:

- High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.
- Inappropriate fire regimes causing disruption to sustainable ecosystem processes and resultant loss of biodiversity.
- Invasion of native vegetation from weed species.
- Predation of native wildlife by the introduced red fox (*Vulpes vulpes*).
- Wetland loss and degradation because of change in water regime, dredging, draining, filling, and grazing.

Two of the above-mentioned points have occurred at Black Swamp since 2008. Fire razed the wetland in 2014 resulting in the loss of terrestrial species as the wetland was dry at the time. The addition of environmental water to the wetland a month after the fire did however promote good aquatic vegetation growth which in turn assisted with a large waterbird breeding event. Foxes were observed wading into the wetland to predate on waterbirds nesting at the site. Fox hunting could occur to mitigate this.

Threats to the site that are not listed under the FFG Act include an altered water regime, poor water quality from pest fish such as carp and the introduction of exotic plants and invasive native species. These threats were also identified in the 2011 Plan. Since the delivery of environmental water to Black Swamp, Goulburn Broken CMA and Goulburn-Murray Water have worked together to mitigate these threats (Table 17).

**Table 17: Identified threats and mitigation actions at Black Swamp**

Cause	Identified threat 2011 EWMP	Likelihood	Consequence	Risk	Mitigation between 2008-2023	Residual Risk
<b>Presence and operation of irrigation infrastructure</b>	Altered water regime.	High	Medium	Medium	Water delivered from link channel with regulating structure.	Low
<b>Disturbance due to carp</b>	Poor water quality due to disturbance of sediments that reduces aquatic macrophyte habitat quality.	High	High	High	Installation of carp screen on regulating structure.	Low
<b>Introduction of exotic plants and invasive natives</b>	Poor habitat diversity due to native wetland-dependent species being outcompeted by introduced exotic and invasive native wetland-dependent species.	High	High	High	Goulburn-Murray Water spray program of Nine Mile Creek and GB CMA mechanical removal of exotic and invasive native species within link channel. Introducing a natural wetting and drying regime using environmental water.	Low



▲ **Dead carp at Black Swamp 2009**

*Photo: GB CMA stock image*

Climate change poses a threat for Black Swamp. Projections for Australia reported in the 2020 'State of the Climate report' (CSIRO 2020) are for more heat extremes; more time in drought; more intense, short-duration storms; continued decrease in cool-season rainfall; and a longer fire season for southern and eastern Australia. The likely effect of these impacts will be less water available for agriculture, urban water supplies and ecosystems in coming decades, especially in southern Australia. Reduced water availability will affect the quality of the limited water resources, leading to increased costs of water treatment, degradation of aquatic ecosystems, and loss of habitat for flora and fauna, followed by a decline in populations.

The 'Indicative assessment of climate change vulnerability for wetlands in Victoria' (DSE, 2013) report, indicates that there is a predicted reduction of rainfall and increased temperatures across Victoria with wetlands in the north of the state to be most likely be affected. Black Swamp is classified as an intermittent wetland. The report identifies that intermittent wetlands may experience a longer dry phase, although they are already adapted to a mostly dry regime, so from a biological perspective are likely to remain relatively unchanged.

In summary, there will likely be a decrease in the number and area of permanent and seasonal wetlands and an increase in the number and area of intermittent wetlands. Environmental water may assist with the prevention of prolonged dry phases which may occur at this site.

Potential risks associated with impacts from the application of environmental water to Black Swamp during an actual watering event are listed in Appendix 4. These risks may or may not occur at any site obtaining an environmental water delivery. In addition, a detailed risk assessment process is developed prior to delivering environmental water in any given season and will be provided in the site Seasonal Watering Proposal and delivery plan. Mitigation measures are also implemented during environmental water delivery to address any potential risks.

# 5. Management goals, objectives and targets

## 5.1 Management goal

The long-term objective for Black Swamp is:

*“Maintain and improve the biological values, functioning and resilience of Black Swamp by providing a more natural wetting and drying regime.”*

It is supported by the following Goulburn Broken CMA Waterway Strategy goals:

- Maintain or improve the resilience of the region’s waterways.
- Wetlands with formally recognised significance are maintained or improved.
- Maintain or improve waterways of high community value.

## 5.2 Environmental objectives and targets

Environmental objectives and targets have been updated since the 2011 Plan. Objectives now reflect improved alignment with the Basin Plan and Victorian Long-Term Watering Plans. Updated objectives can be found in section 5.2.2 and Table 19.

▼ Aurora Damselfly at Black Swamp  
Photo: J Geddes, GB CMA



## 5.2.1 SUMMARY OF CHANGES

A summary of the changes suggested to the original plan objectives for Black Swamp are presented in Table 18. Note that post June 2019 the target for Basin Plan objectives is to improve outcomes, not just maintain.

In addition, objectives are required to address all the priority environmental asset criteria identified for the site that are not currently addressed by the existing objectives (Table 18). This includes adding objectives specific to criteria:

- 3(b) is essential for maintaining, and preventing declines of, native water-dependent biota (note this will be achieved by achieving provision of vital habitat as a lack of water in the landscape is the main reason for declines of native water-dependent biota).
- 4(a): Supports threatened species – EPBC Act listed, Australasian bittern and River Swamp Wallaby-grass.
- 4(c): Supports threatened species – FFG Act listed; seven species.

Whilst some functions are listed as being met at the site in the update, most are not directly measured. Therefore, additional objectives are considered for the following priority ecosystem functions (PEF) at the site. All the wetlands are managed to ensure water is in the landscape, particularly in dry periods so most act as refugium for native water-dependent biota.

- PEF 1(a): a refugium for native water-dependent biota during dry periods and drought.
- PEF 1(c): a diversity of important feeding, breeding, and nursery sites for native water-dependent biota.

**Table 18: Summary of recommended changes to objectives for Black Swamp**

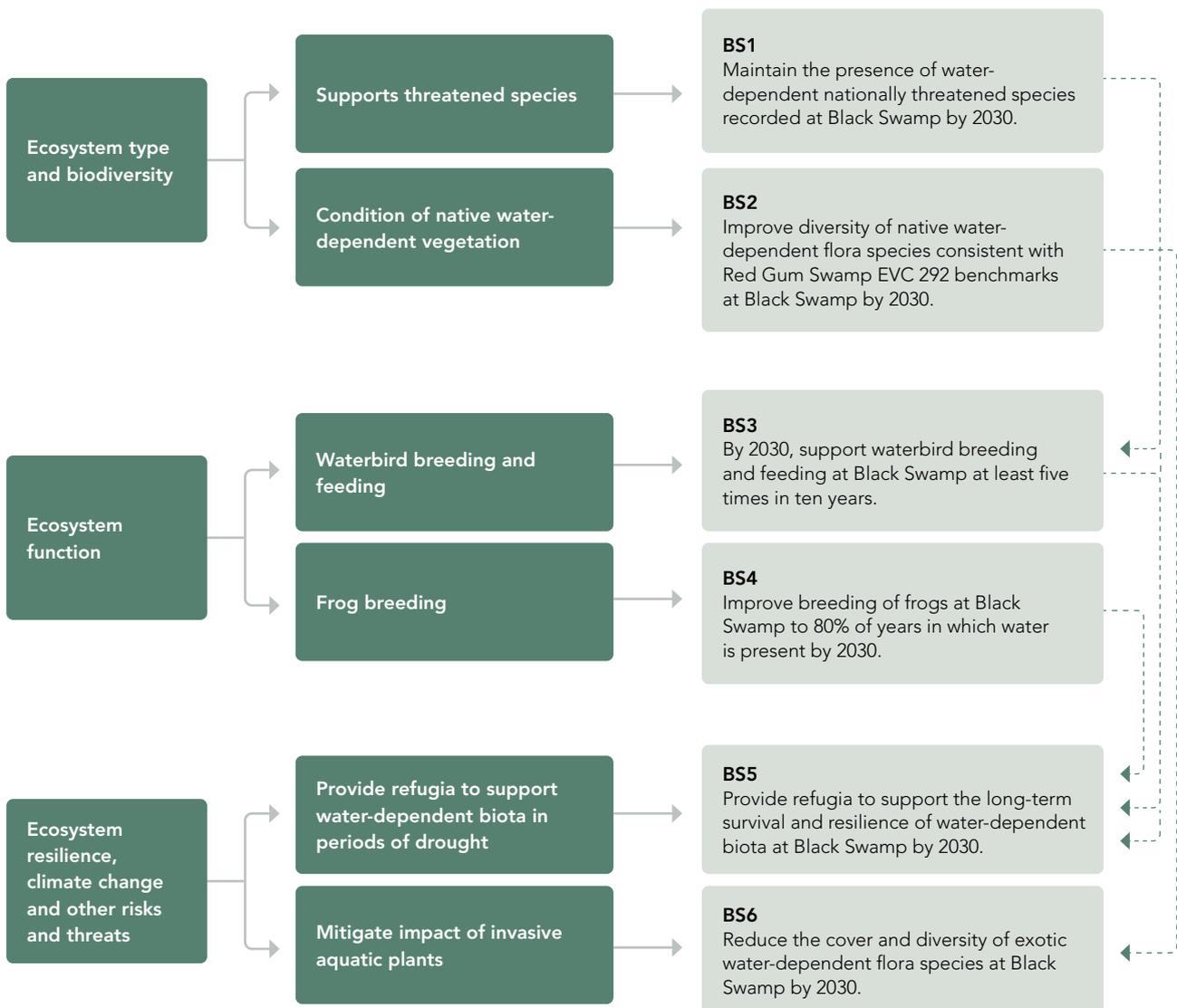
Black Swamp EWMP objectives 2011		Recommended changes to align with Basin Plan 2012
<b>BS1</b>	Achieve a diversity of native wetland-dependent species consistent with Red Gum Swamp EVC benchmark.	Change language to Improve as per Basin Plan Schedule 7 advice. Change date to 2030.
<b>BS2</b>	Reduce the cover and diversity of exotic flora species.	Identify target species in consultation with Goulburn Broken CMA.
<b>BS3</b>	Provide opportunities for waterbird breeding and feeding at least five in every ten years.	This is an ecosystem function as measuring the outcome i.e. breeding success as opposed to just supporting habitat.  Keep separate to breeding as there are likely to be different watering requirements. Specify benchmark. Addresses PEA criteria 3aiii.
<b>BS4</b>	Provide opportunities for native frog breeding at least five in every ten years.	Update and relate to vital habitat to support biodiversity.

## 5.2.2 UPDATED OBJECTIVES AND TARGETS

The update of this plan maintains the intent of the 2011 Plan objectives but improves the specificity and measurability of the objectives and targets and improves alignment to the Basin Plan.

Figure 7 shows the alignment of the updated Plan objectives to the three overarching environmental objectives of the Basin Plan Chapter 8 hierarchy and then to the relevant sections within this chapter (S8.05, 8.06 and 8.07). Table 19 presents the updated objectives and their targets.

**Figure 7: Chapter 8 Basin Plan Objectives, sections, and their relationships to the updated objectives for Black Swamp**

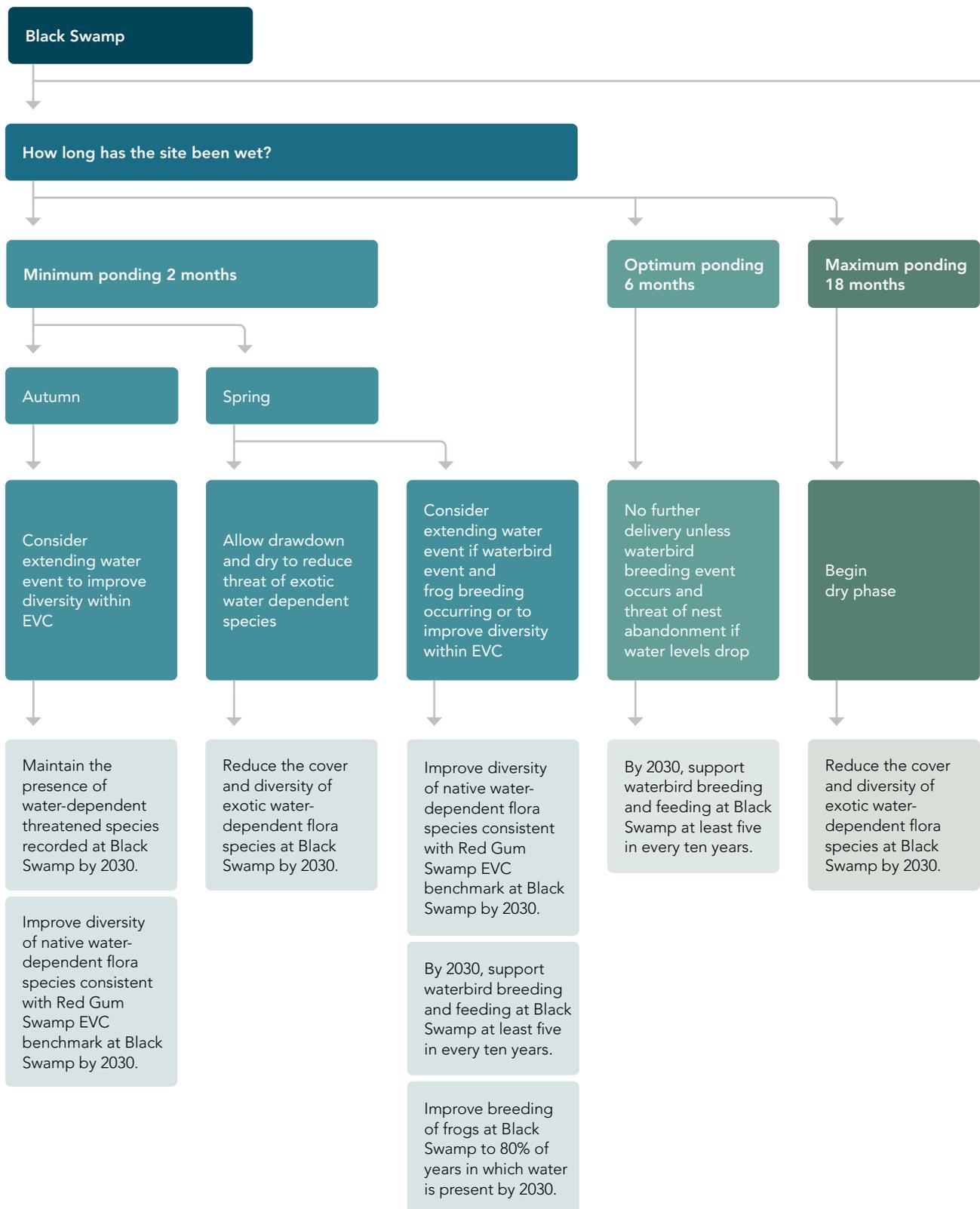


**Table 19: Updated objectives and targets for Black Swamp EWMP**

NO.	Objective	Target
BS1	Maintain the presence of water-dependent nationally threatened species recorded at Black Swamp by 2030.	Protect and restore biodiversity that is wetland-dependent, including supporting life cycles of threatened species at Black Swamp by 2030: <ul style="list-style-type: none"> <li>• Maintain presence of Australasian bittern (<i>Botaurus poiciloptilus</i>) in 70% of targeted surveys undertaken.</li> <li>• Maintain presence of listed plant species including River Swamp Wallaby-grass (<i>A.fluitans</i>) in 70% of surveys undertaken.</li> </ul>
	Maintain the presence of six state listed threatened waterbird species at Black Swamp by 2030.	Continue to support the presence of <i>Flora and Fauna Guarantee Act 1988 (Vic)</i> listed waterbirds in three out of five targeted surveys including: <ol style="list-style-type: none"> <li>1. Australasian bittern (<i>B.poiciloptilus</i>)</li> <li>2. Australian little bittern (<i>Ixobrychus dubius</i>)</li> <li>3. Baillon's crane (<i>Porzana pusilla</i>)</li> <li>4. Eastern great egret (<i>Ardea alba modesta</i>)</li> <li>5. Plumed egret (<i>Ardea intermedia plumifera</i>)</li> <li>6. White-bellied sea-eagle (<i>Haliaeetus leucogaster</i>).</li> </ol>
BS2	Improve diversity of native water-dependent flora species consistent with Red Gum Swamp EVC 292 benchmarks at Black Swamp by 2030.	Improve condition water-dependent native vegetation at Black Swamp by 2030: <ul style="list-style-type: none"> <li>• Red Gum Swamp EVC 292 with 5-10% cover of river red gum trees, at least two species of medium to large sedges with &gt;10% cover, at least three species of medium to large grasses with &gt;10% cover in zone where dominant, and greater than eight aquatic herb species with &gt;10% cover.</li> </ul>
BS3	By 2030, support waterbird breeding and feeding at Black Swamp at least five times in ten years.	Protect and restore ecosystem functions of water-dependent ecosystems that support successful non-colonial nesting of waterbird species at Black Swamp providing conditions for breeding and fledging at least five times in ten years: <ul style="list-style-type: none"> <li>• As a minimum at least seven species recorded breeding at Black Swamp over any ten-year assessment period: <ol style="list-style-type: none"> <li>1. Australian shelduck (<i>Tadorna tadornides</i>)</li> <li>2. Australasian reed warbler (<i>Acrocephalus stentoreus</i>)</li> <li>3. Australian wood duck (<i>Chenonetta jubata</i>)</li> <li>4. Black swans (<i>Cygnus atratus</i>)</li> <li>5. Grey teal (<i>Anas gracilis</i>)</li> <li>6. Pacific black duck (<i>Anas superciliosa</i>)</li> <li>7. Purple swamphen (<i>Porphyrio porphyrio</i>).</li> </ol> </li> </ul> <p>Protect and restore ecosystem functions at Black Swamp that support the creation of vital habitat for waterbird feeding habitat guilds on a regular basis, including during drought. Target waterbird feeding habitat guilds are densely vegetated habitat and shallow water &lt;0.5m habitat as per</p>
BS4	Improve breeding of frogs at Black Swamp to 80% of years in which water is present by 2030.	Maintain breeding of frogs at Black Swamp in 80% of years in which water is present, including: <ol style="list-style-type: none"> <li>1. Barking marsh frog (<i>Limnodynastes fletcheri</i>)</li> <li>2. Common froglet (<i>Crinia signifera</i>)</li> <li>3. Peron's tree frog (<i>Litoria peronii</i>)</li> <li>4. Plains froglet (<i>Crinia parinsignifera</i>)</li> <li>5. Pobblebonk (<i>Limnodynastes dumerilii</i>)</li> <li>6. Spotted marsh frog (<i>Limnodynastes tasmaniensis</i>).</li> </ol>
BS5	Provide refugia to support the long-term survival and resilience of water-dependent biota at Black Swamp by 2030.	Maintain Black Swamp at least 50% full over summer months during prolonged dry periods to provide a refugium to support the long-term survival and resilience of populations of waterbirds and other water-dependent biota, to allow for subsequent recolonisation beyond Black Swamp.
BS6	Reduce the cover and diversity of exotic water-dependent flora species at Black Swamp by 2030.	Reduced diversity and cover of target invasive aquatic plant species, especially aster-weed ( <i>Aster subulatus</i> ), water couch ( <i>Pastpalum distichum</i> ) and arrowhead ( <i>Sagittaria platyphylla</i> ) which is classified as a Weed of National Significance (WoNS), by 30% at Black Swamp by 2030 compared to benchmark 2008-2011.

Decision making on watering events at the site are shown below (Figure 8). Note this is only a guide as climate scenarios will also influence decision making at the site.

**Figure 8: Black Swamp watering decision chart**



\*YYNAC to be consulted on how watering actions can support cultural heritage and traditional knowledge

How long has the site been dry?

Minimum dry period 3 months

Optimum dry period 6 months

Maximum dry period 54 months

Drought scenario

Maintain dry period

Consider water event to support waterbird and frog breeding or to improve diversity within EVC

Consider environmental water event

Improve diversity of native water-dependent flora species consistent with Red Gum Swamp EVC benchmark at Black Swamp by 2030.

Improve diversity of native water-dependent flora species consistent with Red Gum Swamp EVC benchmark at Black Swamp by 2030.

Provide refugia to support the long-term survival and resilience of water-dependent biota at Black Swamp by 2030.

Reduce the cover and diversity of exotic water-dependent flora species at Black Swamp by 2030.

By 2030, support waterbird breeding and feeding at Black Swamp at least five in every ten years.

Maintain the presence of water-dependent threatened species recorded at Black Swamp by 2030.

Improve breeding of frogs at Black Swamp to 80% of years in which water is present by 2030.

### 5.3

## Cultural objectives aligned with watering objectives

Yorta Yorta cultural objectives were developed with Yorta Yorta Nation Aboriginal Corporation on country during a site visit to Black Swamp. These were aligned with watering objectives to ensure both Yorta Yorta cultural and environmental needs are met (Table 20).

**Table 20: Alignment of environmental and cultural objectives at Black Swamp**

2022 Objectives	Aligned Cultural Objective
<b>Improve diversity of native wetland dependent flora species consistent with Red Gum Swamp EVC benchmark at Black Swamp by 2030.</b>	Improve diversity of native wetland dependent flora species consistent with Red Gum Swamp EVC benchmark at Black Swamp by 2030. Partially filling Black Swamp to maintain and promote growth of diverse plant communities which include traditional plant species important to the Yorta Yorta People such as Nardoo (food source), native grasses, old man Weed (medicinal) and weaving sedges/rushes.
<b>Reduce the cover and diversity of exotic water-dependent flora species at Black Swamp by 2030.</b>	Reduced diversity and cover of target invasive aquatic plant species, by undertaking cultural burning before and /or after environmental watering to assist with the reduction of weed cover within the swamp.
<b>By 2030, support waterbird breeding and feeding at Black Swamp at least five in every ten years.</b>	Protect and restore biodiversity which is water-dependent by the introduction of cultural burning of native plants before and/or after watering to promote growth and provide nesting habitat for waterbirds such as swans which are an important food source for Yorta Yorta People.

▼ Swans nest with eggs  
Photo: GB CMA stock image



# 6. Environmental water requirements

## 6.1 Watering requirements

The recommended number of watering events has changed from the 2011 Plan where a recommendation of five to seven years in ten was recommended. The updated recommendation of watering aligns with the water regime adopted in the Victorian Wetland Classification framework (section 3.1.1, Table 8). Consistent with the management goal and the ecological objectives, the water regime for Black Swamp is for flooding to occur three to seven in ten years, in late autumn-spring, and drying out within a year (Table 21).

In the long term, reinstating a more natural hydrological regime will encourage the restoration

of the original Red Gum Swamp EVC, and reduce the abundance and distribution of aquatic weeds. River red gums grow more if flooded in spring-summer (Roberts and Marston 2011). This coincides with most waterbird breeding events; hence water delivery may need to be extended into summer to avoid birds abandoning nests and drawdown should be gradual.

Monitoring will be needed to determine how long water should be held within the wetland. Soil should be kept moist for a duration of 12-18 months if establishment of river red gum seedlings is desired (Committee 2011). Watering the wetland every three to seven in ten years will allow submerged aquatic native species to germinate, grow and reseed.

**Table 21: Hydrological requirements to meet environmental objectives for Black Swamp**

Objectives	Water management area	Hydrological Objectives												
		Recommended number of events in 10 years			Tolerable interval between events once wetland is dry (months)			Duration of ponding (months)			Preferred timing of inflows	Volume to fill to target supply level (ML)	Depth (mm)	
		Min	Opt	Max	Min	Opt	Max	Min	Opt	Max				
Improve diversity of native water-dependent flora species consistent with Red Gum Swamp EVC benchmark at Black Swamp by 2030.	Wetland body and riparian zone	2	3-7	10	3	6	54	2	6	18 <sup>1</sup>	Late Autumn – Spring or spring summer for more growth <sup>2</sup>	80	Variable to 500mm	
By 2030, support waterbird breeding and feeding at Black Swamp at least five in every ten years.	Wetland body	3	10	10	6	9	12	6	8	NA	Spring <sup>3</sup>	80 <sup>4</sup>	Variable to 500mm <sup>5</sup>	
Improve breeding of frogs at Black Swamp to 80% of years in which water is present by 2030.	Wetland fringe	NA	NA	NA	NA	NA	NA	1	2-6	NA	Autumn <sup>6</sup> - Spring	80	Variable to 500mm	

1. River red gums have been used as the main indicator plant for this watering regime. River red gums should not be wet for more than two consecutive summers (Barlow 2011).
2. More growth achieved for river red gums if flooded during spring-summer (Roberts and Marston 2011).
3. (Young 2003, Rogers and Ralph 2011).
4. Filling wetland from dry based on monitoring of past environmental water deliveries to Black Swamp.
5. Water depth should be kept consistent if waterbirds are nesting/ breeding to avoid nests being abandoned (Young 2003).
6. (ARC 2010).

## 6.2

### Expected watering effects

The expected watering effects at a site relate to the physical, chemical, biological or behavioural responses to a watering regime and clarify the outcomes expected with environmental watering actions.

Table 22 provides detail on the expected watering effects that may take place at Black Swamp during an environmental water delivery.

**Table 22: Expected watering effects at Black Swamp**

Environmental objectives	Potential watering action	Expected watering effect
<b>Increase the extent and condition of river red gums</b>	Fill Black Swamp in autumn or spring three to seven years in ten, to a maximum depth of 1m in the deepest parts, for six to eight months.	Inundate river red gums to stimulate growth and increase condition of EVC.
<b>Increase opportunities for waterbird breeding</b>	Fill Black Swamp in autumn or spring, three to seven years in ten, to a maximum depth of 1m in the deepest parts, for six to eight months.	Maintain water levels to trigger bird breeding event.
<b>Increase opportunities for frog populations</b>	Fill Black Swamp in autumn or spring, three to seven years in ten, to a maximum depth of 1m in the deepest parts, for two to six months.	Increase water levels to outer boundaries of swamp to trigger spawning of frogs.

▼ **Black Swan with cygnets**  
Photo: J Geddes, GB CMA



### 6.3

## Seasonally adaptive approach

A seasonally adaptive approach identifies the priorities for environmental watering under different climatic conditions. This means that watering events can be tailored to current conditions and be easily adapted in response to short-term local climatic variability, as conditions change throughout the year.

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.

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. Table 23 rationalises the volumes required for delivery at Black Swamp under these scenarios.

**Table 23: Scenario planning for environmental water delivery to Black Swamp**

Scenario 1	Scenario 2	Scenario 3	Scenario 4
			
Extreme Dry	Dry	Average	Wet
99% PoE No natural inflow to wetlands	90% PoE Little to no natural inflow to wetlands, rainfall	50% PoE Average natural inflow to wetland	10% PoE Above average inflow to wetland
<b>160ML</b> – provide drought refuge and maintain wetland to avoid critical loss of threatened wetland-dependent species such as River Swamp Wallaby-grass. Wetland of such small volume of water required to fill may also be less demand on environmental water account. 2008 and 2009 environmental watering of site proved it to be a high priority drought refuge area.	<b>160ML</b> – provide refuge and maintain wetland to avoid critical loss of threatened species such as River Swamp Wallaby-grass.	<b>80ML</b> – maintain water levels or fill wetland if primed due to natural inflows. Provide conditions for bird breeding and improve or maintain EVCs.	<b>40ML</b> – maintain water levels if wetland holding water. Provide optimal conditions for bird breeding events and improve or maintain EVCs.

# 7. Environmental water delivery infrastructure

## 7.1 Water delivery infrastructure

Environmental water can be delivered to Black Swamp via a link channel on Nine Mile Creek with a regulator on the channel operated by Goulburn-Murray Water during times of environmental water delivery.

▼ Opening the regulator on the link channel (left) and the link channel used to deliver environmental water to Black Swamp (right)

*Photo: J Geddes, GB CMA*

## 7.2 Complementary works

Nine Creek is the conduit to deliver environmental water to Black Swamp. Works over the past ten years on the creek to improve flows include a regular spray program for arrowhead and cumbungi plus the construction of a new weir and offtake door at Katandra. All these works assist with better regulation and flow along the creek which in turn assists with more efficient delivery of environmental water to Black Swamp. Maintenance of the link channel into Black Swamp also occurred between 2008 and 2022. The excavation of silt and weeds such as arrowhead from the link channel occurred to ensure efficient delivery of environmental water and to reduce the risk of spreading weed seed into the wetland.



## 7.3 Constraints

A notice period of one to two days minimum, preferably four days, is required for environmental water orders from Murray and Broken system storages. If constraints 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 one to three days during the irrigation season (August-May) depending on system demands. Goulburn Broken CMA is continuing to work with Goulburn-Murray Water to increase the opportunity to deliver water to the Lower Broken Creek and possibly Black Swamp outside of the irrigation season.

Black Swamp can only receive environmental water when 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 wetland may be delayed.

Delivery can be constrained by:

- **Flow volume** – flow in Nine Mile Creek needs to be greater than 100ML/day before water enters the wetland.
- **Flow duration** – flow in Nine Mile Creek needs to be greater than 100ML/day long enough for the required volume of water to enter the wetland.
- **Irrigation demands** – Black Swamp does not have a delivery share; therefore, environmental water can only be delivered when there is spare capacity to carry the water in Nine Mile Creek.

Mitigation actions for the constraints can be found in Table 24.

**Table 24: Mitigating actions to reduce the risk of constraints at Black Swamp**

Delivery Constraint	Mitigation Action
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.	Goulburn Broken CMA to discuss appropriate timing of watering with Goulburn-Murray Water to meet both irrigation demands and environmental water delivery requirements.
Black Swamp does not have a delivery share, thus environmental water can only be delivered when there is capacity to carry the water in the Nine Mile Creek.	Goulburn Broken CMA to discuss appropriate timing of watering with Goulburn-Murray Water to ensure channel capacity is available for the required amount of delivery time to the site.

# 8. Demonstrating outcomes

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 and 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 Black Swamp in late 2017 (DELWP 2021). This monitoring will complement the monitoring undertaken by Goulburn Broken CMA staff and consultants.

Compliance monitoring is 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 Black Swamp 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 the site 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.

Monitoring by Yorta Yorta Nation Aboriginal Corporation should also be encouraged at this site. Monitoring the effect of environmental water on the aligned cultural objectives is imperative.

▼ A water quality monitor (left) and monitoring sound at Black Swamp (right)

Photo: J Geddes, GB CMA



# 9. Knowledge gaps and recommendations

There are currently several knowledge gaps in relation to environmental water management at Black Swamp. While most of these do not impact the ability to provide water to the wetland and generate ecological benefit, addressing these would significantly improve the accuracy of environmental water bids, and provide long-term ecological understanding of the site.

The following list describes recognised knowledge gaps that may assist with more efficient environmental water delivery to Black Swamp.

1. Monitoring River Swamp Wallaby-grass and its response to prolonged inundation.
2. Monitoring of the sites environmental conditions and issues that may pose threats. This includes monitoring exotic species such as arrowhead when conditions are deemed favourable for their prolific growth. This monitoring should continue a long-term basis ensuring control of these plants. Pest animals should be monitored, and prevention and eradication should occur where possible.
3. Simulating the natural hydrological regime to provide ecological benefits by delivering environmental water on average five to seven years in ten years if conditions prevail.
4. Observing scientific knowledge gaps and working toward filling these gaps. This includes modelling of flows within the wetland if infrastructure upgrades are proposed and continuation of monitoring of the wetland during an environmental water delivery and thereafter.
5. Observing Yorta Yorta knowledge gaps and work together towards better preservation and protection of their knowledge. This will involve genuinely engaging with Yorta Yorta Nation Aboriginal Corporation and undertaking the appropriate cultural assessments led by Yorta Yorta Nation Aboriginal Corporation with respectful protocols.
6. Modelling the impact of reinstating Nine Mile Creek natural meander on commence to flow levels at Black Swamp.
7. Investigate the groundwater impact upon Black swamp – pre-European and current.
8. Continue to work with Goulburn-Murray Water to increase the opportunity to deliver environmental water outside of the irrigation season.
9. Work with Parks Victoria to install signage at the site to improve community understanding of environmental water and Yorta Yorta history and their benefits to the wetland.
10. Replant to reintroduce wetland dependent species that may be required to assist with meeting EVC benchmarks.

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# 11. Appendices

## Appendix 1: Flora of Black Swamp

Common Name	Scientific Name	EPBC	FFG	Indigenous use
Gold-dust Wattle	<i>Acacia acinacea s.l.</i>			Food source – mature seed ground for flour.
Silver Wattle	<i>Acacia dealbata</i>			Wood used for stone axe handles and boomerangs. Gum mixed with ash for use as resin to fasten tools, such as axe heads to handles. Gum eaten or dissolved in water with nectar to make a sweet drink. Bark infused in hot water as remedy for indigestion.
Black Wattle	<i>Acacia mearnsii</i>			Gum eaten or used to make a drink or adhesive. Seeds edible, bark used to treat wounds and used as medicine.
Mallee Wattle	<i>Acacia montana</i>			Medicine and food source.
Golden Wattle	<i>Acacia pycnantha</i>			Roasted seeds and gum were eaten, bark used for medicine as a mild sedative for rheumatism. Wood used for tools.
Water Plantain	<i>Alisma plantago-aquatica</i>			Root possibly used for food and medicine.
Buloke	<i>Allocasuarina luehmannii</i>		CE	Wood used for tools. Young shoots and female cones were eaten.
Marsh Fox-tail	<i>Alopecurus geniculatus</i>			
Lesser Joyweed	<i>Alternanthera denticulata</i>			Seeds may have been ground into flour.
River Swamp Wallaby-grass	<i>Amphibromus fluitans</i>	V		
Common Swamp Wallaby-grass	<i>Amphibromus nervosus</i>			
Common Wheat-grass	<i>Anthosachne scaber</i>			
Nodding Chocolate-lily	<i>Arthropodium fimbriatum</i>			Edible tubers.
Small Vanilla-lily	<i>Arthropodium minus</i>			Edible tubers.
Common Woodruff	<i>Asperula conferta</i>			
Berry Saltbush	<i>Atriplex semibaccata</i>			Edible berries and leaves. Used to poison fish also.
Plump Spear-grass	<i>Austrostipa aristiglumis</i>			
Crested Spear-grass	<i>Austrostipa blackii</i>			
Feather Spear-grass	<i>Austrostipa elegantissima</i>			
Spurred Spear-grass	<i>Austrostipa gibbosa</i>			
Knotty Spear-grass	<i>Austrostipa nodosa</i>			
Slender Spear-grass	<i>Austrostipa scabra subsp. falcata</i>			
Rough Spear-grass	<i>Austrostipa scabra subsp. scabra</i>			
Wild Oat	<i>Avena barbata</i>			
Pacific Azolla	<i>Azolla filiculoides</i>			
Ferny Azolla	<i>Azolla pinnata subsp. pinnata</i>			
Basalt Daisy	<i>Brachyscome basaltica var. gracilis</i>			
Variable Daisy	<i>Brachyscome ciliaris</i>			
Variable Daisy	<i>Brachyscome ciliaris var. subintegrifolia</i>			
Brome	<i>Bromus spp.</i>			
Bulbine Lily	<i>Bulbine bulbosa</i>			Food source -rounded root was eaten.

Common Name	Scientific Name	EPBC	FFG	Indigenous use
Sweet Bursari	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>			Food and medicine source.
Bottlebrush	<i>Callistemon</i> sp			
Winged Water-starwort	<i>Callitriche umbonata</i>		EN	
Lemon Beauty-heads	<i>Calocephalus citreus</i>			
Cut-leaf Burr-daisy	<i>Calotis anthemoides</i>		CE	
Tuffed Burr-daisy	<i>Calotis scapigera</i>			
Burr-daisy	<i>Calotis</i> spp.			
Riverine Bitter-cress	<i>Cardamine moirensis</i>		EN	Leaves are eaten.
Fen Sedge	<i>Carex gaudichaudiana</i>			Used for weaving of baskets
Knob Sedge	<i>Carex inversa</i>			
Hollow Sedge	<i>Carex tereticaulis</i>			Perennial rush-like tussocky plants to 1 m tall. Stems of this sedge contain very strong longitudinal fibres and can be split lengthwise into fine strips and used to make traditional baskets.
Drooping Cassinia/ Chinese Scrub	<i>Cassinia arcuata</i>			
Old Man Weed	<i>Centipeda cunninghamii</i>			Medicinal powers highly regarded. Used to treat colds, infected eyes and throats, skin infections and as a contraceptive. Prepared tonic used to cure colds, chest complaints, tuberculosis and as a general tonic. Also used externally for eye and skin complaints.
Common Sneezeweed	<i>Centipeda minima</i> subsp. <i>Minima</i> s.s.			
Caustic Spurge	<i>Chamaesyce drummondii</i>			
Chara	<i>Chara</i> sp.			
Narrow Rock Fern	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>			
Rock Fern	<i>Cheilanthes</i> spp.			
Small-leafed Goosefoot	<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>			Seeds ground as flour.
Windmill Grass	<i>Chloris truncata</i>			
Common Everlasting	<i>Chrysocephalum apiculatum</i> s.l.			Medicine and Food source
Clustered Everlasting	<i>Chrysocephalum semipapposum</i>			
Pink Bindweed	<i>Convolvulus erubescens</i> spp. <i>agg.</i>			A tough starchy root that is cooked and kneaded into a dough, leaves steamed as food. Also used medicinally
Grass Bindweed	<i>Convolvulus remotus</i>			
Dense Crassula	<i>Crassula colorata</i>			
Dense Crassula	<i>Crassula colorata</i> var. <i>acuminata</i>			
Spreading Crassula	<i>Crassula decumbens</i> var. <i>decumbens</i>			
Water Crassula	<i>Crassula natans</i> var. <i>minus</i>			
Sieber Crassula	<i>Crassula sieberiana</i> s.l.			
Australian Stonecrop	<i>Crassula sieberiana</i> ssp. <i>Tetramera</i>			
Slender Water-ribbons	<i>Cynogeton dubium</i>		EN	
Sweet Hounds-tongue	<i>Cynoglossum suaveolens</i>			
Variable Flat-sedge	<i>Cyperus difformis</i>			
Tall Flat-sedge	<i>Cyperus exaltatus</i>			
Star Fruit	<i>Damasonium minus</i>			

Common Name	Scientific Name	EPBC	FFG	Indigenous use
Pale Flax-lily	<i>Dianella longifolia</i> s.l.			
Black-anther Flax-lily	<i>Dianella revoluta</i> var. <i>revoluta</i> s.l.			The leaves were split and then twisted together to make a strong tie.
Grey Parrot-pea	<i>Dillwynia cinerascens</i> s.l.			
Wedge-leaf Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>			Wood used for tool making. Juice of root used as medicine for toothache, cuts and stings.
Tangled Lignum	<i>Duma florulenta</i>			
Globular Pigweed	<i>Dysphania glomulifera</i> ssp. <i>glomulifera</i>			
Clammy Goosefoot	<i>Dysphania pumilio</i>			
Yellow Twin-heads	<i>Eclipta platyglossa</i>			
Saloop	<i>Einadia hastata</i>			The small red fruits can be eaten or used as a dye or face paint.
Nodding Saltbush	<i>Einadia nutans</i> subsp. <i>nutans</i>			Small red fruits eaten, and plant used as fish poison. Dye can be used as face paint.
Waterwort	<i>Elatine gratioloides</i>			
Common Spike-sedge	<i>Eleocharis acuta</i>			Tubers can be eaten raw, baked or ground into flour.
Slender Spike-sedge	<i>Eleocharis gracillis</i>			
Small Spike-sedge	<i>Eleocharis pusilla</i>			
Ruby Saltbush	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>			Food source and fish poison. Edible red fruits.
Spider Grass	<i>Enteropogon acicularis</i>			
Grey Willow-herb	<i>Epilobium billardierianum</i> var. <i>cinereum</i>			
Hairy Willow-herb	<i>Epilobium hirtigerum</i>			
Southern Cane-grass	<i>Eragrostis infecunda</i>			
Turkey Bush	<i>Eremophila deserti</i>			
Blue Devil	<i>Eryngium ovinum</i>			
River Red Gum	<i>Eucalyptus camaldulensis</i>			Smaller scars indicate bark dishes (coolamons). Water containers made from large, gnarled burls.
Grey Box	<i>Eucalyptus microcarpa</i>			Wood used for tool making. Food source and shelter.
Red Ironbark	<i>Eucalyptus tricarpa</i> (planted)			
Annual Cudweed	<i>Euchiton sphaericus</i>			
Common Eutaxia	<i>Eutaxia microphylla</i>			
Spreading Eutaxia	<i>Eutaxia microphylla</i> var. <i>diffusa</i>			
Common Eutaxia	<i>Eutaxia microphylla</i> var. <i>microphylla</i>			
Grassland Cranesbill	<i>Geranium retrorsum</i> s.l.			
Indian Cudweed	<i>Gnaphalium polycaulon</i>			
Slender Goodenia	<i>Goodenia gracilis</i>			
Cut-leaf Goodenia	<i>Goodenia pinnatifida</i>			
Rough Raspwort	<i>Haloragis aspera</i>			
Bluish Raspwort	<i>Haloragis glauca</i>			
Tiny Star	<i>Hypoxis glabella</i> var. <i>glabella</i>			
Star	<i>Hypoxis</i> spp.			
Hollow Rush	<i>Juncus amabilis</i>			The seeds of species of this genus are mixed in with grains, and the stems used to make string and baskets.
Tussock Rush	<i>Juncus aridicola</i>			
Toad Rush	<i>Juncus bufonius</i>			

Common Name	Scientific Name	EPBC	FFG	Indigenous use
Gold Rush	<i>Juncus flavidus</i>			
Giant Rush	<i>Juncus ingens</i>			The seeds of species of this genus are mixed in with grains, and the stems used to make string and baskets.
Hoary Rush	<i>Juncus radula</i>			
Rush	<i>Juncus spp</i>			
Finger Rush	<i>Juncus subsecundus</i>			
Billabong Rush	<i>Juncus usitatus</i>			
Common Blown-grass	<i>Lachnagrostis filiformis</i> var. 1			
Thin Duckweed	<i>Landoltia punctata</i>			
Jersey Cudweed	<i>Laphangium luteoalbum</i>			
Woolly Buttons	<i>Leiocarpa panaetioides</i>			
Stalked Plover-daisy	<i>Leiocarpa websteri</i>			
Common Duckweed	<i>Lemna disperma</i>			
Austral Mudwort	<i>Limosella australis</i>			
Native Flax	<i>Linum marginale</i>			Edible seeds. Stems stripped and beaten to free fibre and make string.
Poison Pratia	<i>Lobelia concolor</i>			
Poison Lobelia	<i>Lobelia pratioides</i>			
Scented Mat-rush	<i>Lomandra effusa</i>			
Wattle Mat-rush	<i>Lomandra filiformis</i> var. 1			
Clove-strip	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>			
Small Loosestrife	<i>Lythrum hyssopifolium</i>			
Black Cotton-bush	<i>Maireana decalvans</i>			
Wingless Bluebush	<i>Maireana enchylaenoides</i>			
Bluebush	<i>Maireana spp.</i>			
Narrow leaf Nardoo	<i>Marsilea costulifera</i>			
Common Nardoo	<i>Marsilea drummondii</i>			Spore cases eaten after being carefully prepared.
Short-fruit Nardoo	<i>Marsilea hirsuta</i>			
Moonah	<i>Melaleuca lanceolata</i>			
Creeping Mint	<i>Mentha saturoides</i>			
Smooth Minuria	<i>Minuria integerrima</i>		Vu	
Waterbush	<i>Myoporum montanum</i>		En	
Upright Water-milfoil	<i>Myriophyllum crispatum</i>			
Robust Water-milfoil	<i>Myriophyllum papillosum</i>			
Red Water-milfoil	<i>Myriophyllum verrucosum</i>			
Water Nymph	<i>Najas tenuifolia</i>		En	
Swamp Lily	<i>Ottelia ovalifolia</i> subsp. <i>ovalifolia</i>			
Native Millet	<i>Panicum decompositum</i> var. <i>decompositum</i>			
Warrego Summer-grass	<i>Paspalidium jubiflorum</i>			
Water Pepper	<i>Persicaria hydropiper</i>			Crushed plants used to stupefy fish in waterholes. Peeled stem cooked and eaten.
Pale Knotweed	<i>Persicaria lapathifolia</i>			
Phragmites	<i>Phragmites australis</i>			Roots are eaten. Root described as crisp and non-starchy with a taste rather like bamboo shoots. Edible only after roasting, with the fibrous root requiring considerable effort in collecting and processing. Spear shafts made from flowering stems and necklaces from stem sections. Basket weaving undertaken with the leaves.

Common Name	Scientific Name	EPBC	FFG	Indigenous use
Picris	<i>Picris</i> spp.			Stems cooked and eaten.
Curved Rice-flower	<i>Pimelea curviflora</i> s.s.			
Weeping Pittosporum	<i>Pittosporum angustifolium</i>			Wood used for tool making. Plant used for ceremonies. Sticky seeds and the gum are eaten. The seed and leaves are medicines for colds and eczema.
Narrow Plantain	<i>Plantago gaudichaudii</i>			
Variable Plantain	<i>Plantago varia</i>			
Forde Poa	<i>Poa fordeana</i>			
Common Tussock-grass	<i>Poa labillardierei</i>			Fibre extracted from stems to manufacture string for nets, bags, baskets and mats.
Common Tussock-grass	<i>Poa labillardierei</i> var. <i>labillardierei</i>			
Grey Tussock-grass	<i>Poa sieberiana</i>			
Tussock Grass	<i>Poa</i> spp.			
Red Pondweed	<i>Potamogeton cheesmanii</i>			
Blunt Pondweed	<i>Potamogeton ochreatus</i>			
Moirra Grass	<i>Pseudoraphis spinescens</i>			
Pussy Tails	<i>Ptilotus spathulatus</i> f. <i>spathulatus</i>			
Drumsticks	<i>Pycnosorus globosus</i>			
Ferny Small-flower Buttercup	<i>Ranunculus pumilio</i> var. <i>pumilio</i>			
Slender Dock	<i>Rumex brownii</i>			
Narrow-leaf Dock	<i>Rumex tenax</i>			
Common Wallaby-grass	<i>Rytidosperma caespitosa</i>			
Brown-backed Wallaby-grass	<i>Rytidosperma duttoniana</i>			
Hill Wallaby-grass	<i>Rytidosperma erianthum</i>			
Bristly Wallaby-grass	<i>Rytidosperma setacea</i>			
Bristly Wallaby-grass	<i>Rytidosperma setacea</i> var. <i>setacea</i>			
Black Roly Poly	<i>Sclerolaena muricata</i>			
Groundsel	<i>Senecio campylocarpus</i>		EN	
Cotton Fireweed	<i>Senecio quadridentatus</i>			
Desert Cassia	<i>Senna artemisioides</i> spp. agg.			
Variable Sida	<i>Sida corrugata</i>			Medicine and food source
Smooth Solenogyne	<i>Solenogyne dominii</i>			
Sea-spurrey/ Sand-spurrey	<i>Spergularia brevifolia</i>			
Lesser Sand-spurrey	<i>Spergularia diandra</i>			
Red Sand-spurrey	<i>Spergularia rubra</i> s.l.			
Large Duckweed	<i>Spirodela polyrhiza</i>			
Thin Duckweed	<i>Spirodela punctata</i>			
Broughton Pea	<i>Swainsona procumbens</i>			
Leafy Templetonia	<i>Templetonia stenophylla</i>			
Grey Germander	<i>Teucrium racemosum</i> s.l.			
Kangaroo Grass	<i>Themeda triandra</i>			String made from leaves and stems.
Narrow-leaf Cumbungi	<i>Typha domingensis</i>			Underground stems (rhizomes) a granular potato tasting starch cooked by steaming in an earth oven. This was then chewed until the starch was gone and the remaining fibre used to make string for waist belts, brow bands, bags and nets.

Common Name	Scientific Name	EPBC	FFG	Indigenous use
Cumbungi	<i>Typha orientalis</i>			Underground stems (rhizomes) a granular potato tasting starch cooked by steaming in an earth oven. This was then chewed until the starch was gone and the remaining fibre used to make string for waist belts, brow bands, bags and nets.
Eel Grass	<i>Vallisneria australis</i>			
Annual New Holland Daisy	<i>Vittadinia cervicalis</i>			
Fuzzy New Holland Daisy/ Fuzz Weed	<i>Vittadinia cuneata</i>			
Fuzzy New Holland Daisy	<i>Vittadinia cuneata</i> var. <i>cuneata</i>			
Tufted Bluebell	<i>Wahlenbergia capillaris</i>			
River Bluebell	<i>Wahlenbergia fluminalis</i>			Food source
Sprawling Bluebell	<i>Wahlenbergia gracilis</i>			
Bronze Bluebell	<i>Wahlenbergia luteola</i>			
Rigid Panic	<i>Walwhalleya proluta</i>			
Tiny Duckweed	<i>Wolffia australiana</i>			

## INTRODUCED SPECIES

Cape Weed	<i>Arctotheca calendula</i>			
Hastate Orache	<i>Atriplex prostrata</i>			
Bearded Oat	<i>Avena barbata</i>			
Wild Oat	<i>Avena fatua</i>			
Oat	<i>Avena</i> spp.			
False brome	<i>Brachypodium distachyon</i>			
Soft brome	<i>Bromus hordeaceus</i> subsp. <i>hordeaceus</i>			
Thread Water-starwort	<i>Callitriche brutia</i> var. <i>brutia</i>			
Water-starwort	<i>Callitriche hamulata</i>			
Common Water-starwort	<i>Callitriche stagnalis</i>			
Kikuyu	<i>Cenchrus clandestinus</i>			
Skeleton weed	<i>Chondrilla juncea</i>			
Spear Thistle	<i>Cirsium vulgare</i>			
Eastern Larkspur	<i>Consolida ajacis</i>			
Flaxleaf Fleabane	<i>Erigeron bonariensis</i>			
Tall Fleabane	<i>Erigeron sumatrensis</i>			
Ferny Cotula	<i>Cotula bipinnata</i>			
Water Crassula	<i>Crassula natans</i> var. <i>minus</i>			
Couch	<i>Cynodon dactylon</i> var. <i>dactylon</i>			
Drain Flat-sedge	<i>Cyperus eragrostis</i>			
Barnyard Grass	<i>Echinochloa crus-galli</i>			
Cleavers	<i>Gallium aparine</i>			
Ganziana	<i>Ganzizna</i> spp			
Creeping Heliotrope	<i>Heliotropium supinum</i>			
Ox-tongue	<i>Helminthotheca echinoides</i>			
Barley-grass	<i>Hordeum murinum</i> s.l			
Smooth Cat's-ear	<i>Hypochoeris glabra</i>			

Cat's Ear	<i>Hypochoeris radicata</i>		
Willow-leaf Lettuce	<i>Lactuca saligna</i>		
Prickly Lettuce	<i>Lactuca serriola</i>		
Hairy Hawkbit	<i>Leontodon taraxacoides</i> subsp. <i>taraxacoides</i>		
Common Peppergrass	<i>Lepidium africanum</i>		
Lilaea	<i>Lilaea scilloides</i>		
Perennial Rye-grass	<i>Lolium perenne</i>		
Wimmera Rye-grass	<i>Lolium rigidum</i>		
African Box-thorn	<i>Lycium ferocissimum</i>		
Burr Medic	<i>Medicago polymorpha</i>		
Scotch Thistle	<i>Onopordum acanthium</i> subsp. <i>acanthium</i>		
Grassland Wood-sorrel	<i>Oxalis perennans</i>		
Paspalum	<i>Paspalum dilatatum</i>		
Water Couch	<i>Paspalum distichum</i>		
Lesser Canary-grass	<i>Phalaris minor</i>		
Paradoxical Canary-grass	<i>Phalaris paradoxa</i>		
Kentucky Blue-grass	<i>Poa pratensis</i>		
Prostate Knotweed	<i>Polygonum aviculare s.l</i>		
Hogweed	<i>Polygonum aviculare s.s</i>		
Annual Beard-grass	<i>Polypogon monspeliensis</i>		
Sharp Buttercup	<i>Ranunculus muricatus</i>		
Celery Buttercup	<i>Ranunculus sceleratus</i> subsp. <i>sceleratus</i>		
Onion Grass	<i>Romulea rosea</i>		
Onion Grass	<i>Romulea spp</i>		
Curled Dock	<i>Rumex crispus</i>		
Sagittaria	<i>Sagittaria platyphylla</i>		
Silver-leafed Nightshade	<i>Solanum elaeagnifolium</i>		
Black Nightshade	<i>Solanum nigrum s.s</i>		
Rough Sow-thistle	<i>Sonchus asper</i>		
Common Sow-thistle	<i>Sonchus oleracea</i>		Stem eaten like celery.
Lesser Sand-spurrey	<i>Spergularia diandra</i>		
Red Sand-spurrey	<i>Spergularia rubra s.l</i>		
Aster-weed	<i>Symphyotrichum subulata</i>		
Hare's-foot Clover	<i>Trifolium arvense var. arvense</i>		
Suckling Clover	<i>Trifolium dubium</i>		
Cluster Clover	<i>Trifolium glomeratum</i>		
Rough Clover	<i>Trifolium scarbrum</i>		
Woolly Clover	<i>Trifolium tomentosum</i>		
Wandering Speedwell	<i>Veronica peregrina</i>		
Squirrel-tail Fescue	<i>Vulpia bromoides</i>		
Wall Fescue	<i>Vulpia muralis</i>		
Rat's-tail Fescue	<i>Vulpia myuros</i>		
Tufted Bluebell	<i>Wahlenbergia communis s.l</i>		

## Appendix 2: Fauna of Black Swamp

### BIRDS

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Vulnerable	Endangered	Critically Endangered			
Australasian Darter	<i>Anhinga novaehollandiae</i>	Least concern					
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	Least concern					
Australasian Shoveler	<i>Anas rhynchotis</i>	Least concern		Vulnerable			
Australasian Swamphen	<i>Porphyrio melanotus</i>	Least concern					
Australian Hobby	<i>Falco longipennis</i>	Least concern					
Australian Little Bittern	<i>Ixobrychus dubius</i>	Least concern		Endangered			
Australian Magpie	<i>Gymnorhina tibicen</i>	Least concern					
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	Least concern					
Australian Pelican	<i>Pelecanus conspicillatus</i>	Least concern					
Australian Raven	<i>Corvus coronoides</i>	Least concern					
Australian Reed Warbler	<i>Acrocephalus stentoreus</i>	Least concern					
Australian Shelduck	<i>Tadorna tadornoides</i>	Least concern					
Australian White Ibis	<i>Threskiornis molucca</i>	Least concern					
Australian Wood Duck	<i>Chenonetta jubata</i>	Least concern					
Baillon's Crake	<i>Porzana pusilla palustris</i>	Least concern					
Barn Owl	<i>Tyto alba</i>	Least concern					
Black Swan	<i>Cygnus atratus</i>	Least concern					
Black-chinned Honeyeater	<i>Melithreptus gularis</i>	Least concern					
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Least concern					
Black-fronted Dotteral	<i>Elseya melanops</i>	Least concern					
Black-shouldered Kite	<i>Elanus axillaris</i>	Least concern					
Black-tailed Native Hen	<i>Gallinula ventralis</i>	Least concern					
Black-winged Stilt	<i>Himantopus himantopus</i>	Least concern					
Brown Falcon	<i>Falco berigora</i>	Least concern					
Brown Goshawk	<i>Accipiter fasciatus</i>	Least concern					
Brown Quail	<i>Synoicus ypsilophorus</i>	Least concern					
Brown Treecreeper (south-eastern ssp.)	<i>Climacteris picumnus victoriae</i>	Least concern	Vulnerable				
Buff-banded Rail	<i>Gallirallus philipensis</i>	Least concern					
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	Least concern					
Bush Stone-curlew	<i>Burhinus grallarius</i>	Least concern		Critically Endangered			
Chestnut Teal	<i>Anas castanea</i>	Least concern					
Cockatiel	<i>Nymphicus hollandicus</i>	Least concern					
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	Least concern					
Crested Pigeon	<i>Ocyphaps lophotes</i>	Least concern					
Crimson Rosella	<i>Platycercus elegans</i>	Least concern					
Dusky Moorhen	<i>Gallinula tenebrosa</i>	Least concern					
Dusky Woodswallow	<i>Artamus cyanopterus</i>	Least concern					
Eastern Great Egret	<i>Ardea modesta</i>	Least concern		Vulnerable			
Eastern Rosella	<i>Platycercus eximius</i>	Least concern					
Eastern Shrike-tit	<i>Falcunculus frontatus</i>	Least concern					
Eurasian Coot	<i>Fulica atra</i>	Least concern					

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Fairy Martin	<i>Hirundo ariel</i>	Least concern					
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	Least concern					
Flame Robin	<i>Petrocia phoenicea</i>	Least concern					
Freckled Duck	<i>Stictonetta naevosa</i>	Least concern		Endangered			
Fuscous Honeyeater	<i>Ptilotula fusca</i>	Least concern					
Galah	<i>Eolophus roseicapilla</i>	Least concern					
Glossy Ibis	<i>Plegadis falcinellus</i>	Least concern			A2S		
Golden Whistler	<i>Pachycephala pectoralis</i>	Least concern					
Great Cormorant	<i>Phalacrocorax carbo</i>	Least concern					
Grey Fantail	<i>Rhipidura albiscarpa</i>	Least concern					
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Least concern					
Grey Teal	<i>Anas gracilis</i>	Least concern					
Hardhead	<i>Aythya australis</i>	Least concern		Vulnerable			
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	Least concern					
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>	Least concern					
Jacky Winter	<i>Microeca fascinans</i>	Least concern					
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Least concern					
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	Least concern					
Little Buttonquail	<i>Turnix velox</i>	Least concern					
Little Corella	<i>Cacatua sanguinea</i>	Least concern					
Little Grassbird	<i>Megalurus gramineus</i>	Least concern					
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	Least concern					
Little Raven	<i>Corvus mellori</i>	Least concern					
Long-billed Corella	<i>Cacatua tenuirostris</i>	Least concern					
Magpie Goose	<i>Anseranas semipalmata</i>	Least concern		Vulnerable			
Magpie-lark	<i>Grallina cyanoleuca</i>	Least concern					
Masked Lapwing	<i>Vanellus miles</i>	Least concern					
Masked Woodswallow	<i>Artamus personatus</i>	Least concern					
Nankeen Kestrel	<i>Falco cenchroides</i>	Least concern					
Nankeen Night Heron	<i>Nycticorax caledonicus</i>	Least concern					
Noisy Friarbird	<i>Philemon corniculatus</i>	Least concern					
Noisy Miner	<i>Manorina melanocephala</i>	Least concern					
Pacific Black Duck	<i>Anas superciliosa</i>	Least concern					
Peaceful Dove	<i>Geopelia placida</i>	Least concern					
Peregrine Falcon	<i>Falco peregrinus</i>	Least concern					
Pied Butcherbird	<i>Cracticus nigrogularis</i>	Least concern					
Pied Currawong	<i>Strepera graculina</i>	Least concern					
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	Least concern					
Plumed Egret	<i>Ardea intermedia plumifera</i>	Least concern		Critically Endangered			
Plumed Whistling Duck	<i>Dendrocygna eytoni</i>	Least concern					
Rainbow Bee-eater	<i>Merops ornatus</i>	Least concern					
Red Wattlebird	<i>Anthochaera carunculata</i>	Least concern					
Red-rumped Parrot	<i>Psephotus haematonotus</i>	Least concern					
Restless Flycatcher	<i>Myiagra inquieta</i>	Least concern					
Royal Spoonbill	<i>Platalea regia</i>	Least concern					
Rufous Songlark	<i>Cincloramphus mathewsi</i>	Least concern					
Rufous Whistler	<i>Pachycephala rufiventris</i>	Least concern					

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Sacred Kingfisher	<i>Todiramphus sanctus</i>	Least concern					
Scarlet Robin	<i>Petroica boodang</i>	Least concern					
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	Least concern					
Silvereeye	<i>Zosterops lateralis</i>	Least concern					
Southern Boobook	<i>Ninox novaeseelandiae</i>	Least concern					
Spotless Crake	<i>Porzana pusilla</i>	Least concern					
Spotted Pardalote	<i>Pardalotus punctatus</i>	Least concern					
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	Least concern					
Striated Pardalote	<i>Pardalotus striatus</i>	Least concern					
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Least concern					
Superb Fairy Wren	<i>Malurus cyaneus</i>	Least concern					
Superb Parrot	<i>Polytelis swainsonii</i>	Least concern	Vulnerable	Endangered			
Swamp Harrier	<i>Circus approximans</i>	Least concern					
Tawny Frogmouth	<i>Podargus strigoides</i>	Least concern					
Tree Martin	<i>Hirundo nigricans</i>	Least concern					
Wedge Tail Eagle	<i>Aquila audax</i>	Least concern					
Weebill	<i>Smicromis brevirostris</i>	Least concern					
Welcome Swallow	<i>Hirundo neoxena</i>	Least concern					
Whistling Kite	<i>Haliastur sphenurus</i>	Least concern					
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Least concern		Endangered			C
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	Least concern					
White-browed Babbler	<i>Pomatostomus superciliosus</i>	Least concern					
White-browed Woodswallow	<i>Artamus superciliosus</i>	Least concern					
White-faced Heron	<i>Egretta novaehollandiae</i>	Least concern					
White-fronted Honeyeater	<i>Purnella albifrons</i>	Least concern					
White-naped Honeyeater	<i>Melithreptus lunatus</i>	Least concern					
White-necked Heron	<i>Ardea pacifica</i>	Least concern					
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	Least concern					
White-winged Chough	<i>Corcorax melanorhamphos</i>	Least concern					
Willie Wagtail	<i>Rhipidura leucophrys</i>	Least concern					
Yellow Thornbill	<i>Acanthiza nana</i>	Least concern					
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	Least concern					
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>	Least concern					
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	Least concern					
Zebra Finch	<i>Taeniopygia guttata</i>	Least concern					

## AQUATIC INVERTEBRATES

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Aurora Bluetail	<i>Ischnura aurora</i>	Least concern	Endangered	Endangered			
Backswimmer	Family Notonectidae						
Creeping Waterbug	<i>Naucoris sp</i>						
Dragonfly larvae	<i>Hemicordulia sp</i>						
Dragonfly larvae	<i>Hemianax sp</i>						
Eastern Billabongfly	<i>Austroagrion watsoni</i>	Least concern					
Predaceous Diving Beetle	<i>Eretes australis</i>			Endangered			

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Slender Ringtail	<i>Xylocopa vulpecula</i>	Least concern					
Small water strider	Family Veliidae						
Wandering Percher	<i>Diplacodes bipunctata</i>	Least concern					
Water boatman	<i>Sigara</i> sp						
Water Scavenger Beetle	<i>Berosus discolour</i>						

## AMPHIBIANS

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Barking Marsh Frog	<i>Limnodynastes fletcheri</i>	Least concern	Endangered				
Common Froglet	<i>Crinia signifera</i>	Least concern					
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	Least concern					
Perons Tree Frog	<i>Litoria peronii</i>	Least concern					
Plains Froglet	<i>Crinia parinsignifera</i>	Least concern					
Pobblebonk	<i>Limnodynastes dumerili</i>	Least concern					
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i> (NCR)	Least concern					

## MAMMALS

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	Least concern	Endangered				
Common Ringtail Possum	<i>Pseudocheirus peregrinus</i>	Least concern					
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Least concern					
Swamp Wallaby	<i>Wallabia bicolor</i>	Least concern					
White-stripe Freetail Bat	<i>Auromotus australis</i>	Least concern					

## REPTILES

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Boulenger's Skink	<i>Morethia boulengeri</i>	Least concern	Endangered				
Eastern Brown Snake	<i>Pseudonaja textilis</i>	Least concern					
Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Eastern snake-necked Turtle	<i>Chelodina longicollis</i>	Not assessed					
Lace Goanna	<i>Varanus varius</i>	Least concern		Endangered			
Large Striped Skink	<i>Ctenotus robustus</i>	Least concern					
Tiger Snake	<i>Notechis scutatus</i>	Least concern					

## INTRODUCED SPECIES

Common Name	Scientific Name	IUCN Red List	EPBC	FFG 2022	Bonn	JAMBA	CAMBA
Cat	<i>Felis</i> spp.	Not assessed	Endangered				
Common Starling	<i>Sturnus vulgaris</i>	Least concern					
Eurasian Carp	<i>Cyprinus carpio</i>	Not assessed for Australia					
Eastern Gambusia	<i>Gambusia holbrooki</i>	Least concern					
European Rabbit	<i>Oryctolagus cuniculus</i>	Not assessed for Australia					
Hare	<i>Lepus capensis</i>	Least concern					
House Sparrow	<i>Passer domesticus</i>	Least concern					

## Appendix 3: Index of wetland condition scoring

The total IWC score for a wetland is calculated by summing each sub-index score multiplied by its respective weight.

This can be represented by the following formula:

$$IWC_{total} = \sum_{i=1}^6 (w_i \times s_i)$$

where IWC total is the total IWC score,  $s_i$  is the sub-index score and  $w_i$  is the weight of the corresponding sub-index. The IWC data management system automatically calculates the sub-index scores and the IWC total score and assigns condition categories based on these scores.

### Weights for each sub-index (DSE 2009)

IWC sub-index	Weight
Biota	0.190
Wetland catchment	0.068
Water properties	0.122
Hydrology	0.081
Physical form	0.021
Soils	0.018

Each sub-index has a maximum score of 20. After the weights are applied, the maximum possible total score is 10. This score should then be rounded to the nearest whole number to determine its wetland condition category. Where data is not available for one or more sub-indices (due to prolonged dry conditions, for example), no total score should be given and the wetland should be assigned the category 'insufficient data'.

### Wetland condition categories and their respective score ranges

Sub-index score range (except hydrology and biota)	Hydrology score	Biota sub-index score range	IWC total score range	Wetland condition category
0–5	0	0–8	0–2	Very poor
>5–9	5	>8–13	3–4	Poor
>9–13	10	>13–16	5–6	Moderate
>13–17	15	>16–18	7–8	Good
>17–20	20	>18–20	9–10	Excellent

## Appendix 4: Risk of environmental water delivery to Black Swamp

Risk description	Likelihood of risk occurring	Consequence	Risk Rating	Mitigation actions	Residual Risk
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"> <li>• Communications on the environmental benefits of watering actions.</li> <li>• 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.</li> <li>• Communicate the need for complimentary measures to optimise the benefits of environmental watering actions.</li> </ul>	
Overestimates of environmental water demand prevents planning for supplying demands at other locations.	Possible	Minor	Low	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> <li>• River operators provide regular updates on flows, including through OAG meetings</li> <li>• Manage Water Holdings to maximise supply opportunities for all sites</li> </ul>	
Volumes of environmental water delivered or released exceed volumes approved for use in the event, leading to potential overdrawing of accounts or preventing other planned actions being undertaken.	Unlikely	Major	Low	<ul style="list-style-type: none"> <li>• Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume.</li> <li>• Ensure ordering and delivery procedures are kept up-to-date and adhered to.</li> <li>• Ensure metering and reporting processes for temporary pump operations are suitable and effective</li> </ul>	
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.	Unlikely	Major	Low	<ul style="list-style-type: none"> <li>• Monitor ABA balances and undertake regular communications with CMA and RWC as part of portfolio management activities.</li> <li>• Ensure that deliveries are reported progressively throughout the event and are monitored against ordered volume.</li> </ul>	
Failure of poorly maintained environmental delivery infrastructure results in planned/specified flows not being achieved, reducing the ability to achieve planned environmental outcomes.	Likely	Moderate	Medium	<ul style="list-style-type: none"> <li>• Asset ownership is clarified, and the asset owners perform regular maintenance, and pre-event asset inspections, on delivery infrastructure. *Note that insufficient resources are likely to limit the asset owner's ability to regularly inspect and maintain infrastructure. Increased resources for these activities may further reduce the likelihood and risk ratings.</li> <li>• Report vandalism to police.</li> <li>• Review asset design to minimise opportunities for interference or damage.</li> <li>• For privately owned assets, arrange approvals to use/operate assets and undertake pre-delivery inspections</li> <li>• Communicate failures to the CMA</li> <li>• Initiate documentation of asset ownership and management arrangements in national parks.</li> </ul>	
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	Likely	Minor	Low	<ul style="list-style-type: none"> <li>• Event planning will seek to avoid peak demand periods, and events will be monitored and adjusted as necessary.</li> <li>• System operators to provide longer term forecasts for future consumptive demands as an input to planning watering proposals</li> <li>• Develop longer term agreements on river capacity access for environmental deliveries.</li> <li>• Investigate opportunities to undertake deliveries outside the irrigation season with consideration of appropriate delivery costs.</li> </ul>	

Risk description	Likelihood of risk occurring	Consequence	Risk Rating	Mitigation actions	Residual Risk
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.	Possible	Major	Medium	<ul style="list-style-type: none"> <li>Ensure currency of any landholder agreements for inundation of private land.</li> <li>Release plans designed to avoid overbank flows or unauthorised flooding.</li> <li>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.</li> <li>Monitor forecast rainfall and tributary inflows and adjust releases to avoid overbank flows.</li> <li>Monitor deliveries to new locations to build an understanding of flow patterns and inundation thresholds and adjust releases accordingly.</li> </ul>	
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"> <li>Consider likelihood of initiating Blue Green Algal blooms in event planning and amend as required to manage risk.</li> <li>Land managers or water corporation implement a risk-based monitoring program during environmental watering events, and where issues are identified, activate BGA response processes.</li> <li>Regional monitoring and advice on BGA status.</li> </ul>	
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"> <li>Communicate benefits of environmental water management to the broader community and engage with recreational user peak bodies.</li> <li>Engage with local recreational user groups to inform them of environmental water management activities and the underlying rationale.</li> <li>Adjust events or actions to reduce/avoid impact where practical without reducing environmental outcomes.</li> <li>Communicate alternate recreational opportunities.</li> <li>Enhance community understanding of water system operations and entitlement frameworks (water literacy).</li> </ul>	
Environmental watering causes harm to identified cultural heritage.	Unlikely	Moderate	Medium	<ul style="list-style-type: none"> <li>Work with Yorta Yorta Nation Aboriginal Corporation to ensure that the potential impact of environmental water deliveries on cultural heritage is understood and agreed, minimised or avoided. This must be consistent with the AHA Act.</li> </ul>	
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"> <li>Rationalise and refocus current monitoring programs (e.g., Wetmap) to better identifying outcomes.</li> <li>Seek additional funds to address gaps in monitoring programs and knowledge.</li> <li>Communicate the benefits of environmental watering and monitoring results</li> </ul> <p><i>(Note: It may not be possible/affordable to address all monitoring gaps, so this risk may still be rated as medium after mitigation actions.)</i></p>	
Environmental deliveries improve conditions for non-native species (e.g., carp, invasive species, feral horses) leading to adverse environmental impacts. Or pest plants and animals prevent environmental water outcomes being achieved.	Likely	Moderate	Medium	<ul style="list-style-type: none"> <li>Study/understand life history of species and develop high level management strategies.</li> <li>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).</li> </ul> <p><i>(Note: This risk is still rated as medium after mitigation actions.)</i></p>	
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"> <li>Undertake monitoring and communicate these issues as they arise and apply adaptive management and review of delivery plans.</li> <li>Consider including contingency allowance in delivery plan water volumes to complete breeding events.</li> </ul>	

## Appendix 5: Rationale for updated objectives

Site-specific ecological objectives for Blacks Swamp from GBCMA (2011a) and Butcher (2017).

Overarching EWMP objective (GBCMA 2011a)	EWMP objectives (GBCMA 2011a)	EWMP objectives (Butcher 2017)
<b>To provide a watering regime that supports Red Gum Swamp EVC and provides breeding opportunities for a diverse range of native wetland biota.</b>	<b>BS1.</b> Achieve a diversity of native wetland flora species consistent with Red Gum Swamp EVC benchmark.	Maintain or improve Red Gum Swamp EVC 292 at Black Swamp by 2025 with 5-10% cover of river red gum trees, at least 2 species of medium to large sedges with >10% cover, at least 3 species of medium to large grasses with >10% cover in zone where dominant, and > 8 aquatic herb species with >10% cover.
	<b>BS2.</b> Reduce the cover and diversity of exotic flora species.	Reduced diversity and cover of target invasive aquatic plant species by 30% at Black Swamp by 2025 compared to benchmark 2008-2011.
	<b>BS3.</b> Provide opportunities for waterbird breeding and feeding at least five in every ten years.	Support successful non-colonial waterbird breeding events at Black Swamp in five out of every ten years in which conditions are suitable and breeding surveys are undertaken. As a minimum at least seven species recorded breeding at Black Swamp over the ten-year assessment period: Australian Shelduck ( <i>Tadorna tadornides</i> ), Australasian Reed Warbler ( <i>Acrocephalus stentoreus</i> ), Australian Wood Duck ( <i>Chenonetta jubata</i> ), Black Swans ( <i>Cygnus atratus</i> ), Grey Teal ( <i>Anas gracilis</i> ), Pacific Black Duck ( <i>Anas superciliosa</i> ) and Purple Swamphen ( <i>Porphyrio porphyrio</i> ).
	<b>BS4.</b> Provide opportunities for native frog breeding at least five in every ten years.	Maintain the following species at Black Swamp in 80% of years: Barking marsh frog ( <i>Limnodynastes fletcheri</i> ), Common froglet ( <i>Crinia signifera</i> ), Perons tree frog ( <i>Litoria peronii</i> ), Plains froglet ( <i>Crinia parinsignifera</i> ), Pobblebonk ( <i>Limnodynastes dumerilii</i> ), and Spotted marsh frog ( <i>Limnodynastes tasmaniensis</i> ).

Mapping objectives for Black Swamp to Basin Plan EWP objectives, Schedule 7 target groups, BWS QEEO, and LTWP Vic Murray objectives.

Overarching EWMP objective (MDBA, 2012a)	Detailed EWMP objectives (MDBA 2012a)	Relevant Basin Plan EWP objective	Relevant Schedule 7 target groups	Relevant BWS QEEO	LTWP objective
<b>To provide a watering regime that supports Red Gum Swamp EVC and provides breeding opportunities for a diverse range of native wetland biota.</b>	<b>BS1.</b> Achieve a diversity of native wetland flora species consistent with Red Gum Swamp EVC benchmark.	8.05,3(b) 8.06,6(a)	<ul style="list-style-type: none"> <li>Diversity of water-dependent native vegetation</li> <li>Ecosystem type</li> <li>Recruitment and populations of native water-dependent vegetation</li> <li>Condition of priority assets – supports biodiversity</li> </ul>	BWS12 BWS10	LTWPM5**
	<b>BS2.</b> Reduce the cover and diversity of exotic flora species.	8.07,5	<ul style="list-style-type: none"> <li>Condition of native water dependent vegetation</li> </ul>	-	-
	<b>BS3.</b> Provide opportunities for waterbird breeding and feeding at least five in every ten years	8.06,6(a) 8.06,6(b)	<ul style="list-style-type: none"> <li>Recruitment and populations of native water-dependent birds</li> <li>Condition of priority ecosystem functions – creation of vital habitat for breeding and feeding</li> </ul>	BWS19	LTWPM11
	<b>BS4.</b> Provide opportunities for native frog breeding at least five in every ten years	8.05,3(b)	<ul style="list-style-type: none"> <li>Recruitment and populations of other native water-dependent biota</li> <li>Condition of priority ecosystem functions – creation of vital habitat for breeding</li> </ul>	-	LTWPM19**



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