Seasonal Watering Proposal for the Wimmera Mallee Pipeline Wetlands Wimmera CMA Region 2021-22

Report prepared for: Victorian Environmental Water Holder
Report prepared by: Wimmera CMA

April 2021

Wimmera CMA

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Yellow-billed Spoonbill – Wal Wal Swamp – January 2020 (Photo: Michael Gooch)

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However, it is acknowledged that the contents and views expressed within this report are those of the Wimmera Catchment Management Authority and do not necessarily reflect the views of the parties acknowledged below.

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1. Executive summary

Dry conditions in the northern Wimmera have prevailed since 2016 and should this continue in 2021-22, the wetlands supplied by the Wimmera Mallee pipeline will continue to provide vital refuge habitat for local flora and fauna. They also provide stopover locations for wetland birds undertaking migrations to breeding and feeding habitats across eastern Australia.

Given a number of these wetlands were inundated by natural rainfall events in 2016 and they have an episodic hydrology, watering under most circumstances will again be targeted at filling/topping up the dams associated with the wetlands rather than inundating the broader wetland area. This means these wetlands retain their value as a watering point for local fauna, especially birds. Another year of no allocation to the pipeline wetland entitlement in 2020-21 means that modest watering actions continue to be proposed in order to conserve volumes for critical use in future years. Therefore, the focus will be on retaining water in dams at these wetlands with only limited watering of wetland areas. This approach has been able to achieve positive outcomes at several wetlands in recent years with the wetlands providing important habitat for local bird populations (terrestrial and waterbirds) as well as triggering positive responses from frogs and wetland plants.

Monitoring will be undertaken to ensure environmental water is being used efficiently and effectively to maintain the value of these wetlands, including via citizen science using audio recorders to monitor frog calls and eDNA sampling. The episodic hydrology of these wetlands means a sequence of wetting and drying over several years should achieve the maximum environmental outcomes.

Estimation of volumes required to achieve these objectives are included in Table 1 which provides the watering scenarios based on varying climatic conditions.

Table 1: Priority watering actions under a range of planning scenarios for Wimmera Mallee Pipeline wetlands in the Wimmera CMA region.

<table>
<tr><th rowspan="2">Wimmera Mallee Pipeline Wetlands – Wimmera CMA</th><th colspan="4">Scenario</th></tr>
<tr><th>Drought</th><th>Dry</th><th>Average</th><th>Wet</th></tr>
<tr><td rowspan="2">Total maximum environmental water required</td><td colspan="4">Fill/top up all dams plus provide wetland inundation for Carapugna– total of 77 ML</td></tr>
<tr><td colspan="2"></td><td colspan="2">Water adjacent wetland areas at Mutton Swamp, Tarkedia, Schultz/Koschitzke, Crow Swamp, Harcoans, Sawpit, Pinedale – total of 144.5 ML</td></tr>
</table>

Table of contents

Australasian Grebe at Tarkedia – December 2019 (Photo: M. Gooch)

2. Introduction

This seasonal watering proposal outlines the Wimmera CMA's proposed priorities for use of environmental water from the Wimmera and Glenelg Rivers Environmental Entitlement (the 'Water Holdings'), in the Wimmera CMA region for off-stream wetlands connected to the Wimmera Mallee Pipeline for the water year 2021-22. This seasonal watering proposal is submitted to the Victorian Environmental Water Holder (VEWH) in accordance with section 192A of the *Water Act 1989*. This seasonal watering proposal is endorsed by the Wimmera CMA for use by the VEWH as part of the development of the VEWH *Seasonal Watering Plan 2021-22*.

This proposal also flags intentions for monitoring and communication to demonstrate the outcomes the watering has achieved as well as analysing and mitigating the risks associated with environmental watering activities. It is also valuable in terms of communicating priorities to storage operators to manage infrastructure to undertake releases as well as the community to flag priorities and highlight the assumptions, transparency and rigor that goes into decisions around the use of environmental water.

3. Engagement

It is prescribed in the Environmental Entitlement for the Wimmera and Glenelg Rivers that the best available science is needed to determine environmental water use in order to achieve the best regional ecological outcomes. There is a growing dataset on which to base decision making but there is fewer than five years of monitoring data and a total of 13 sites, so community information and input assists greatly.

Several community members and stakeholders are engaged during the process of developing the proposal given they have wetlands on their property (Table 2). Beyond this, a couple of dozen community members have an interest in environmental watering of these wetlands and the outcomes that result given there are not many wetlands that regularly contain water in this part of Victoria. Wimmera CMA has co-ordinated several engagement events in conjunction with Birchip Landcare Group, focused on these wetlands. This has included a field trip in conjunction with North Central CMA in March 2017 looking at wetland vegetation, a wetland bird monitoring workshop, partnered with Birchip Landcare Group in April 2018 and an acoustic monitoring workshop in April 2019. Another event, in conjunction with Barengi Gadjin Land Council and North Central CMA was planned for March 2020 looking at cultural values associated with wetlands around Birchip but was cancelled due to COVID-19. Subject to budgets and protocols around COVID-19, it is anticipated that an event will be held in spring 2021.

Figure 1. Community members listening to Jo Deretic (GBCMA) at acoustic monitoring workshop, Birchip – April 2019

Table 2. Consultation undertaken in the development of the Seasonal Watering Proposal and level of engagement defined by International Association for Public Participation's Public Participation Spectrum (IAP2).

Organisation/ individual consulted	IAP2 Engagement Level	Consultation mechanism	Purpose of consultation	Consultation outcomes
Landholders with wetlands on their property	Collaborate	Phone calls	Discuss outcomes of current year's watering and plans for next year	Happy with watering program undertaken to date and provided information on ecological outcomes they observe.
Traditional Owners - Barengi Gadjin Land Council	Involve	Online meeting	Seek feedback on draft proposal for 2021-22 and opportunities for cultural values identification.	Supportive of the plans and have provided additional observations from visiting sites in 2020-21.
Recreational Users - Natimuk and District Field and Game	Consult	E-mail	Seek feedback re. outcomes for game reserves	No feedback provided presumably given size and distance of wetlands from Natimuk/Horsham.
Program Partner - Parks Victoria	Involve	Online meeting and e-mail	Illustrate outcomes of current year's watering and plans for next year as well as determining process for Parks Victoria endorsement	Value in having an online meeting with local Parks Victoria staff each year to discuss plans. in May-June. Provided letter of support for watering proposal.
Program Partner - GWMWater	Involve	E-mail	Illustrate plans for next year in terms of determining feasibility of delivery and determining process for GWMWater endorsement	No feedback provided – will have a key role in implementation.
Program Partner - VEWH	Collaborate	E-mail, meeting	Seek feedback on draft seasonal watering proposal	Provided suggestions to enhance proposal.
Program Partner – North Central CMA, Mallee CMA	Collaborate	Phone calls	Discuss indicative plans and risk management considerations	Need for Mallee CMA to continue as proponent for wetland monitoring resources across the three CMAs.

4. Shared Benefits

Aboriginal Cultural Values and Uses of Waterways

These wetlands are on the lands of the Wotjobaluk, Jaadwa, Jadawadjali, Wergai and Jupagulk peoples, collectively known as the Wotjobaluk peoples. Barengi Gadjin Land Council is the body that represents traditional owners of these lands. In 2020, Wimmera CMA and Barengi Gadjin Land Council (BGLC) Aboriginal Water Officers Ben Muir and Daniel Clarke visited several of these wetlands (Sawpit Swamp, Wal Wal Swamp and Mutton Swamp) to monitor the impact of environmental water deliveries as well as removing an illegal opera house trap that had led to the death of several turtles at Mutton Swamp. This has been a very valuable boost to the capacity of Wimmera CMA to monitor conditions at these waterways.

No formal mapping of water-dependent cultural values has taken place that the Wimmera CMA is aware of at these sites, however there are indications that there are sites of cultural significance at several of these wetlands. There are scar trees that are understood to be supported by environmental watering at Carapugna and Fielding's Dam.

There have also been reported sightings of clay balls for earth ovens at Carapugna (Kate Bennetts, Fire, Flood and Fauna, *pers. comm*.) and Tarkedia (Rae Talbot, Wimmera CMA, *pers. comm.*). Cultural values mapping at many of these would be a worthwhile project given their potential significance and increase opportunities to achieve cultural outcomes with environmental watering and other activities.

Figure 2: Worked glass fragment – Carapugna (Photo: Dylan Osler)

Social, recreational and economic values and uses of waterways

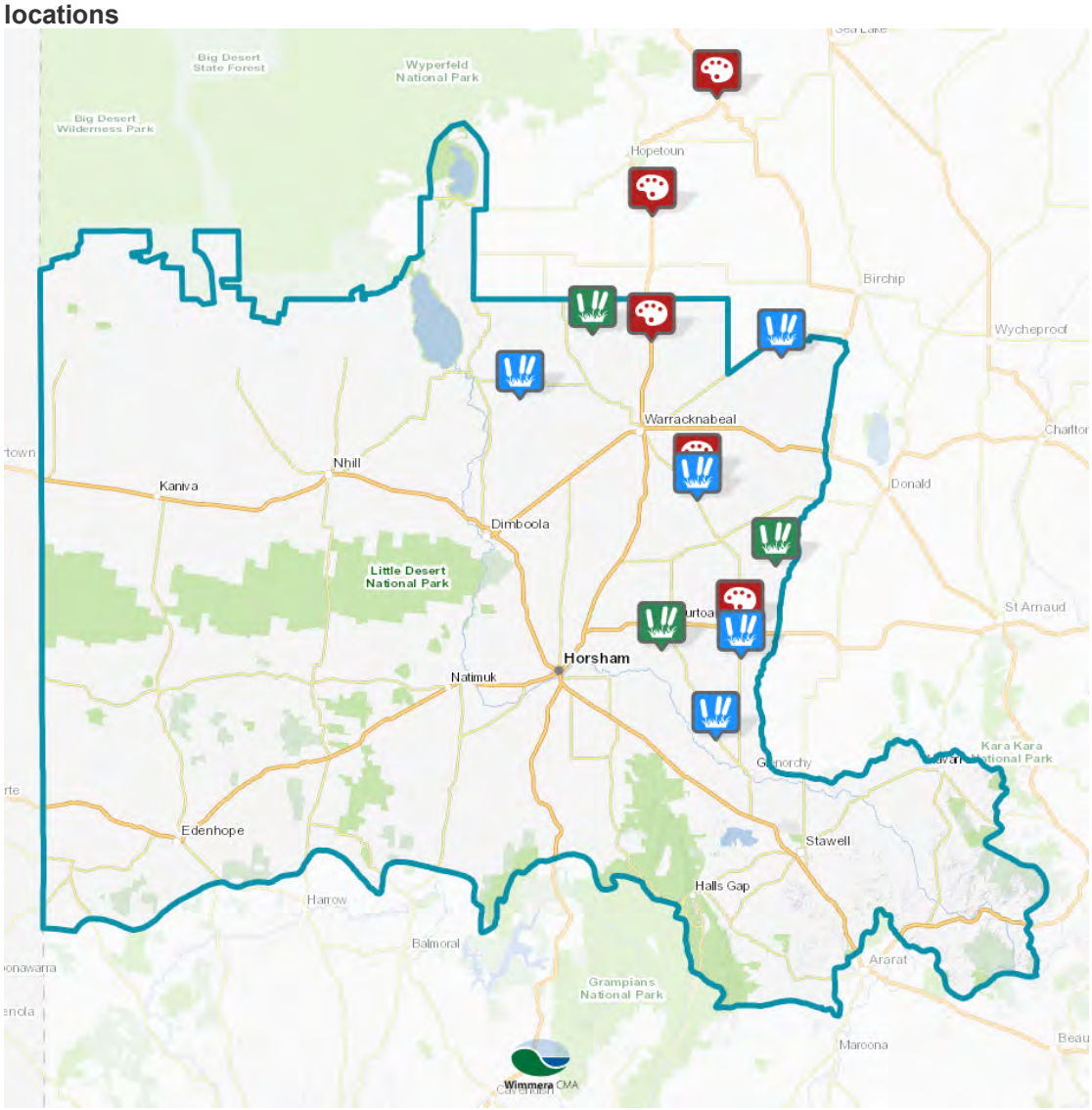
These wetlands are highly valued by the local community given there are few open water bodies in the northern Wimmera and are prized spots for birdwatching and a raft of other activities. The watering of wetlands that are State Game Reserves (Sawpit Swamp, Mutton Swamp, Wal Wal Swamp and Crow Swamp) will provide social benefits in terms of increased duck hunting opportunities (should duck hunting be allowed due to seasonal conditions and COVID-19 mitigation measures). There will be other social benefits around bird watching and the aesthetics of surface water in a typically dry, semi-arid environment. Local community members, including landholders with wetlands on their property have been able to benefit from yabbying in dams that would otherwise be dry. The wetlands have their community values listed in Table 3.

Table 3. Community values provided by supplying water to Wimmera Mallee Pipeline wetlands

Wetland	Community Values	Beneficiaries	Actions
Carapugna	Swimming, yabbying, aesthetics, potential firefighting water supply	Local community members, CFA	Top up dam, inundate wetland areas
Challambra	Swimming, yabbying, aesthetics, potential firefighting water supply	Local community members, CFA	Top up dam
Mutton Swamp	Duck hunting, aesthetics, potential firefighting water supply, yabbying	Local community members, CFA, Field and Game	Top up dam, inundate wetland areas
Pinedale	Yabbying, aesthetics, potential firefighting water supply	Landholders, CFA	Top up dam
Wal Wal Swamp	Duck hunting, aesthetics, fishing	Local community members, Field and Game, anglers	Top up dam
Crow Swamp	Duck hunting, aesthetics, potential firefighting water supply	Local community members, CFA, Field and Game	Top up dam, inundate wetland areas
Tarkedia	Aesthetics, potential firefighting water supply	Local community members, CFA	Top up dam
Harcoans	Aesthetics	Local community members	Fill up dam
Sawpit Swamp	Aesthetics, duck hunting	Local community members, Field and Game	Fill up dam
Krong Swamp	Aesthetics	Local community members	Fill up dam
Opie's Dam	Aesthetics, potential firefighting water supply	Landholders, CFA	Fill up dam
Schultz/Koschitzke			Fill up dam
Fielding's Dam			Top up dam

The Wimmera CMA has in the past sought to promote their community values through linking the wetlands with the Yarriambiack Silo art trail on the organisation's spatial information site (Pozi) (Figure 3) and advertised through social media. Yarriambiack Shire is developing a Waterways Masterplan and Marketing Plan to activate the shire's lakes, weirpools, wetlands and parks and Wimmera CMA has contributed information around pipeline wetlands in their area for their consideration in the plan.

Figure 3: Pozi map showing pipeline supplied wetlands on public land and silo art locations



5. Environmental Objectives and Flow Recommendations

The Wimmera Mallee Pipeline Project (WMPP) was implemented to modernise water delivery infrastructure throughout the Wimmera Mallee Region. Upon its completion in 2010, the project converted approximately 17,500 km of highly inefficient earthen water channels to 8,800 km of reticulated pipeline. The project has resulted in substantial water savings which have been re-directed to deliver a range of environmental, economic and social benefits.

The *Wimmera and Glenelg Rivers Environmental Entitlement 2010* provided the legal means by which most of the water savings could be returned to the region's flow stressed rivers as well as isolated wetlands within the Wimmera Mallee Pipeline footprint. The 1000 ML entitlement supports priority wetlands that were historically associated with water storages under the former open channel water supply system. These wetlands, typically containing dams, are no longer part of the water delivery system, being replaced with tanks and pipes. The entitlement recognises the significance water within these wetlands provides within a region characterised by a semi-arid climate and limited surface water. Wetlands eligible to receive water from this entitlement are scattered across the Wimmera, North Central and Mallee CMA regions. The following 13 wetlands were identified for supply within the Wimmera CMA region and are in the north-east portion (see Table 4 and Figure 4).

Table 4. Land Tenure of Wetlands

Wetland	Land Manager	Reserve name (if applicable)
Carapugna	Parks Vic	Watchem I120 Bushland Reserve
Challambra Swamp	Private/Parks Vic	Bangerang I101 Bushland Reserve
Harcoan's Swamp	Parks Vic	Burrero Bushland Reserve
Mutton Swamp	Parks Vic	Mutton Swamp Wildlife Reserve
Pinedale	Private	
Sawpit Swamp	Parks Vic	Saw Pit Swamp Wildlife Reserve
Wal Wal Swamp	Parks Vic	Wal Wal Swamp Wildlife Reserve
Crow Swamp	Parks Vic	Crow Swamp (Phillips Dam) Wildlife Reserve
Tarkedia	Parks Vic	Nullan I106 Bushland Reserve
Opie's Dam	Private	
Schultz/Koschitzke	Private	
Fielding's Dam	Private	
Krong Swamp	Parks Vic	Willenabrina I86 Bushland Reserve

The long-term objectives for these wetlands are for them to act as a refuge for native fauna, especially wetland species during summer/autumn particularly during droughts as well as enhancing their wetland vegetation abundance and diversity. The linkages between the environmental values these wetland support and the objectives that pertain to these values and the watering objectives/components to achieve them are summarised following (Table 5).

Table 5. Environmental Values and Objectives with associated Watering Objectives/Components

Environmental Value	Environmental Objective	Watering Objective	Watering Component
Waterbirds, Frogs	Maintain/improve habitat to support increased diversity and abundance	Maintain water in dams and period watering of adjacent wetlands	Fill dams in winter/spring each year and overtop into adjacent wetlands approx. every 3 years
Wetland vegetation	Increase abundance of appropriate native wetland vegetation for wetland type	Institute wetting/drying regime for dams and adjacent wetlands	
Turtles	Increase abundance	Maintain water in dams	Fill dams in winter/spring

The absence of definitive information on the values and watering requirements of these wetlands led to the undertaking of studies by Australian Ecosystems in 2012 and Rakali Consulting in 2013, on behalf of Wimmera CMA. The studies benchmarked their condition through Index of Wetland Condition and flora surveys, mapping Ecological Vegetation Classes (EVCs) and recording observed fauna at each wetland. Following this the approximate areas and the recommended watering regime as classified in the *Water the Salinity Regime and Depth Preferences for Victorian Wetland EVCs* (DSE, 2012) were used as a guide to provide approximate volumes for each EVC area in each wetland (Table 6).

Ideally, dams should contain water perennially for local fauna but filling them in winter/spring and then having them dry out (but not empty) over summer/autumn will lead to fluctuation of water levels and encourage the growth of a diverse range of wetland vegetation. This in turn leads to benefits for fauna such as provision of habitat for tadpoles. For more details on the watering regimes recommended for these wetlands see the *Environmental Water Management Plan – Wimmera Mallee Pipeline Wetlands – Wimmera CMA Region* (Wimmera CMA, 2016).

Figure 4: Off-stream wetlands proposed to be supplied in the Wimmera CMA region

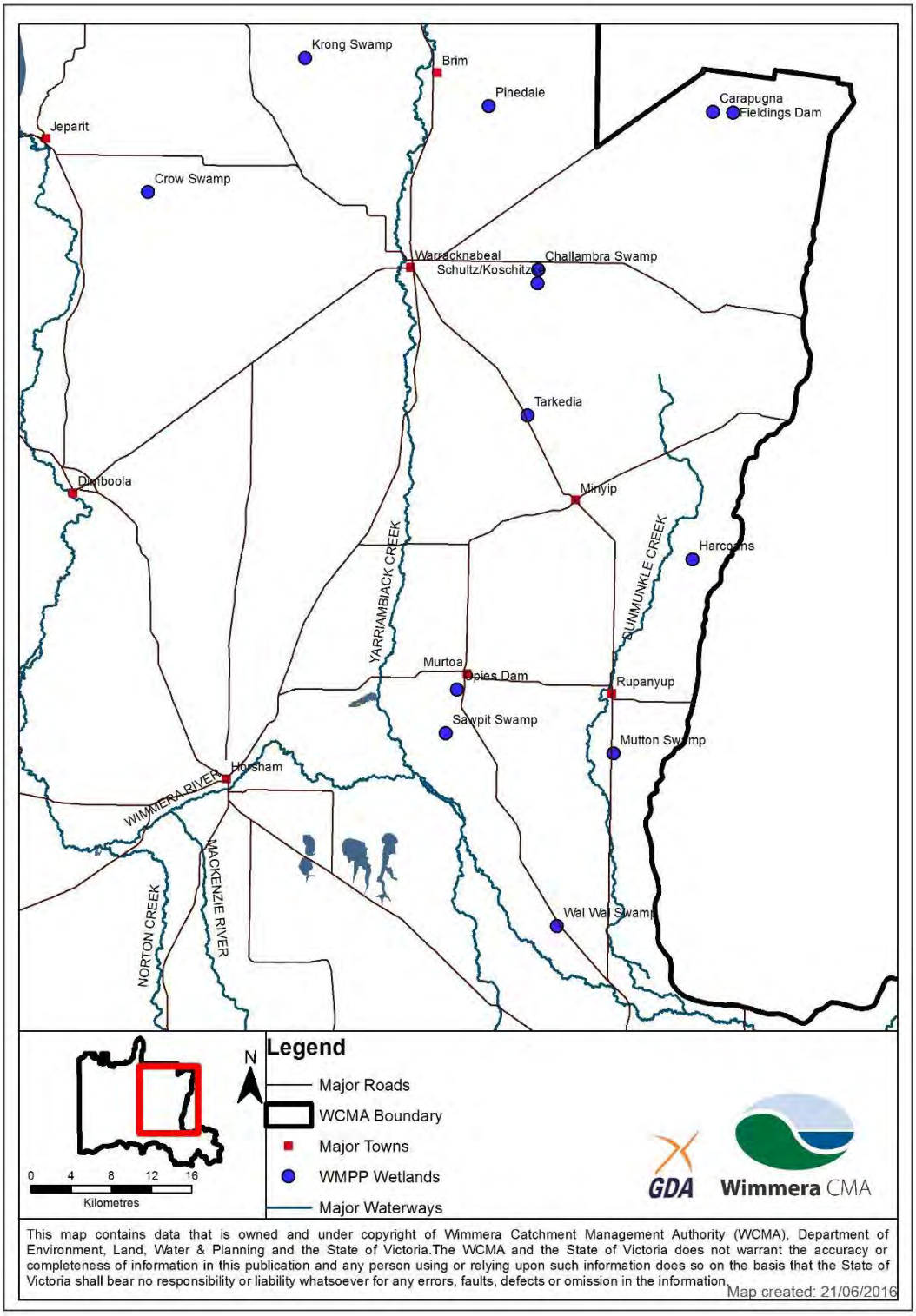


Table 6. Wetland categories of nominated wetlands and inundation preference information from Australian Ecosystems (2013) and Rakali Consulting (2014).

Wetland name	Wetland category	Wetland EVCs	Optimum inundation frequency	Inundation duration	Inundation depth	Approx. Vol. (ML)	Approx. Dam Vol. (ML)
Carapugna	Freshwater Meadow	Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	50.4	
		Northern Wimmera Riverine Chenopod Wetland	Sporadic and uncommon	Not recommended to be artificially inundated			5
Challambra Swamp	Freshwater Meadow	Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	32	5
		Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 2 m	46.4	
Crow Swamp	Shallow Freshwater Marsh	Intermittent Swampy Woodland	3-7 years in 10	1 month to > 1 year	30 cm to 1 m	14	
		Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 2 m	37.5	5
		Northern Wimmera Riverine Chenopod Wetland	< 3 years in 10	1 month to > 1 year	Up to 30 cm	2.4	
Harcoan's Swamp	Freshwater Meadow	Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 2 m	40	4
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	2.1	
Krong Swamp	Freshwater Meadow	Lignum Swampy Woodland	Once every 2 – 5 years	Up to 4 months	Up to 30 cm	4	
		Lignum Shrubland	Only if dry for > 2 years	< 6 months	50 cm on average	11	2
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	18.6	
Mutton Swamp	Freshwater Meadow	Lake Bed Herbland	< 3 years in 10	1 month to > 1 year	30 cm to 2 m	39	5
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	40	
Pinedale	Shallow Freshwater Marsh	Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	12.9	5
		Northern Wimmera Riverine Chenopod Wetland	Sporadic and uncommon	Not recommended to be artificially inundated		8.9	
Sawpit Swamp	Shallow Freshwater Marsh	Intermittent Swampy Woodland	3-7 years in 10	1 month to > 1 year	30 cm to 1 m	17.4	
		Floodway Pond Herbland	3-7 years in 10 Only if dry for > 6 months	< 12 months	30 cm to 2 m	18	10
		Floodway Pond Herbland-Riverine Swamp Complex	Only if dry for > 2 years	< 4 months	50 cm on average	65.5	
Wal Wal Swamp	Shallow Freshwater Marsh	Red Gum Swamp-Cane Grass Wetland Complex	3-7 years in 10	1 month to > 1 year	30 cm to 1 m	24	
		Cane Grass Wetland-Aquatic Herbland Complex	8-10 years in 10	1 – 8 months	30 cm to 1 m	16.5	3

Wetland name	Wetland category	Wetland EVCs	Optimum inundation frequency	Inundation duration	Inundation depth	Approx. Vol. (ML)	Approx. Dam Vol. (ML)
		Riverine Swampy Woodland	Sporadic and uncommon	Not recommended to be artificially inundated		2.2	
Opie's Dam	NA – Dam	NA	Permanent	Maintenance of surface water for Growling Grass Frog population		2	2
Tarkedia	Shallow Freshwater Marsh	Lignum Swampy Woodland	Once every 2 – 5 years	Up to 4 months	Up to 30 cm	13.5	3
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	13.5	
Fielding's Dam	Freshwater Meadow	Herb-rich Gilgai Wetland	3-7 years in 10	Up to 3 months	Up to 20 cm	10	2
Schultz/ Koschitzke	Freshwater Meadow	Plains Grassy Wetland/ Spike-sedge Wetland	3-7 years in 10	1 month to > 1 year	Up to 1 m	50	4
		Black Box Wetland	3-7 years in 10	1 month to > 1 year	Up to 30 cm	24	

Red Rumped Parrot at Wal Wal Swamp (January 2020) Photo: M. Gooch

6. Seasonal Review

The following Priority Watering Actions (PWAs) undertaken to date in 2020-21 include the delivery of water to achieve wetland vegetation outcomes at Carapugna and Sawpit Swamp whilst water has also been provided to Wal Wal Swamp and Fielding's Dam to retain surface water for local fauna outcomes. Most PWAs will be implemented in late autumn and early winter to ensure the maximum period of wetland wetting-drying can be achieved. This took place in 2020 with Carapugna, Challambra, Harcoans, Mutton Swamp, Pinedale and Tarkedia receiving water to top up the dam portion of the wetland (and small sections of the adjacent wetland areas in the case of Mutton Swamp and Harcoans).

There have been incremental increases in the information base regarding these wetlands and the ecological values they support and how these values have responded to changes in watering actions. After receiving environmental water for several years now there have been notable changes at some of these wetlands as parts are continuing to transition in response to the change from episodic to annual watering.

Prior to the completion of the Wimmera Mallee Pipeline in 2010, these wetlands would have received inflows either due to local heavy rainfall events or 'surplus' water within the channel system, beyond that required to fill local stock and domestic dams. These sorts of events were rare or non-existent during the Millennium Drought and even during record flooding in 2010-11 some wetlands remained dry due to land use and catchment features (such as channel banks and raised roads). Sawpit Swamp was the first wetland connected to the Wimmera Mallee Pipeline and benefited from two watering events prior to 2014/15. Following the completion of wetland assessments and infrastructure works from mid-2014 through to early 2015, watering efforts subsequently escalated.

Wet conditions in spring 2016 led to Wal Wal Swamp, Harcoan's, Krong Swamp, Mutton Swamp, Carapugna, Schultz/Koschitzke and Sawpit Swamp receiving good levels of natural runoff to achieve desired wetland water outcomes. Environmental watering since then has largely focused on filling/topping up dams with some wetlands having water overtop into adjacent wetland areas. These wetlands have an episodic hydrology and would not be filled annually but rather several times per decade on average. The inundation history of these wetlands from 2004/05 is outlined in Table 7 and outcomes from watering in 2020-21 are summarised in the following section. It should be noted that most watering of these wetlands takes place in April-June to maximise the availability of wetted habitat during cooler, wetter months and so is not captured in that year's Seasonal Watering Plan seasonal review.

Carapugna

Water was supplied to the dam and two of the three wetland areas connected to the pipeline in the bushland reserve. The wetland continues to generate impressive responses to environmental watering. Following the creation of a shallow (typically < 0.3m), crystal clear pools there is prolific growth of wetland plants (sedges, nardoos etc.) in the wetland areas. It has also prevented the growth of annual exotic grasses and enhanced the condition of Blackbox trees with a notably denser leaf growth in the canopy.

The site has been noted to continue to support a healthy woodland bird community and the provision of environmental water creates an upsurge in activity with a boost in the insect population. It is planned to top up the dam and water the most south-easterly wetland in winter 2021. Following the recommendation from ARI staff to increase the number of outlets to wetland areas within the wetland, Wimmera CMA will progress opportunities to construct them. It will enable wetland areas on the northern side of the pipeline that bisects the reserve.

Bottom: Cane-grass emerging at Carapugna – March 2021 (left), dam – October 2020 (right) (Photo (right): B. Muir),

Crow Swamp

Deliveries in 2019-20 involved filling and overtopping the dams in the north of the swamp. The vegetation in the swamp itself (beyond the dam) continues to be affected a heavy cover of annual weeds. In the areas which are not watered this is mostly grasses (e.g. rye grass, barley grass) and the areas that are inundated it triggers the growth of thistles and dock plants. Whilst there are minor improvements in wetland vegetation (e.g. increased coverage of nardoo), they are not significant given the high density of annual grasses crowds them out. Based on advice from wetland plant ecologists, a controlled burn continues to be recommended for the swamp to provide increased bare earth and reduce competition from exotic grasses. It is suggested that deliberate inundation outside the dam areas not continue until there is a controlled burn.

The vegetation in and around the dams continues to transition in response of them being filled annually in recent years. The margins that were previously bare ground or annual grasses now have a suite of species that rely on regular inundation such as red milfoil, club-rushes and typha with the resident Australasian Grebes using the milfoil for nesting with breeding noted again in 2021. It continues to support reasonable numbers of Grey Teal and Australian Wood Ducks.

Whilst no frog surveys took place this year based on WETMAP monitoring four species are known to inhabit the swamp (Eastern Banjo Frogs, Common Eastern Froglets, Spotted Grass Frogs and Plains Froglets) (ARI, 2021). Similarly sensor cameras deployed in previous years have shown the importance of the dam in terms of supporting a diverse range of terrestrial birds like Galahs and Red-rumped Parrots.

It is planned to top up the dam again in April-June 2021 to continue these improvements.

Crow Swamp – February 2007 (left) and February 2021 (right) illustrating the shift from terrestrial grasses to wetland plants.

Crow Swamp showing the change brought about by a sequence of watering events – January 2016 (left) and February 2021 (right) with species like typha and red milfoil present.

Challambra

The dam received a small top up in May-June 2020 to ensure it provided suitable conditions for wetland birds and plants as it draws down through to autumn 2021. The dam as usual provides habitat for several species of common wetland birds such as Grey Teal. Wetland vegetation outcomes are more muted than at other wetlands, however, due to the steep sides and grazing pressures from native fauna although there has been a notable improvement in water clarity which has also led to abundant growth of milfoils. It is planned to top up the dam again in April-June 2021.

Challambra Swamp – November 2019 (left) and March 2021 (right) – note improvement in water clarity

Fielding's Dam

Fielding's Dam (along with Opie's Dam) is a very small dam and quite shallow, it had gradually drawn down to low levels after being topped up in January to March 2020 so a top up was commenced again in February 2021. The vegetation outcomes are potentially limited by the comparatively large numbers of native fauna (e.g. Australian Wood Ducks) using the wetland as habitat and diminished seedbed.

Fielding's Dam – March 2021 (right) and showing the large number of Australian Wood Ducks that were using the dam as habitat (left).

Pinedale

The dam at Pinedale received another small top up in May-June 2020 for the wetland birds that use it as habitat which include Australasian Grebes, Grey Teal and Australian Wood Ducks. Given the adjacent wetland area was inundated in autumn 2019 which created an emphatic wetland vegetation response, there are no plans to inundate it in 2021 and watering will remain confined to refilling the dam in April-June.

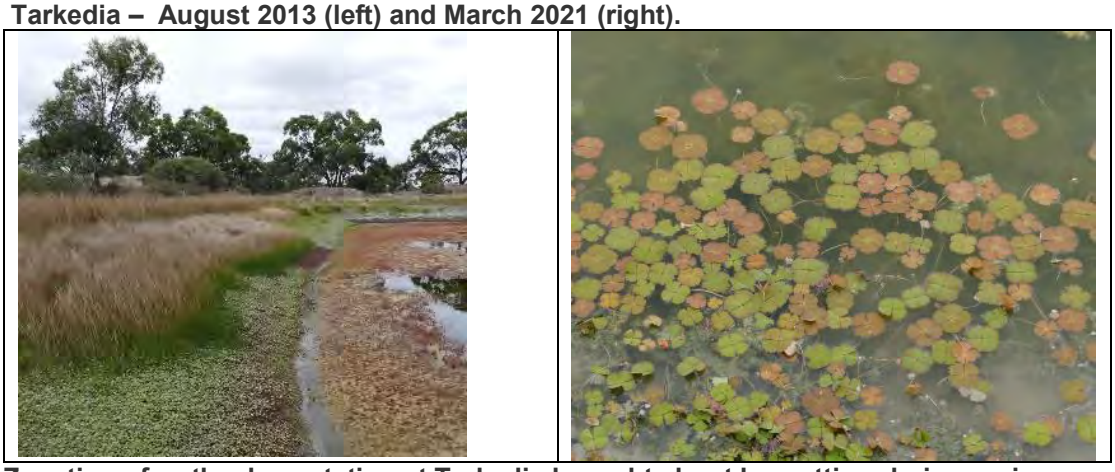
Pinedale – March 2021

Tarkedia

The dam was again watered from May to July 2020 and it continues to show a positive response to environmental watering with improved water quality (reduced algae and turbidity) and increased abundance of Red Water Milfoil. Annual grasses and thistles have been replaced by a fringing coverage of Small Spike-sedges and Plains Rushes as well as juvenile Black Box.

It supports common waterbird species like Grey Teal, Australian Wood Duck, Australasian Grebes and Australian Shelducks as well as terrestrial species in the bushland reserve such as kangaroos and wallabies. Like other wetlands, it is proposed to top up the dam in April-June 2021.

Tarkedia – August 2013 (left) and March 2021 (right).



Zonation of wetland vegetation at Tarkedia brought about by wetting-drying regime (sedges-nardoos-milfoils) (left) and nardoo (right) – March 2021.

Mutton Swamp

The watering in May-June 2020 topped up the dam which supports several waterbird species such as Australasian Grebes and White-necked Herons and continues to generate positive responses from wetland vegetation (sedges, wallaby grass, cane grass). It also helps sustain local terrestrial bird species like White-plumed Honeyeaters and a small turtle population. Another top up of the dam is again planned for April-June. The regular fluctuations in water levels in the shallower margins of the dam has led to a diverse mosaic of vegetation species. Unfortunately, an illegal opera house yabby trap was found in the dam in March 2021 by Dan Clarke (BGLC) which contained several dead turtles.

Mutton Swamp, April 2014 (left) and October 2020 (right) (Photo: B Muir) – showing the gradation in different wetland vegetation types that have resulted from several years of filling/drying Mutton Swamp

Opera house net containing remains of dead turtles and young Grey Teal at Mutton Swamp – March 2021.

Opie's Dam

The small dam on private land received its third watering in May 2020. The dam retains water well and the modest wetland vegetation outcomes continue such as an increasing presence of cane grass appearing on the western edge. The main rationale for watering is the provision of habitat for Growling Grass Frogs with the landowner continuing to report that he hears their calls. It is planned to provide water to top up the dam in April-June 2021 to ensure the maximum habitat availability in winter/spring for the frogs to lay eggs and tadpoles to be able to hide from predation.

Opie's Dam – Pacific Black Ducks and ducklings September 2020 (Photo: R. Opie) (left) and Eastern Snake-necked Turtle and Grey Teal March 2021 (right)

Wal Wal Swamp

The swamp was down to very low levels prior to receiving a top up in August – September 2020. There has been a notable change in the water quality following the 2020 watering as the water has become less turbid than in previous years. It is hoped that this will gradually lead to improvements in aquatic vegetation at the swamp given there is very little currently present.

There continues to be a reasonable population of waterbirds at Wal Wal Swamp with Grey Teal, Australasian Grebes and Little Pied Cormorants noted there. Heavy rainfall events in summer 2020-21 led to a small response from wetland vegetation at the site such as nardoo.

Wal Wal Swamp – August (left) and October (right) 2020 (Photo: B Muir).

Improved water quality at Wal Wal Swamp from October 2020 above (left) and to February 2021, also note the Grey Teal and Australasian Grebe February 2021 (right)

Harcoans

The environmental outcomes at Harcoans tend to be modest due to historic land management practices affecting the wetland vegetation at the site. After several years of environmental watering, improvements have been minor. However it does provide habitat for local wetland birds such as Australasian Grebes and Black-tailed Native Hens. It is planned to water the site again in April-June 2021.Watering in winter means the dam contains water much longer and there is greater opportunity of water overtopping into the adjacent wetland which benefits species like Red-kneed Dotterels.

Harcoans Swamp March 2021 (left) and Black-tailed Native Hens (right) November 2019

Sawpit Swamp
The soil characteristics of Sawpit Swamp mean that it does not retain water for a long time, drying out within several weeks of deliveries ceasing. However the watering triggers the growth and recruitment of wetland vegetation species like knotweeds, sedges and sneezeweeds.

Sawpit Swamp March 2021

Shared Benefits Review
The capturing of shared benefits for these wetlands in 2020-21 was difficult given their small size, fact that some of them are on freehold land and limitations in recreational opportunities as a result of the COVID-19 pandemic. Whilst there is evidence of duck hunting taking place at Crow Swamp, most recreation was passive with community members and landholders enjoying the aesthetics of these wetlands and taking opportunities to photograph them.

Photo of Carapugna by renowned bird photographer, Jenny Stephens who is based in Hopetoun.

Table 7. Historical watering regime of wetlands from 2004/05 up to March 2021

Key	Dry	Wet	Wet-Dry or Part wetland inundated	Dam inundated only

Wetland	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	Noted Responses 2020-21
Carapugna			U				E	E	U	E	E U	E	E	Strong wetland plant and woodland bird response to environmental watering as per previous years.
Challambra Swamp			U				E	E	E	E	E	E	P	Water clarity in dam has drastically improved, leading to prolific growth of milfoils. Still sustains a good duck population (Grey Teal, Australian Wood Ducks)
Harcoans Swamp			U				E		U		E	E	P	Fills quite quickly and retains water for a reasonable period of time (months). Wetland bird population is the main beneficiary with poor quality native vegetation.
Mutton Swamp			U				E	E	U		E	E	P	Dam area's habitat value continues to increase. Overflow of channel en route to dam as triggered black box recruitment which may change the character of part of the wetland.
Pinedale			U				E	E	E		E	E	P	Although this is a small dam, the availability of nearby habitat such as surrounding black box trees means that it sustains a comparatively large wetland bird (duck) population.
Sawpit Swamp			U			E	E	E	U	E D	E		E	Parks Victoria approved watering in August 2020 (so no watering in 2019/20). It does not hold water for a long time but generates a strong response from mudflat plant species.
Wal Wal Swamp			U			E	E	E	U	E	E		E	Water quality has notably improved in comparison to previous years. Heavy rain has helped generate a mudflat plant response. Still supports good wetland bird numbers.
Krong Swamp			U				E	E	U		E			Dam does not hold water well. No water will be delivered until this can be addressed which is anticipated to be later in 2021 with reworking the clay surface of the dam.
Crow Swamp							E	E	E	E	E	E	P	Wetland birds continue to use it as habitat and there is a shift from terrestrial to wetland plant species in areas that are regularly inundated.
Opie's Dam			U								E	E	P	Minor wetland vegetation and wetland bird outcomes given its small size and condition (stock and domestic dam). Growling Grass Frogs and turtles continue to use the dam as habitat.
Tarkedia			U				E	E	E	E		E	P	Water in dam leads to benefits for local fauna with a number of ducks and grebes using it as habitat. Wetland vegetation abundance and condition continues to improve.
Fielding's Dam			U				E	E	E	E	E U	E	E	Water in dam leads to benefits for local fauna, particularly abundant Australian Wood Ducks and turtles.
Schultz/Koschitzke			U					E	U					No environmental water delivered to date as agreements for watering are not yet resolved.

Key- U: Received unregulated water E: Received environmental water P: Planned delivery for April-June 2021

7. Scenario Planning and Prioritisation

Increased information around the watering of these wetlands has been developed during the development of the relevant Environmental Water Management Plan (EWMP). It has established recommendations around the frequency and duration of wetland inundation events. Given the highly episodic nature of the wetlands' hydrology, they would not naturally be inundated every year. In fact, during droughts, it might be over a decade between significant inundation events which may result from a heavy summer deluge or repeated rainfall events during winter/spring. It should be noted that the EWMP is currently being reviewed, however, this should not manifestly change the watering regime prescribed within it but rather relate to targets and monitoring requirements for the wetlands.

Table 8 lists the priority watering actions for the Wimmera Mallee Pipeline wetlands in 2020-21 in the Wimmera region. Table 9 outlines where these priority watering actions fit within the context of different climate scenarios. Table 10 lists these watering objectives in more detail with associated priorities and volumes.

7.1. Priority Watering Actions

Table 8. Priority watering actions 2021-22

Priority Watering Action 1	**Fill/ top up dams at all wetland sites (not wetland areas).**
Expected Watering Effects	Provide surface water for local fauna to drink/bathe and for waterbirds, turtles and frogs Provide a wetting/drying regime on dam banks to increase the coverage of wetland plants
Environmental Objectives	Increase the extent of wetland vegetation (e.g. cane grass, sneezeweeds) Maintain the condition of fringing Black Box and/or River Red Gums (including scar trees) Maintain local fauna populations that rely on the surface water supply (e.g. woodland birds) Maintain populations of turtles and frogs
Rationale for 2021-22	Small volumes are required to maintain water in these dams and they can continue to support water-dependent fauna in good numbers. There are comparatively few other surface water points in this part of the region since the decommissioning of the channel supply system and a sequence of dry years.
Priority Watering Action 2	**Water adjacent wetland area outside dams (Carapugna)**
Expected Watering Effects	Shallow water (typically < 30cm) will disperse across the low wetland areas which will trigger flora and fauna responses, including mudflat species when it dries out.
Environmental Objectives	Reduce coverage of exotic annual grasses and increase coverage of bare earth and wetland plant species such as threatened Ridged Water Milfoil
Rationale for 2021-22	There are several disconnected small wetland areas within the wetland complex that are rotated through in subsequent years via a series of outlet points. This provides a balance between triggering positive outcomes at the site and overwatering given their episodic natural hydrology.
Priority Watering Action 3	**Water adjacent wetland area outside dams (Crow, Sawpit, Harcoans, Mutton, Schultz/Koschitzke, Pinedale, Tarkedia)**
Expected Watering Effects	Shallow water (typically < 30cm) will disperse across the low wetland areas which will trigger flora and fauna responses, including mudflat species when it dries out.
Environmental Objectives	Reduce coverage of exotic annual grasses and increase coverage of wetland plant species such as sneezeweeds and knotweeds
Rationale for 2021-22	It has been several years since these wetlands have received substantial inundation (2016) so providing water will help in terms of enhanced vegetation outcomes and not create a threat of overwatering. However, the dry conditions, low allocations and in some cases low delivery rates due to pipeline capacity constraints means that this is a low priority.

The timing of water deliveries will typically be during cooler months (April to November) which are off-peak demand periods from the pipeline. There are occasional exceptions to this, for instance if capacity is available just prior to or after the off-peak period and Fielding's Dam which tends to need a top up in late spring or early summer, subject to pipeline capacity.

7.2. Scenario Planning

Table 9. Scenario Planning

Scenario outcomes	Drought	Dry	Average	Wet
Expected climatic conditions and water availability	Carryover approx. 350 ML Allocation 0ML	Carryover approx. 350 ML Allocation 0 ML	Carryover approx. 350 ML Allocation 250 ML	Carryover approx. 350 ML Allocation 500 ML
Expected inflows	Nil	Nil	Shallow inundation (< 0.2 m)	Moderate inundation (<0.5 m)
Env. objectives	Refuges for fauna and enhancing flora at priority wetlands			
Priority watering actions (Tier 1)	Fill/ top up dams at all wetland sites. Water adjacent wetland areas at Carapugna			
Estimated environmental water requirement (Tier 1)	67 ML all dams, 10 ML Carapugna (77 ML – total)			
Additional Priority watering actions (Tier 1 – average/wet)			Water adjacent wetland areas at Tarkedia, Schultz/Koschitzke, Mutton, Crow, Harcoans, Pinedale, Sawpit	
Estimated environmental water requirement (Tier 1 – average/wet)			45 ML Mutton Swamp, 9.5 ML Tarkedia, 20 ML Schultz/Koschitzke, 15 ML Crow, 10 ML Harcoans, Sawpit 40 ML, Pinedale 15 ML (144.5 ML – total)	
Priority carryover for 2022-23	118 ML			
Additional water need	Nil			

Australasian Grebe and juveniles – Challambra, March 2021

Despite a lack of allocations since 2016, a focus on maintaining sufficient carryover volumes should enable priority watering actions one and two to be achieved. The estimated environmental water requirement volumes are sufficient to fill/top up all dams as well as a volume to inundate wetlands at Carapugna. The volumes for these wetlands are slightly more than the maximum modelled volume that can be delivered (Table 11) given pipeline consumptive demands are likely to be less than assumed modelled rates. Based on previous watering events, it seems the actual delivery rate at these wetlands are reflective of modelled rates as opposed to others like Challambra Swamp where actual flow rates are much lower than modelled ones.

Table 10. Priority watering actions proposed for wetlands supplied by the Wimmera Mallee Pipeline in the Wimmera CMA area and priority for watering in 2020-21.

Wetland	Priority watering actions	Functional watering objective	Estimated max. volume required (ML)		Priority (Dam)	Priority (Wetland)
			Dam	Wetland		
Carapugna	Refill dam and priority wetland EVC	Provide a permanent water source for refuge and to support feeding and breeding opportunities for frogs, waterbirds and terrestrial species Stimulate aquatic and fringing vegetation growth and allow plans to complete their life cycles including ridged water milfoil, black box and spiny lignum	8	22	Very High	Very High
Crow Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC		8	17	Very High	Medium-Low
Harcoans Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC		5	35	Very High	Medium-Low
Tarkedia	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC		4	9.5	Very High	Medium-Low
Mutton Swamp	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC		5	45	Very High	Low
Pinedale	Refill dam and provide a small volume of water to commence watering wetland priority wetland EVC		4	15	Very High	Low
Sawpit Swamp	Refill dam and provide a small volume of water to commence		10	40	Very High	Low

Wetland	Priority watering actions	Functional watering objective	Estimated max. volume required (ML)		Priority (Dam)	Priority (Wetland)
			Dam	Wetland		
	watering wetland priority wetland EVC					
Challambra Swamp	Refill dam (flow rate is currently insufficient to inundate adjacent wetland)	Provide a permanent water source for refuge and to support feeding and breeding opportunities for frogs, waterbirds and terrestrial species	5	45	Very High	NA
Wal Wal Swamp	Refill dam		5	15	Very High	NA
Opie's Dam	Refill dam		4	NA	Very High	NA
Fielding's Dam	Refill dam		2	NA	Very High	NA
Schultz/Koschitzke	Refill dam and priority wetland EVC		5	45	Very High	Medium-Low
Krong Swamp	Fill dam (if works to fix dam lining leakage take place)		2	NA	Very High	NA
Total	*For wetland watering actions listed above*		*67*	*293.5*		

8. Delivery Constraints

The information provided by Australian Ecosystems (2013) and Rakali Consulting (2014) provides a solid foundation for undertaking watering actions through the mapping of EVCs and development of watering recommendations based on DSE (2012). For each wetland there needs to be consideration of the modelled pipeline capacity to deliver water compared to the volumes required to meet the recommended water level and duration (see Table 11).

There are some wetlands where hydraulic modelling indicates that the amount that can be delivered on an annual basis is close to or above that required to inundate the lowermost EVC within the wetlands (highlighted in green). Whilst in others the hydraulic capacity to supply the wetland is much lower than the volume required to supply sufficient water to fill the wetland to the recommended level within a year (highlighted in yellow). It would be worth reviewing actual delivery rates compared to actual for all pipeline wetlands now that deliveries have taken place over a few years as some actual delivery rates are much less than that modelled such as Challambra Swamp. This will help assist understanding likely future demands and scope for increasing the number of wetlands that can be connected to the pipeline.

Table 11. Comparison between modelled maximum annual demand delivered from the pipeline outlet (from GWMWater 2012, 2013), compared to the initial target wetland EVC volume(from Australian Ecosystems, 2013; Rakali, 2014). Dam volumes within the wetland area would be much smaller (several megalitres).

Wetland	Modelled Maximum Demand (ML)	Wetland target EVC Approximate Capacity
Carapugna	20	50.4
Challambra Swamp	45	46.4
Crow Swamp	12	37.5
Harcoans	30	40
Krong Swamp	15	11
Mutton	50	39
Pinedale	25	12.9
Sawpit Swamp	50	83.5
Wal Wal Swamp	15	16.5
Opie's Dam	2	2
Tarkedia	8	13.5
Schultz/Koschitzke	20	50
Fielding's Dam	4	10

Some other key factors are worth noting:

- Given the long period of delivery (several months) there are reasonable seepage and evaporation losses within the wetlands whilst deliveries are occurring. They increase during the warmer months although deliveries are typically during cooler months.
- The period for delivery is typically 'off-peak' which are months where demand on the Wimmera Mallee Pipeline for supplying towns and farms is lowest (April-November). This maximises the delivery rate of water to wetlands. It may not be possible to deliver water to these wetlands in peak periods due to other demands. In some cases, actual delivery rates are much less than those modelled (e.g. Challambra) whereas for others (e.g. Sawpit Swamp) the opposite applies.
- Some wetlands have had infrastructure constructed in February 2015 to enable much better environmental outcomes to be achieved from the application of environmental water. The details of which are included in RPS (2014) and an example is included in Figure 7. This enables targeted watering of the wetland or both the dam and wetland. Wimmera CMA is looking to enhance this in the future by creating additional outlets.
- The estimates of the volumes required to be supplied to these wetlands are very coarse (i.e. calculated from area of EVC multiplied by the recommended depth) and so does not consider variations in topography within the wetlands themselves. Given they

are depressions within the landscape it is likely that they are underestimates. Given that the estimated volume is calculated to achieve the maximum height recommended within these wetland EVCs, shortfalls will still achieve a similar outcome (i.e. a wetland requiring inundation level of 0.3 m to 1m will still benefit if the inundation is 0.7 m compared to 1m). Adaptive management based on observed outcomes through environmental water delivery will be crucial to ensuring that watering outcomes are obtained into the future (i.e. volumes required to inundate the wetland to a certain level and how long the water persists).

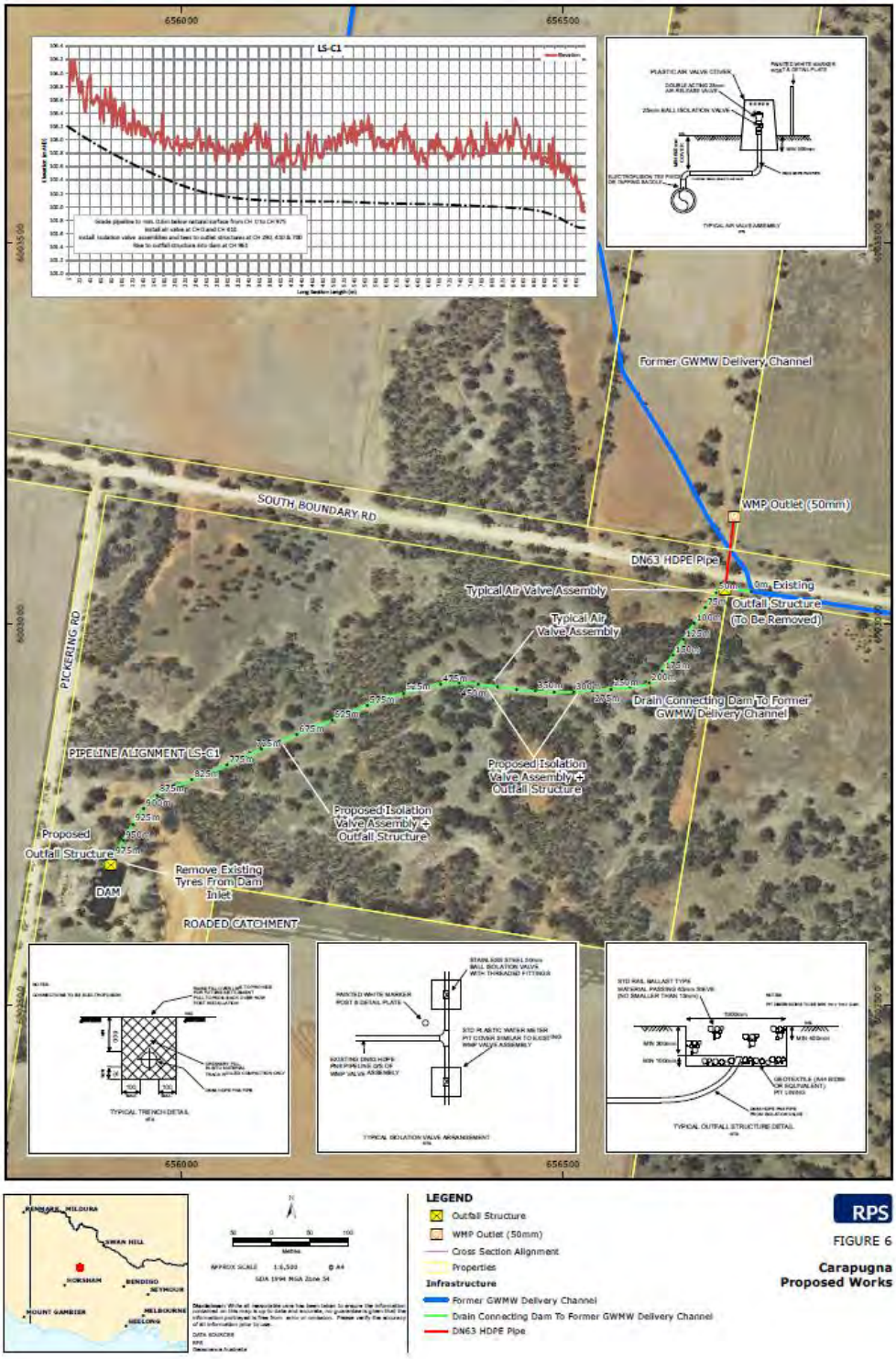


Figure 7. Example diagram of works undertaken at Carapugna in February 2015 to enhance wetland hydrology.

9. Confounding Factors

Many of the confounding factors that relate to these wetlands are documented in Section 8. Managing Risks to Achieving Environmental Objectives in the *Environmental Water Management Plan – Wimmera Mallee Pipeline Wetlands Wimmera CMA Region* (Wimmera CMA, 2016), such as lack of wetland connectivity to enable dispersal of native flora and fauna and impacts of activities like duck hunting.

The key confounding factors relate to water delivery rates (Section 8) and the impacts of exotic species. Some wetlands such as Crow Swamp and Harcoans are heavily impacted by weeds (i.e. annual grasses) and in some cases there may not be a viable seedbank to enable wetland vegetation to recover in a meaningful way. Remote cameras have also noted that foxes, rabbits and hares use these wetlands as a drinking water and potential food source; however, their impacts are assumed to be less than that of weed species. Wimmera CMA and Parks Victoria will look for opportunities to obtain funding for vegetation management at these sites. A planned burn is also recommended for Crow Swamp and Harcoans.

10. Increasing Knowledge

The work undertaken by Australian Ecosystems in 2012 and Rakali Consulting in 2013 has provided an invaluable initial benchmarking exercise and fills some key knowledge gaps in watering requirements and values to be enhanced. DELWP (2015, draft) also provides useful information on the watering needs of wetland vegetation, waterbirds and wetland dependent fauna, namely frogs and turtles. There is still limited data available for these locations given their isolated nature and lack of previous watering activities so adaptive management through effective monitoring is a critical process going forward.

Wimmera CMA and Birchip Landcare Group have in the past deployed equipment including frog monitoring equipment, water level sensors and motion sensor cameras at several wetlands receiving environmental water in the Wimmera CMA region. Carapugna and Crow Swamp have been including in WETMAP and have been monitored for vegetation and birds in 2017-19 (no bird surveys in 2019) as well as frogs in 2018-20. Unfortunately, there is no WETMAP monitoring planned for these sites in 2020 but the results have been recently incorporated into a final report (ARI, 2021). A potential option in 2021-22 could be the use of eDNA to provide quantitative snapshots of the fauna species that benefit from environmental water in these sites. This has been successfully applied by Greening Australia for small wetlands in the West Wimmera (EnviroDNA, 2019).

Monitoring of environmental water releases is a critical component of adaptive management and enables meaningful reporting of environmental outcomes generated by these activities and justification for the significant amounts of public investment made in environmental water recovery and management. Some resources have been made available for monitoring these wetlands prior to and after the application of environmental water which is reflected in the monitoring activities that are proposed in Table 12. Wimmera CMA will work with relevant landholders with respect to monitoring and including local knowledge into decision making processes.

Mallee CMA will continue to pursue funding opportunities to undertake a more comprehensive assessment of vegetation which would be beneficial in order to quantify changes that have resulted from watering activities on behalf of North Central and Wimmera CMAs. Monitoring undertaken can not only facilitate reporting on outcomes of environmental watering activities but fill knowledge gaps regarding the effectiveness of these activities going forward.

Table 12. Proposed monitoring for Wimmera Mallee Pipeline Wetlands

Wet-land	Objective	Hypotheses	Indicator(s)	Frequency
All	Area/depth inundated	Need to establish a relationship between volumes delivered and habitat provided	Depth (bathymetry data) and volume (meters) including using pressure sensors	Periodic
	Frogs	Watering will trigger a response in the frog population	Frog audio surveys, site visits, landholder information	Pre, during and post watering (TBC)
	Wetland birds and other fauna	Watering will attract wetland birds and other fauna in a dry region to use habitat	Motion sensor camera, site visits, landholder information, eDNA sampling	

Prolific growth of nardoo at Carapugna following watering in spring 2020 (March 2021)

White-winged Choughs at Carapugna, highlighting the non-waterbird benefits of watering.

11. Risk assessment and management

Risk assessment and management is a critical aspect of long-term environmental water planning, Table 13 illustrates the various risks (likelihood and consequence) associated with planned environmental flow components. The risk assessment was developed in conjunction with program partners. Tables 14 and 15 specify definitions for risk categories.

Table 13. Risk assessment and where appropriate mitigation measures for environmental watering

Legend:

1. Risk category abbreviations are: Env. – environment/sustainability; BC – business cost; Safety – People/safety/wellbeing; Rep – Political/reputation; Legal – legal consequence; Service – service delivery
2. L refers to the Likelihood of a risk occurring. Abbreviations for consequence ratings are: AC – almost certain; L – likely; P – possible; U – unlikely; R - rare
3. C refers to the Consequence if the risk occurs. Abbreviations for consequence ratings are: N – negligible; Min – minor; Mod – moderate; Maj – major; Ext - extreme

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
1	Env	Insufficient water available for proposed watering actions to meet environmental objectives. *Note: there is a need to be alert to cumulative impacts of multiple dry years*	L	Maj	High	Adaptively prioritise and revise watering actions to optimise outcomes from water available considering seasonal conditions, including consideration the need to reserve contingency volumes for the following season. Identify any reservoir release constraints due to low water levels and adapt plans accordingly Maximise use of consumptive water en-route for environmental benefit. Communicate with community and stakeholders around planned watering actions and any revisions required.	CMA/WRAG CMA/WRAG GWMWater CMA	Dynamic

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
						Undertake extra monitoring to guide complementary actions (e.g. carp removal, fencing). Undertake studies to identify key refuge areas for protection in the Glenelg and Wimmera systems. Where feasible, deliver water via pipelines to key drought pools on the Wimmera River Look for water savings to build up a "water bank" for reducing stress in subsequent years	CMA CMA CMA VEWH/WRAG	
2	Env	Environmental water deliveries may generate or mobilise poor quality water (e.g. blackwater, BGA, salinity), with adverse water quality and environmental outcomes; or Areas not targeted for environmental watering actions experience poor quality water (e.g. blackwater, BGA), with adverse water quality and environmental outcomes	L	Min	Low	Ongoing monitoring to inform water deliveries. Adapt flow management based on antecedent conditions and local knowledge. Maximise use of consumptive water en route for environmental benefit. Establish environmental reserve to manage management needs. Communicate around current conditions and revised objectives. Undertake complementary actions, including provision of information to the community	CMA CMA GWMWater VEWH CMA CMA	Static

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
3	Env	Environmental deliveries create improved conditions for non-native species (e.g. carp, invasive weeds, rabbits, foxes) leading to adverse environmental impacts. (*Note: This risk addresses the incremental impact of environmental water deliveries on pest plant and animal populations, noting that even in the absence of environmental delivery actions these pests are likely to spread in waterways with adverse environmental impacts).*	P	Min	Low	Adaptively manage flow to incorporate new knowledge from monitoring and research. Monitor invasive species extent and control existing populations (e.g. opportunistic removal of carp in dry conditions). Install physical barrier to prevent translocation (e.g. carp barriers). Develop management agreements with landholders that include pest plant and animal control measures. Communicate data from fish surveys etc. to inform the community on pest species and outcomes of control measures. Seek additional funding for carp control activities.	CMA CMA CMA CMA CMA CMA	Dynamic
4	Rep	Inability to demonstrate that environmental water objectives have been achieved, which may lead to a loss of public/political support for activities.	P	Mod	Medium	Seek additional funding for and undertake targeted local monitoring (leveraging existing data sets where possible). Invest in monitoring and research to address knowledge gaps and influence existing monitoring programs. Share new knowledge to promote adaptive management. Communicate monitoring results to local communities.	CMA VEWH/ DELWP VEWH CMA	Static

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
5	Legal	Environmental releases cause unauthorised inundation of private land, resulting in impacts on landowner activities and assets.	U	Mod	Low	Ensure the currency of any landholder agreements for environmental watering actions. Ongoing communication with GWMWater and land managers in planning and delivery phases. Consider weather forecasts when conducting environmental releases and reschedule deliveries if forecasts indicate potential for flooding. Test and monitor delivery rate and respond to potential incidents. Maintain and inspect infrastructure, including upgrading infrastructure where required before delivery occurs. Identify likely areas of impact by understanding historical impacts and previous experience, and modify flow planning, or undertake works to reduce risk of inundation.	CMA CMA GWMWater GWMWater GWMWater CMA	Static
6	BC	Insufficient staff resources available to deliver all planned environmental watering actions, leading to cancellation or interruption of deliveries.	L	Mod	Medium	Continue to actively prioritise actions to match available resources and ensure priority actions are delivered. Ongoing communication with GWMWater to understand constraints and develop a schedule of delivery to manage staff resources.	CMA CMA GWMWater	Static

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
						Implement remote monitoring to minimise staff time in the field, within available funding. Provide delivery plans with required lead time prior to target delivery date (usually 2 weeks). Ensure timely approval of seasonal watering statements. Upgrade infrastructure to reduce the need for manual operations. Adjust delivery timing to avoid holidays, weekends and high-risk periods for resourcing.	CMA VEWH CMA CMA	
7	BC	Volume delivered or released exceeds volume approved and/or ordered for use in the event or year.	U	Mod	Low	Communicate seasonal watering statements to all partners. Monitor delivery rate, provide delivery data to CMA/VEWH and respond to potential incidents. Monitor water use against volume approved for use in seasonal watering statement and adapt water orders if required. Monitor water use against volume approved and undertake regular communications with CMA and GWMWater as part of portfolio management activities.	VEWH GWMWater CMA VEWH VEWH	Static

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
						Review and update established ordering processes with GWMWater, (as documented in Operating Arrangements document) at regular intervals.		
8	Safety	Where delivery structures are unsafe and have limitations on their operation, planned environmental deliveries may not be feasible leading to a failure to achieve environmental outcomes.	U	Ext	Medium	Upgrade or modify infrastructure to improve safety. Modify method of operation to avoid unsafe work practices and update safety procedures to reflect this (Note: safe work procedures will need to be communicated to community/volunteer resources as well as agency staff where they undertake structure operations).	Asset owner Asset owner	Static
9	Env	Flow rate at environmental flow compliance point not able to be demonstrated, which may lead to failure to achieve target flows and environmental benefits not being achieved.	P	Mod	Medium	Install/upgrade stream gauge monitoring to improve ability to demonstrate target flow rate achievement. Consider data collection and modelling studies to improve understanding of flow behaviour of systems.	CMA CMA	Static
10	Env	Target flow rate at environmental flow compliance point not achieved due to environmental conditions, (for example high losses at very dry sites, hot weather causing excessive evaporation, antecedent conditions and inflow rates) and environmental benefits not being achieved.	L	Min	Low	Monitor flow rate and adjust delivery volume within approved volume. Use flow forecasting tools/modelling to better understand and allow for losses Arrange releases from weir pools to complement environmental deliveries.	CMA GHCMA WCMA CMA	Dynamic

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
						Consider adjusting delivery timing to avoid holidays, weekends and high-risk periods for system operations resourcing.		
11	Env	Target flow rate at environmental flow release or measurement point not delivered as ordered, leading to sub-optimal environmental outcomes.	U	Mod	Low	Monitor flow rate and adjust delivery to meet ordered flow rates. Ongoing communication with the CMA to manage infrastructure or maintenance constraints.	GWMWater GWMWater	Static
12	Safety	Environmental releases create rapid or unexpected changes in flow conditions, resulting in injury to river user[1]	U	Mod	Low	Communicate flow deliveries to communities and key stakeholders and avoid large flows or rapid changes in flow rate during periods of high river use. (e.g. using community SMS stock management updates services). Erect signage where appropriate. Consider safety management around relevant automated structures.	GWMWater/CMA GWMWater/CMA GWMWater	Dynamic
13	Rep	Changing seasonal conditions results in changes to previously announced watering plans, which leads to a loss of community confidence in environmental water management. (Note: These proposed mitigations are also relevant to Risks 12 and 14)	L	Mod	Medium	Ensure community is informed about intended watering objectives and the scenario planning process used. Provide regular local, place-based updates on planned delivery actions and the current/changing situation in river systems leading to changed actions. Undertake broader awareness programs focussing on the importance of e-watering, its complexity and the need for adaptive management.	CMAs CMAs VEWH	Dynamic

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
14	Rep	Community groups not supportive of environmental watering delivery.	U	Min	Low	Engage with the local community through a variety of avenues (e.g. workshops, forums, individually to communicate benefits of environmental watering. Develop state-wide communication products and engage with peak bodies Each organisation to share their intended environmental water related communications plans with all partners. Provide the community with information on the risks and management changes implemented in response to drier conditions.	CMA VEWH CMA/VEWH CMA	Dynamic
15	Env	Inadequate monitoring of wetland water levels leads to over delivery to wetlands with local flooding and environmental impacts. (Note: Likelihood of this risk is decreased due to smaller delivery volumes under dry conditions)	P	Min	Low	Inspection of wetlands immediately prior to commencement of deliveries to confirm levels and water needs, with regular monitoring of levels during events. Enlist the assistance of local interest groups and landholders to provide feedback on wetland levels during delivery events.	CMA	Dynamic
16	Env	Constraints in the capacity of works used to supply some wetlands may limit the volumes delivered, leading to a failure to achieve planned environmental outcomes	P	Min	Low	Undertake planning with GWMW to identify suitable starting times and schedules to maximise the chances of required deliveries being achieved.	CMA	Static
17	Env	Growth in kangaroo numbers, including around wetlands near roads can pose a possible safety	U	Min	Low	Communication that kangaroos may be present around wetland areas, together with collaboration with local government	CMA	Dynamic

No.	Risk category[1]	Risk description	L[2]	C[3]	Risk rating	Mitigation actions	Lead organisn. for action	Risk type (Static/ Dynamic)
		hazard, which may lead to negative perceptions of environmental watering.				on wider awareness programs around kangaroos and road safety.		
18	Env	Unauthorised stock access to wetlands can lead to damage to the site, negating the benefits of previous watering and limiting the ability to achieve environmental objectives. Note: there are also reputational risks around non-compliance - similar risk rating	L	Min	Low	Develop agreements with landholders for control of stock on privately owned wetland sites. Review proposed watering sites on public land with land manager and identify fencing risks and potential solutions, including fencing upgrades. Monitor and inspect wetlands during deliveries to identify stock issues and modify plans if required. Consider reporting wandering stock to council rangers for action.	CMA CMA/PV CMA CMA	Dynamic
19	Env	Land manager resources may be diverted to fire response, limiting opportunities for timely sign-off of wetland delivery plans, which prevents deliveries proceeding and impacts achievement of environmental outcomes.	P	Mod	Medium	Mitigation options to be further discussed between CMA and PV/DELWP staff Review delivery plan sign off processes with DELWP and PV to improve process - include escalation options if local staff are unavailable to sign-off.	CMA/Land Manager CMA	Dynamic

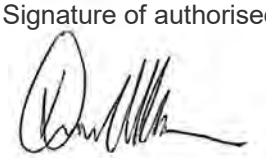
12. Approval and Endorsement

APPROVAL

I, the authorised representative of the agency shown below, approve the Seasonal Watering Proposal for the *Wimmera Mallee Pipeline Wetlands – Wimmera CMA Region 2021-22*.

SIGNED FOR AND ON BEHALF OF Wimmera Catchment Management Authority

Signature of authorised representative



Name of authorised representative
David Brennan, Chief Executive Officer

Date: 23 April 2021

Grey Teal in front of Cane Grass at Mutton Swamp – March 2021

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13. Appendices

13.1. Acronyms

ARI: Arthur Rylah Institute
CMA: Catchment Management Authority
DELWP: Department of Land, Water and Planning
DSE: Department of Sustainability and Environment
EVC: Ecological Vegetation Class
IWC: Index of Wetland Condition
VEWH: Victorian Environmental Water Holder

13.2. Guidance Material – Risk Assessment

Tables sourced from *Seasonal Watering Proposals Guidelines 2018-19* (VEWH, 2017)

Table 14. Risk likelihood

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

Table 15. Risk Consequence

Rating		Environment *Impact on the surrounding environment, including habitats and species, as well as the broader landscape*	Business Costs *Cost to the state*	People *Workers, local communities and other stakeholders*		Political/ Reputational *How media, public and stakeholder perception of State is influenced*	Legal *Legal consequence*	Service Delivery *Effect on the business*
				Safety and Well-being	People and Culture			
RISK								
Negligible Harm	1	No material effect on the environment, contained locally within a single site/ area. Environment affected for days	Cost impact of up to 2.5% of allocated operational budgets (including capital budget); OR a cost impact of up to $2.5m	On-site first aid treatment only	Staff disgruntlement	Minimal adverse local attention (1 day only)	Non-compliance with legislation, identified internally and resulting in internal acknowledgement and process review.	Insignificant impact to the Organisation's capability in providing its services - no inconvenience to customers/ stakeholders
Minor Harm	2	Limited effect on the environment, restricted to a single township or locality. Environment affected for weeks.	Cost impact between 5%-10% of allocated operational budgets (including capital budget); OR a cost impact of up to $5m	Minor injuries/illness requiring medical attention	Complaints, passively upset, and uncooperative	Adverse localised public attention on a single issue over a short period. (up to 1 week)	Non-compliance with legislation or breach of duty of care, identified externally and either (1) resolved without prosecution of or civil action, or (2) resulting in prosecution or civil action involving low level of resourcing required to defend, exposure to low level remedies or damages, and low level risk of negative precedent	Minimal short term temporary impact to the Organisation's capability in providing its services - customers/ stakeholders slightly inconvenienced
Moderate Harm	3	Moderate effect on the environment, impacting on a municipality or multiple localities. Environment affected for months.	Cost impact >10% of allocated operational budgets (including capital budget); OR a cost impact of up to $10m	Significant injury/illness requiring in-patient hospitalisation	Low morale, disengagement, increased absenteeism and workplace conflict	Adverse localised negative public attention on a single issue over a sustained period (up to 2 months)	Non-compliance with legislation or breach of duty of care resulting in prosecution of, or civil action, with one of high level of resourcing required to defend; exposure to high level remedies or damages or high level risk of negative precedent.	Significant impact to the Organisation's capability in providing its services - customers/ stakeholders inconvenienced
Major Harm	4	Major effect on the environment, impacting on a region or multiple municipalities. Environment affected for 1-3 years.	Cost impact between $10m-$50m	Extensive and/or permanent injury/ illness	Major morale issues, high absenteeism and resignations of key staff	Serious adverse public attention on more than one issue over a prolonged period (up to 2 years)	Non-compliance with legislation or breach of duty of care resulting in prosecution of or civil action (with *all of* high level of resourcing required to defend, exposure to high level remedies or damages, and high level risk of negative precedent); or public enquiry	Continuing difficulties in the Organisation's capability in servicing customers/stakeholders over a protracted period - delays caused beyond target)
Extreme Harm	**5**	**Very serious effect on the environment, impacting on the state or multiple regions. Environment affected for >3 years**	**Cost impact of over $50m**	**Death or permanent disability/ illness**	**Organisation wide morale issues, mass resignations and absenteeism**	**Very serious public outcry over a prolonged period (greater than 2 years), or leading to a formal inquiry, serious investigation of other major political event**	**Non compliance with legislation or breach of duty of care resulting in prosecution of or civil action (leading to imprisonment of an officer and/or uninsured compensation payments).**	**Long term detrimental effect on the Organisation's capability in providing services to customers/ stakeholders**

Table 13. Risk Rating

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