From fragmentation to interconnection – A landscape scale approach for floodplain wetland prioritisation and management

Treadwell, S[1*], Duncan, L.[1] and Gaskill, S[2].

*1 Jacobs, Level 11/ 452 Flinders Street, Melbourne, 3000. *Email: Simon.Treadwell@jacobs.com*

2. Melbourne Water, 990 Latrobe St, Docklands VIC 3008

Key Points

- Current approaches to wetland objective setting and water regime management are site based.
- This can result in all wetlands being managed for the same values.
- Adopting a landscape scale approach to wetland management can lead to a greater diversity of outcomes than can be achieved on a site by site basis.

Abstract

Melbourne Water delivers a Billabong Program aimed at restoring water regimes of disconnected floodplain wetlands to improve ecological, social and cultural values. This program has been successful at improving values at a site scale but in recognition that floodplains are a larger-scale interconnected system, a new approach was needed to ensure the greatest benefit is being achieved with a finite resource.

We developed a framework that enables objectives to be developed at a landscape scale that ensures all values are protected or enhanced. It identifies environmental water actions, and complementary actions that may be delivered through other programs or agencies. The application of this framework ensures sites are managed to optimise outcomes both at individual sites and to achieve the vision and objectives of the system at a landscape scale.

Traditionally, environmental water planning and delivery has taken place using a fragmented approach rather than considering the full range of values to be improved across the landscape. Multiple wetlands can be managed for the same values and opportunities to provide for a more diverse suite of values can be missed. The new framework enables consideration of broader landscape-scale objectives when prioritising wetlands. This results in a mosaic of different wetlands capable of providing for the full range of values that stakeholders and the community want to see represented. The approach is transferable to multiple locations.

The approach has been trialed for the Yarra River floodplain and Melbourne Water is now in the process of planning multi-year environmental watering to achieve outcomes at multiple sites across the landscape.

Keywords

Wetland management, environmental water, landscape scale prioritisation, Yarra River

Introduction

Individual wetlands form part of a larger interconnected floodplain system that provides an important mosaic of habitats and floodplain features in a broader landscape. However, wetlands are often manged on a site by site basis, in isolation of their broader landscape context.

This paper presents a landscape scale approach to wetland management in the Melbourne Water region and its application to wetland management on the lower Yarra River floodplain. The approach acknowledges diversity of wetlands types within the landscape and the role individual wetlands play in improving the values of the broader floodplain. It aids in prioritisation of wetlands for water regime management including delivery of environmental water or implementation of a drying regime to achieve a greater range of outcomes than can be achieved if adopting a site by site management approach. Implementing the framework also helps to identify complementary actions that can be delivered through other programs.

Framework development

The framework development involved a review of similar prioritisation frameworks, a number of stakeholder workshops to capture input from stakeholders, including internal Melbourne Water staff, traditional owners (Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation), and relevant government agencies and interest groups.

Figure 1 shows the framework logic and involves:

1. **Developing a System Vision** - A high-level intent of the management of wetlands at a landscape scale that links to other strategies and is developed with the key stakeholders and communities to ensure a range of perspectives are captured.
2. **Identifying Environmental, Social and Cultural outcomes** – This recognises the overlapping connections between environmental, social and cultural outcomes.
3. **Developing performance objectives for values identified across the landscape** – Objectives reflect the long-term aspirational intent for each value that is identified and enables tracking of progression to achieve objectives. This is an iterative process that requires consideration of the desirable values and condition of existing wetlands.
4. **Identifying sites to cater for the range of values** – Once the target values and performance objectives for the wetlands at a landscape scale are determined, individual sites or wetland complexes that can be managed to achieve the performance objectives are identified. Some wetlands could be managed for multiple values and will contribute to meeting multiple performance objectives, some sites will only meet one or two values and some will need to be managed as a complex to support the values identified at a landscape scale.
5. **At individual sites** – Identify water regime requirements and non-water regime actions needed to support identified values for that particular site.

Implementation of the framework involves a number of inputs, processes and outputs (Figure 2) that cover:

1. Background reviews to characterise the existing landscape
2. The development of a conceptual model of what the ideal landscape would look like (based on ecological understanding of wetland functions, values present or desirable for the area, and the capacity of the existing environment and management options to support those values)
3. Stakeholder engagement and input to confirm objectives
4. Development of site-specific objectives, watering requirements and non-watering actions.

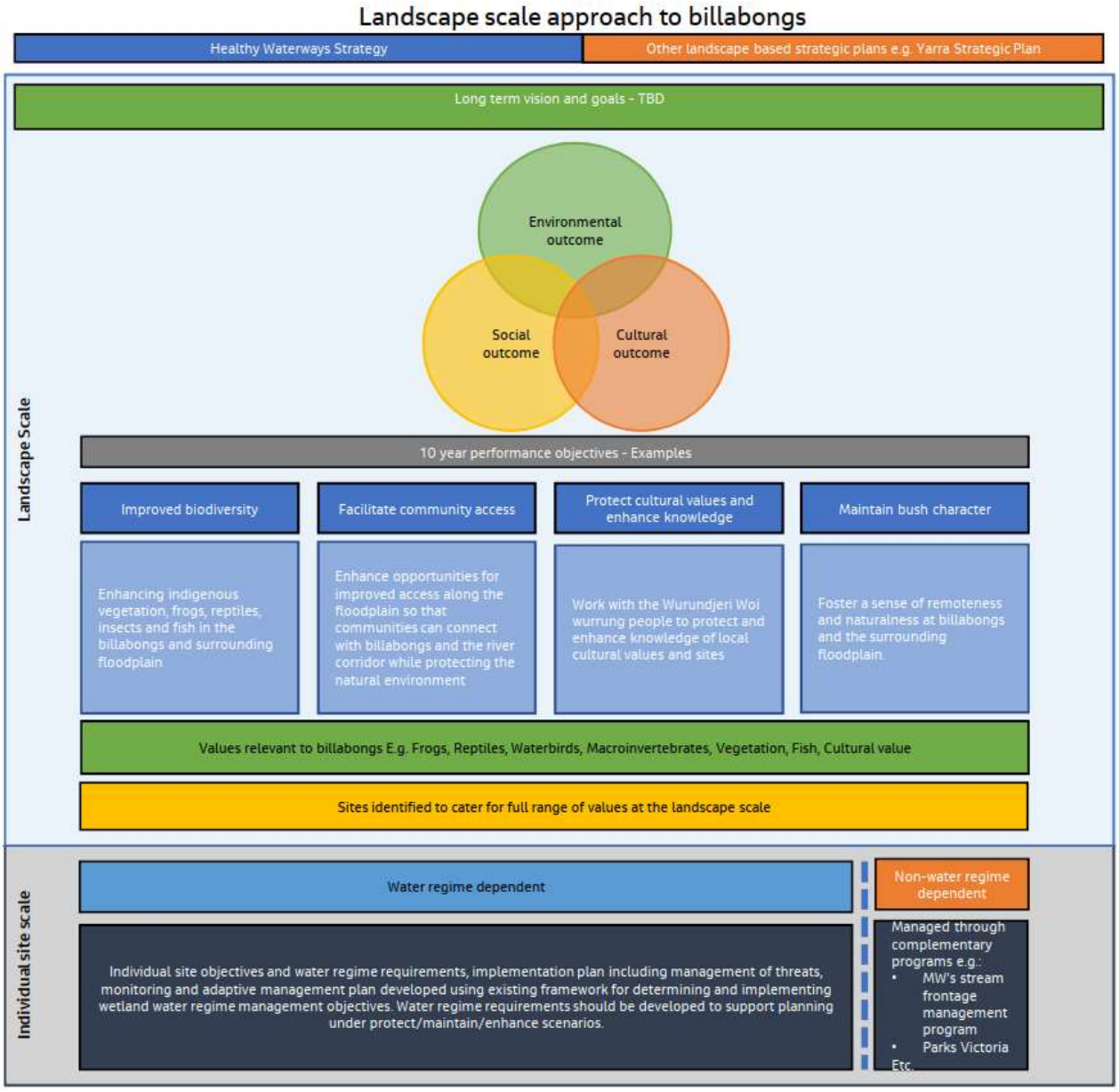

Figure 1 A framework for the landscape scale management of wetland water regime

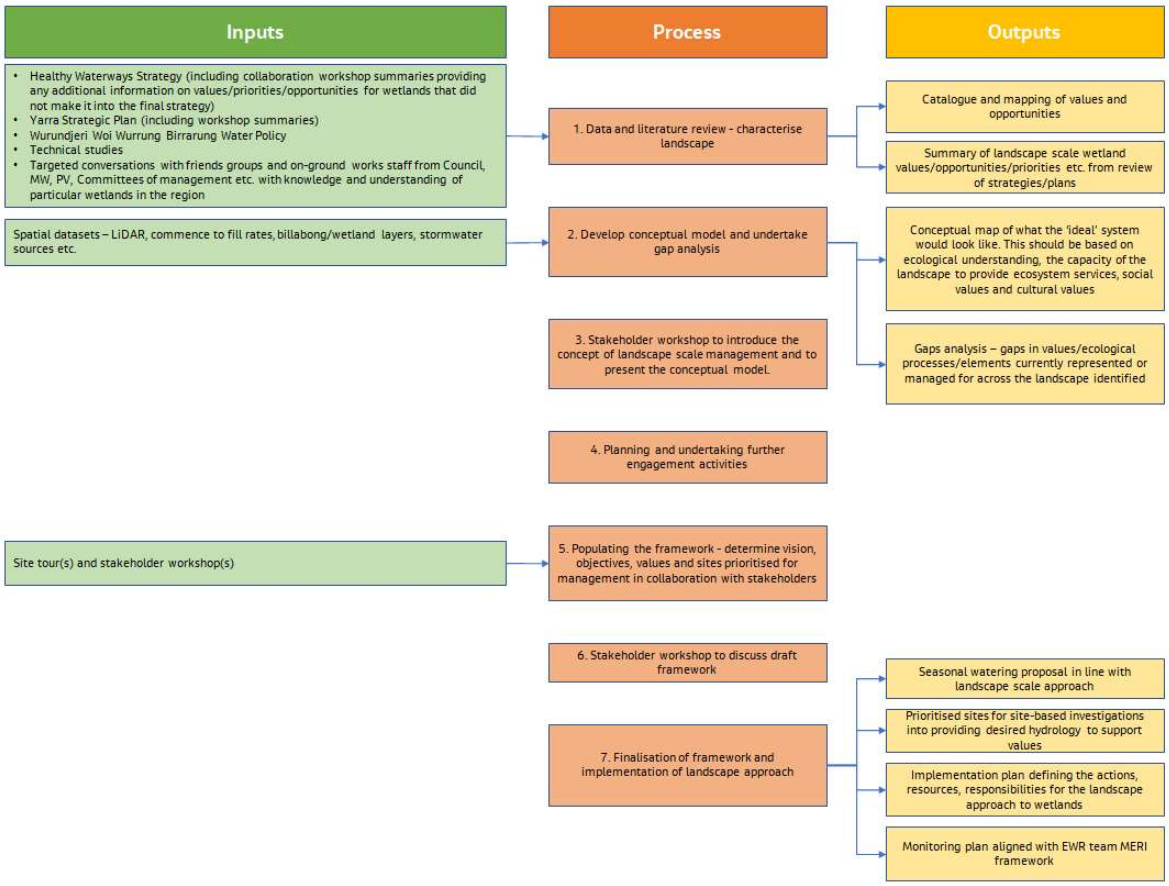

Figure 2 Implementation process for populating the framework for a landscape scale approach to wetlands.

Implementation for the Yarra River

The above framework has been applied to the lower Yarra River floodplain wetlands. There are 39 wetlands within the lower Yarra landscape between Westerfolds Park (upstream) and the Chandler Highway Bridge (downstream), including billabongs, floodplain depressions and permanent waterbodies for irrigation (predominantly golf courses) (Figure 3).

These wetlands range in size, volume and the nature of their connection to the Yarra River. Inundation of some low-lying wetlands commences when flow in the Yarra River exceeds ~6,000 ML/d. However, most wetlands require a river flow of 10,000-25,000 ML/d to experience inundation. Under natural conditions most of these wetlands would have been seasonally inundated but river regulation over the past 60 years, extraction for water supply and climate change are resulting in a decrease in the frequency and duration of flows that would inundate wetlands (Figure 4).

To address the impact of a reduction in frequency of river inundation and to maintain a range of desirable wetland values, Melbourne Water is actively watering some of these wetlands through lowering of commence to flow levels, temporary pumping, and by accessing alternative sources of water (e.g. stormwater).

The application of the landscape scale approach to wetland water management provides an opportunity to maximise environmental, social and cultural outcomes by optimising environmental water management across the landscape, rather than at individual sites.

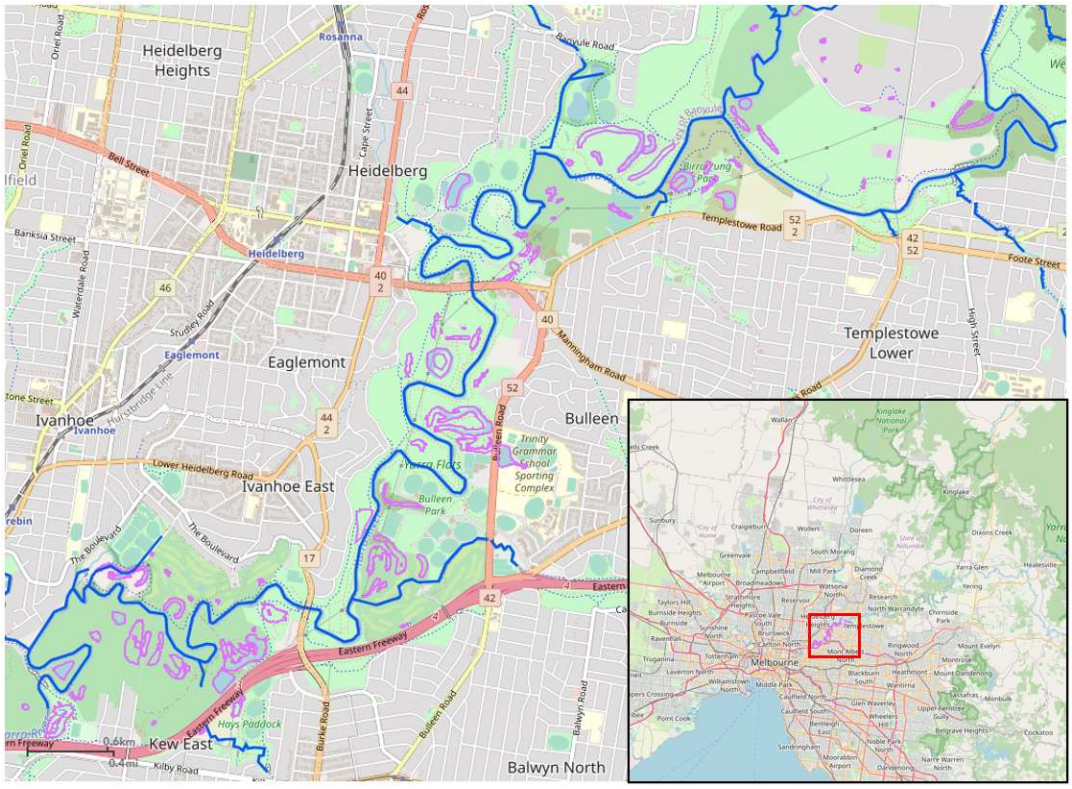

Figure 3 Floodplain wetlands on the lower Yarra River floodplain

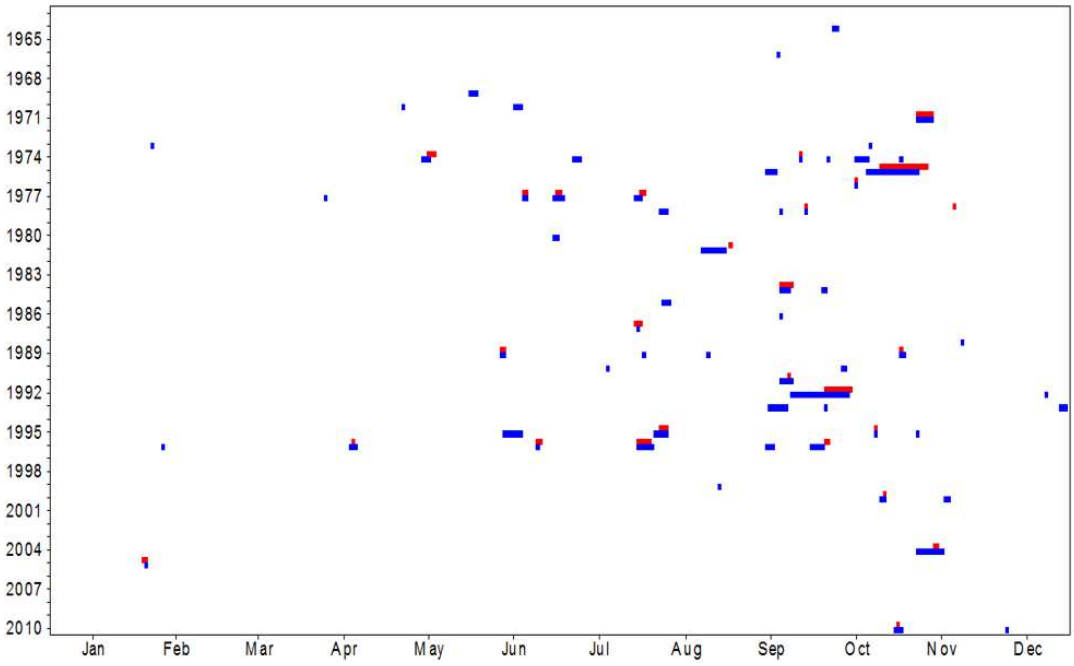

Figure 4 Impact of river regulation on reducing frequency and duration of a typical wetland inundation flow. Blue bars show timing and duration of events >13,000 ML/d under unimpacted conditions (modelled) and red bars show timing and duration of events >13,000 ML/d under actual conditions (gauged).

Through stakeholder engagement a long-term vision statement for the wetlands was derived:

The lower Yarra landscape is a place of significant ecological and cultural value within highly urbanised surrounds. The floodplain wetlands of the lower Yarra form an integral part of this natural landscape providing for the protection, maintenance and enhancement of indigenous plants and animals and supporting ecological processes vital to the overall health of the system.

The floodplain wetlands will be collaboratively cared for by landowners, Traditional Owners, government agencies, local government and the community to improve their ecological, social and cultural values now and into the future. This will provide opportunities for people to connect and interact with the floodplain wetlands in a responsible and sustainable way that balances the social values of the landscape with the need to protect its ecological and cultural values.

Through a review of existing and desirable (i.e. values that were once present but now lost) wetland values we derived landscape scale objectives for specific ecological values (Table 1) and determined which wetlands were most suited to supporting particular values – this was based on available data so not all wetlands have been assigned specific value objectives at this point.

Table 1 Landscape scale objectives for the lower Yarra floodplain wetlands

Ecological objectives
Landscape ecological character
Restore a mosaic of permanently inundated and seasonally inundated deep and shallow wetlands within the landscape which represent, as close as practicable, pre-regulation conditions to support ecological processes and a range of indigenous flora and fauna including species and/or communities depleted at the landscape scale, key values identified in the Healthy Waterways Strategy (fish, frogs, birds and vegetation), other wetland-dependent species (e.g. bats, turtles, rakali etc.) and including flora and fauna species important to Wurundjeri as totems, seasonal indicators and resources required for ceremony/other uses.
Fish
Increase distribution and number of indigenous wetland fish and create conditions suitable for sustainable recruitment. This will be achieved by providing water regimes that create permanent, high quality habitat including provision of permanent refuge habitat during dry conditions and by delivering complementary actions such as translocations, pest fish control and physical habitat improvements. Targeted species include: Australian smelt, Flat-headed gudgeon, Short-finned eel, Southern pygmy perch, Western carp gudgeon and Yarra pygmy perch.
Frogs
Increase distribution and number of indigenous frogs and create conditions suitable for sustainable recruitment. This will be achieved by providing the range of water regimes across the landscape that creates high quality habitat that meets the requirements of each species, including provision of permanent refuge habitat during dry conditions, and by delivering complementary action such as pest plant and animal control and physical habitat improvements. Targeted species include: Eastern Common Froglet, Peron's Tree Frog, Pobblebonk, Southern Brown Tree Frog, Spotted Marsh Frog and Striped Marsh Frog.
Birds
Support presence of birds in the Yarra landscape. This will be achieved by providing water regimes that support species for which the Yarra landscape represents important habitat and by delivering complementary actions such as pest plant and animal control and physical habitat improvement.
Vegetation
Increase distribution of aquatic and semi-aquatic vegetation species and communities that are depleted at the landscape scale. This will be achieved by providing water regimes that meet the specific life-history requirements of target species and delivering complementary actions such as pest plant control and targeted revegetation. Target species and communities to be determined.

For wetlands with suitable data we have determined the water regimes required to support objectives. Wetlands have been classified as permanent to support populations of small bodied native fish, or as seasonal to provide a mosaic of wet/dry conditions and habitats to support vegetation, frogs and birds. Water regimes specify the preferred frequency, timing and duration of inundation and maximum dry phase intervals that would be required to support the identified objectives.

To fully implement the landscape watering plan multiple wetlands may need to be watered in each year. The ability to water multiple wetlands depends on available infrastructure (e.g. inlet regulators, pumps, alternative sources of water etc), the volume of environmental entitlement available and funding (e.g. for installation of temporary pumps). Watering also needs to consider antecedent conditions and climate forecasts. Most important, for the outcomes to be successful a commitment to long-term, multiple-year watering is required to build resilience in wetlands that have experienced long duration dry phases, support the establishment of and long-term maintenance of desirable values, and help manage risk, for example weed invasion that can occur following a wet phase if follow-up watering is not committed to.

To assist with annual water planning, a scheduling tool was developed that enables Melbourne Water to plan for future watering across the landscape based on antecedent conditions, recommended watering regimes, climate forecasts and environmental water availability. For each wetland the tool determines that ideal watering regime for the current and next ten years (Figure 5). The user can adaptively manipulate the proposed filling regime for any individual billabong for the current year based on water availability, outcomes from monitoring etc and the tool then adjusts the schedule to show a revised watering schedule for future years watering based on decisions that might be made in the current year. This way the user can explore different watering options, the volumes of water that would be needed and implications for future watering schedules. If a natural inundation event occurs and environmental watering is consequently not required, the tool can be adjusted to account for this event, through manipulation of antecedent conditions and the future ideal schedule recalculates.

Wetland name	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Watering frequency achieved
Alphington Wetlands	Maintain permanent water without drying										Permanent
Willsmere/Kew Billabong	Fill	Fill	Fill	Dry	Fill	Fill	Fill	Dry	Fill	Fill	**Seasonal:** 3 continuous years in 4, max dry duration 1 year
Bolin Bolin Billabong	Partial fill permanent pool	Fill permanent pool and wet/dry arms	Top up wet/dry arms	Top up wet/dry arms	Partial fill permanent pool	Partial fill permanent pool	Fill permanent pool and wet/dry arms	Top up wet/dry arms	Top up wet/dry arms	Top up wet/dry arms	**Permanent:** inundation maintained in deep pool **Seasonal:** 3-4 continuous years in 4 in wet/dry arms, max dry duration 2 years
Burke Road Billabong	Dry	Dry	Dry	Fill	Fill	Fill	Dry	Dry	Fill	Fill	**Seasonal:** 3 continuous years in 4, max dry duration 3 years
Banyule Billabong	Dry	Fill	Fill	Fill	Partial fill permanent pool	Partial fill permanent pool	Fill	Fill	Fill	Fill	**Permanent:** inundation maintained in deep pool with max dry duration 1 year **Seasonal:** 3-4 continuous years in 4, max dry duration 2 years
Annulus Billabong	Dry	Fill	Fill	Fill	Dry	Dry	Dry	Fill	Fill	Fill	**Seasonal:** 3 continuous years in 4, max dry duration 3 years
Montpelier Billabong	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Fill	Dry	Fill	**Permanent:** inundation maintained in deep pool with max dry duration 1 year
Golf course waterbodies	Maintain permanent water without drying										Permanent

Figure 5 Example watering schedule generated by scheduling tool

Summary

Managing environmental watering at a landscape scale enables consideration of broader landscape-scale objectives when prioritising wetlands for environmental watering. This results in a mosaic of different wetlands capable of providing for the full range of values that stakeholders and the community want to see represented.

Our framework involves a review of wetland characteristics and values across a given landscape and the identification of objectives at a landscape scale. Individual wetlands are then identified to determine which wetlands were most suited to supporting particular values.

The framework was applied to the lower Yarra River Floodplain. Landscape scale objectives were identified for a range of environmental values, including fish, frogs, birds and vegetation. The framework can also be used to incorporate objectives for cultural and social values. Wetlands suitable to support different values were identified and preferred water regimes were determined.

To assist in the water regime planning, a scheduling tool was developed that links recommended wetland water regime to antecede conditions and water availability to derive a ten-year schedule of watering requirements. Alternative watering strategies can be explored using the tool to test how the future schedule would change based on watering decision in the current year.

The application of the framework and the scheduling tool highlights the need to make a commitment to long-term, multiple-year watering in order to build resilience in wetlands that have experienced long duration dry phases, support the establishment and maintenance of desirable values, and help manage risk.

Melbourne Water are now undertaking further investigation to fill knowledge gaps and further developing processes for identifying social and cultural objectives in consultation with key partners and stakeholders including Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation.

Acknowledgments

We acknowledge the Wurundjeri people as the Traditional Owners of the land on which this work was conducted. The authors wish to thank Sarah Hale (Jacobs) and Josie McGushian (Melbourne Water) for their assistance and support through this project.

We also thank representatives from partner organisations and stakeholders for their various contributions during this project, particularly during COVID-19 restriction where consultation and collaboration was undertaken remotely.

- Victorian Environmental Water Holder
- Wurundjeri Woi Wurrung Cultural Heritage Aboriginal Corporation,
- Parks Victoria
- Port Phillip and Westernport Catchment Management Authority
- Department of Environment, Land, Water and Planning
- Yarra Riverkeeper
- Banyule City Council
- Manningham City Council
- Boroondara City Council