Hattah North Environmental Watering Plan Addendum to the Hattah Lakes Environmental Watering Plan 2012

January 2020

VICTORIAN MURRAY FLOODPLAIN RESTORATION PROJECT

HEALTHY LANDSCAPES, STRONG COMMUNITIES

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List of abbreviations

Abbreviation	Full description
BWS	Basin-wide Environmental Watering Strategy
CAMBA	China-Australia Migratory Bird Agreement
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
EMF	Environmental Management Framework
EPBC	Environmental Protection and Biodiversity Conservation
EWMP	Environmental Water Management Plans
FFG	Flora and Fauna gaurantee
GHD	Gutteridge Haskins & Davey
JAMBA	Japan-Australian Migratory Bird Agreement
LTWP	Long-Term Watering Plans
MCMA	Mallee Catchment Management Authority
MDBA	Murray Darling Basin Authority
MDFRC	Murray-Darling Frehswater Research Centre
MER	Monitoring, evaluation and reporting
PEA	Priority Environmental Assets
PEF	Priority Ecosystem Functions
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SDL	Sustainable Diversion Limit
TLM	The Living Murray
VEAC	Victorian Environmental Assessment Council
VMFRP	The Victorian Murray Floodplain Restoration project
WRP	Water Resource Plan

Introduction

Victorian Murray Floodplain Restoration Project

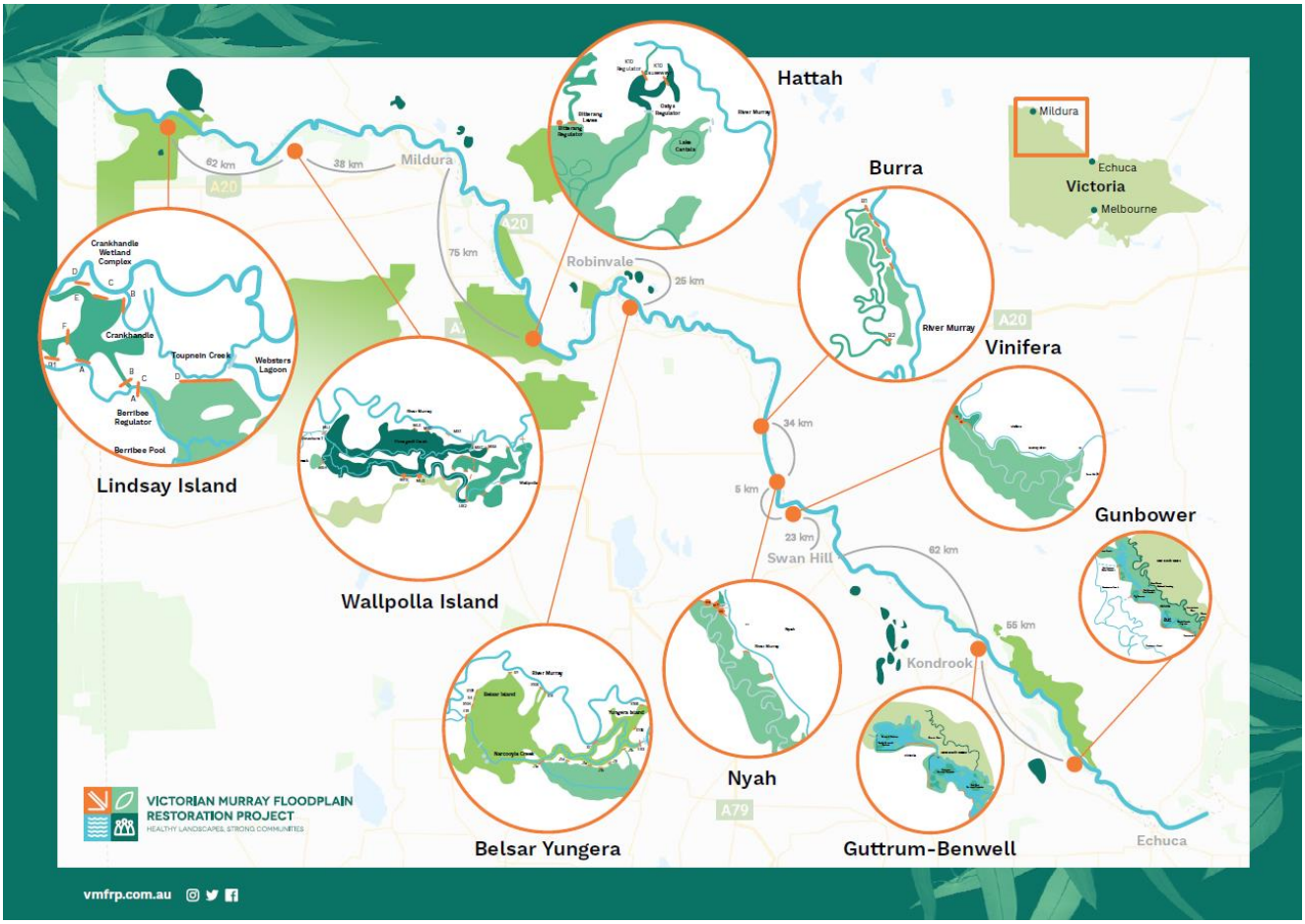
The Victorian Murray Floodplain Restoration project (VMFRP) consists of nine discrete environmental works projects that aim to return an enhanced natural inundation regime across more than 14,000 ha of high ecological value

Murray River floodplain in Victoria through the construction of new infrastructure and in coordination with existing infrastructure operation regimes (Refer to figure 1).

The inundation events will mimic the impact of natural flood events and improve the condition of vegetation communities and provide habitat for native fish, birds, frogs and reptiles.

The VMFRP is being implemented as part of meeting Victoria's obligations under the Murray Darling Basin Plan in partnership with Lower Murray Water, Goulburn Murray Water, Mallee CMA, North Central CMA, Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP).

Figure 1. VMFRP Project Locations



Hattah Lakes North Project

The Hattah Lakes North site is part of the broader Hattah-Kulkyne floodplain, which is nationally recognised for its outstanding environmental values and is located on the western bank of the River Murray between Robinvale and Red Cliffs.

The northern Hattah Lakes are at a higher elevation and are among the last part of the Hattah floodplain to be inundated during a natural flood event.

The Hattah Lakes North project builds on the works funded through The Living Murray (TLM), and extends the area by 9,028 ha that can be inundated to include significant habitats in the northern part of the floodplain (Refer to Figure 2).

The Hattah Lakes North site provides significant habitat for a suite of plant and animal species of conservation significance, both at a Victorian and national level.

The project will leverage on natural high River Murray flow events as well as managed environmental flow events using TLM infrastructure to deliver water to the Chalka North and Lake Boolca areas.

The Hattah Lakes North project will allow for more flexible management of water during high natural flow events by allowing water to flow freely to the north of the park and enable the delivery of water to a wider variety of water-dependent vegetation and habitat types.

Content of Addendum

Environmental Water Management Plans (EWMPs) provide detailed management information at the waterway scale. They set out the environmental watering goals, ecological objectives, and the water regime required to meet the ecological objectives.

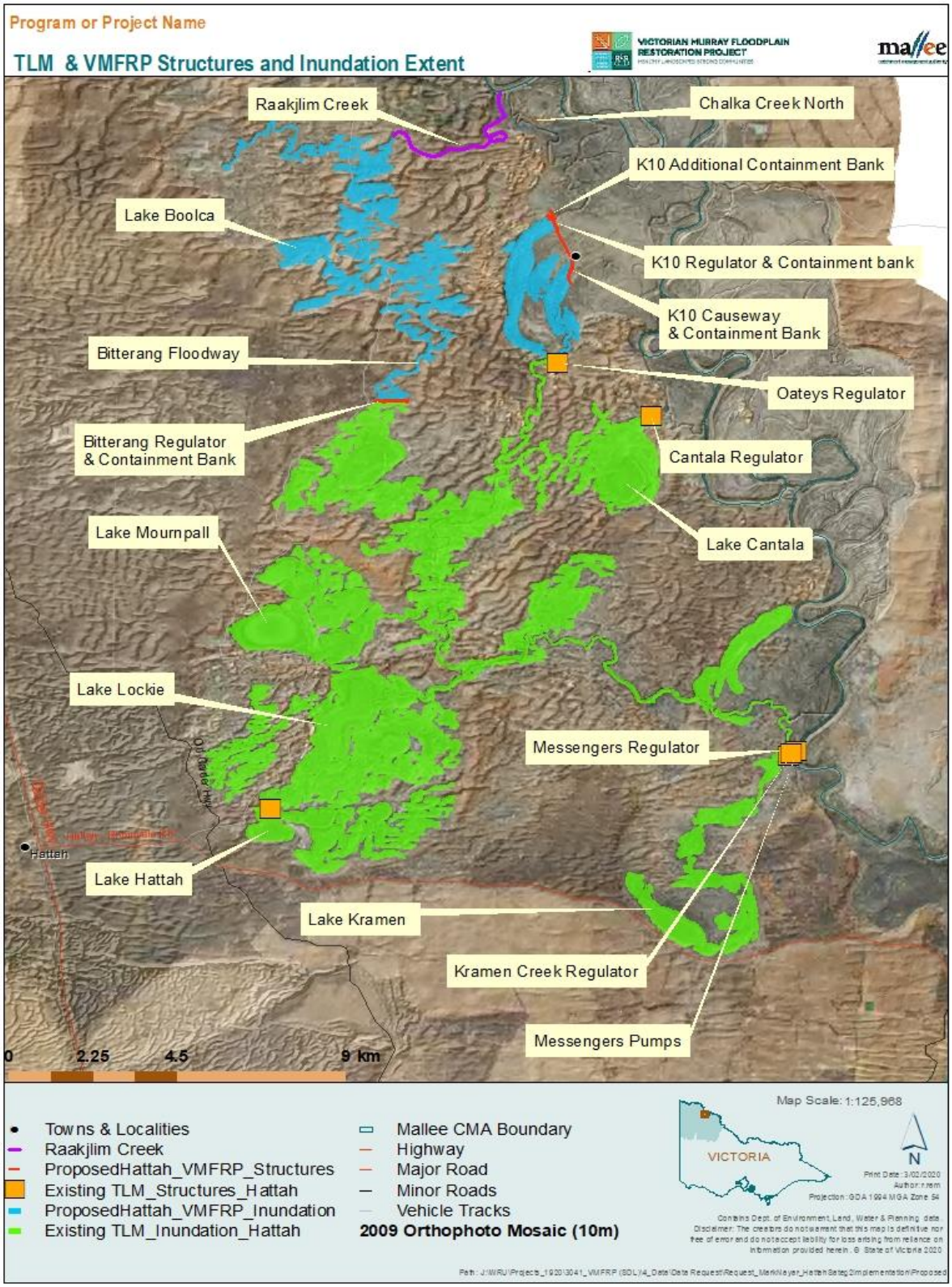
They are characterised by a long-term focus (i.e. more than 10 years) for rivers or wetlands identified by a catchment management authority in their regional Waterway Strategy as priorities for environmental watering.

In northern Victoria, EWMPs are a key reference for the long-term watering plans prepared for Basin Plan The existing Hattah EWMP (MDBA, Hattah Lakes Environmental Water Management plan, 2012b) provides context for the Hattah Lakes' water planning, monitoring and consultation process.

This addendum provides an update of the Hattah Lakes EWMP and should be read in conjunction with the 2012 EWMP (MDBA, Hattah Lakes Environmental Water Management plan, 2012b) and the Operating Plan Addendum 2020.

It identifies environmental objectives and targets (where appropriate), water delivery options and regimes for the Hattah Lakes North project.

Figure 2 – Hattah Lakes North – Existing TLM structures and inundation extent as well as proposed VMFRP structures and inundation extent.



Planning context and legislation framework

Pre-2012 legislative and planning framework

MDBA (Hattah Lakes Environmental Water Management plan, 2012) documents the legislative framework and activities associated with management of TLM icon sites, including construction of works under TLM, the principal pieces of legislation and planning strategies which include a range of international agreements, Commonwealth and state legislation, state planning strategies and regional planning frameworks.

Basin Plan Environmental Management Framework

Since the development of the first Hattah Lakes EWMP the Basin Plan was legislated (Commonwealth of Australia, 2012) with the aim of returning the Murray-Darling Basin to a healthy working system and building on existing initiatives like TLM.

The primary environmental goal of the Basin Plan is the protection and restoration of water dependent ecosystems and ecosystem functions in the Murray-Darling Basin, with strengthened resilience to a changing climate.

The Environmental Watering Plan of the Basin Plan (Chapter 8) sets out the overall environmental objectives for the water dependent ecosystems of the Murray-Darling Basin, the targets (Schedule 7) by which to measure progress towards achieving those objectives and an Environmental Management Framework (EMF) for planned environmental water and held environmental water (Commonwealth of Australia, 2012).

This planning provides for both long-term and annual environmental water objectives, at both the Basin and a more localised scale, as shown in Figure 1.

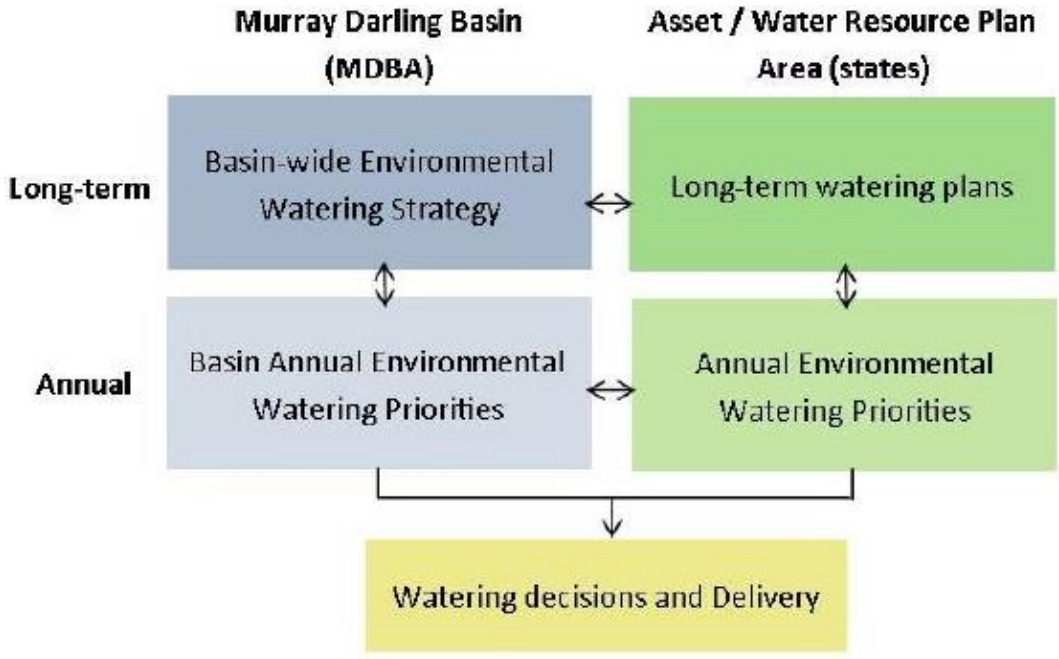


Figure 3: The long-term and annual planning documents required under Basin Plan Chapter 8 'Environmental Watering Plan' (DELWP, 2015)

The EMF is intended to:

- Coordinate the planning, prioritisation and use of environmental water on both a long-term and annual basis;
- Enable adaptive management to be applied to the planning, prioritisation and use of environmental water; and
- Facilitate consultation, coordination and cooperative arrangements between the Authority, the Commonwealth Environmental Water Holder and Basin.

The long-term watering plan (LTWP) has been prepared by the Victorian Government in accordance with its obligations under the Basin Plan. LTWPs will assist planning for environmental water outcomes, in order to meet the Basin Plan objectives and targets, and the overall environmental objectives for water-dependent ecosystems outlined in Part 2 of chapter 8 of Basin Plan.

As part of the development of the Long-Term Watering Plans (LTWPs) for Water Resource Plan Areas, Basin states are required to identify priority environmental assets (PEAs) and priority ecosystem functions (PEFs) that can be supported with environmental water.

Objectives and targets relating to the criteria for which the PEAs and PEFs were identified are to be documented in the LTWP for assets and to have regard to the Basin-wide Environmental Watering Strategy (BWS) environmental outcomes.

The EMF builds on the policies and arrangements in place within Basin States prior to 2012, including the collaborative arrangements for delivering environmental water such as The Living Murray (Productivity Commission, 2018). As such all TLM icon sites are considered PEAs.

The objectives and targets set in this Addendum are consistent with Basin Plan objectives and have been aligned to the criteria for identifying PEAs and PEFs, the BWS outcomes and the Schedule 7 targets.

Water management

The Hattah Lakes North project builds on environmental water infrastructure constructed under TLM to inundate the southern lakes, and will utilise these existing structures to deliver managed inundation events for the proposed project.

The infrastructure has been designed to be operated in several possible flow regimes:

- Natural flood
- Flood capture
- Retain releases in the Hattah North area delivered from the southern lakes using TLM infrastructure
- Managed inundation – gravity released
- Managed inundation – pumped releases

Constructed elements of the water management infrastructure include gated regulators, containment banks, and hardstands on which to place temporary pumps.

For more detail on the operating scenarios, refer to the *Hattah Lakes Operating Report Addendum* (MCMA 2019).

Ecological objectives and targets with associated inundation regimes and requirements

Ecological objectives have been developed for the Hattah lakes north site, drawing on a range of approaches and recommended lines of enquiry, including:

- The overarching objectives in Schedule 7 of the Murray Darling Basin Plan (Commonwealth of Australia, 2012)
- The Basin-wide Environmental Watering Strategy (MDBA, Basin-wide environmental watering strategy, 2014)
- A review of relevant literature including monitoring data from the TLM initiative (Henderson, et al., 2012; Henderson, et al., 2013; Henderson, et al., 2014)
- Desktop and field-based flora and fauna surveys (Australian Ecosystems, 2013; GHD, SDL Offsets - Fauna Survey Hattah North and Belsar Yungera. Report for the Mallee CMA, 2014)
- Site visits
- An ecological objectives workshop with an expert panel comprised of aquatic wildlife and restoration ecologists and key project stakeholders from DELWP and the Mallee CMA.

The ecological objectives for Hattah Lakes North were developed with a view to enhance the conservation values of the site with the proposed works, inform the detailed design and operation of the works, and guide monitoring and evaluation.

Ecosystem type and biodiversity

The Hattah floodplain lies within the Hattah-Kulkyne National Park and adjoining Murray-Kulkyne Park designated under the *National Parks Act 1975,* Victoria, and supports several ecological communities and fauna species listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) including winged peppercress (*Lepidium monoplocoides*), yellow swainson-pea (*Swainsona pyrophila*), Murray cod (*Maccullochella peelii*), Malleefowl (*Leipoa ocellata*), regent parrot (*Polytelis anthopeplus monarchoides*) and Mallee emu wren (*Stripiturus mallee*). Through TLM, Hattah Lakes was identified as one of six Icon Sites within the Murray-Darling Basin and the site is also listed as a Ramsar wetland of national significance in the Directory of Important Wetlands in Australia (Environment Australia, 2001).The Hattah site is an important biodiversity corridor allowing movement of biota on a regional scale / landscape scale. This linkage enables movement and dispersal of biota between floodplain and terrestrial bioregions. Fauna that regularly use the corridor include regent parrot and Major Mitchell's Cockatoo (*Lopocroa leadbeateri).* These birds feed in mallee vegetation and nest in hollow-bearing trees on the floodplain.

Fauna surveys conducted at eight locations within the Hattah lakes North site in November 2013 identified 129 native fauna species (GHD, SDL Offsets - Fause Survey Hattah North and Belsar Yungera, 2014). Observations included 107 native bird species, three native amphibian species, five native and five exotic terrestrial mammal species, four bat species and ten native reptile species. Significant and listed species recorded during these surveys included a total of 50 records of the EPBC Act-listed regent parrot, a total of seven bird species listed as threatened under the *Flora and Fauna Guarantee Act 1988* and nine species of bird listed under the Department of Primary Industries Advisory List of Threatened Vertebrate Fauna in Victoria 2013. The species are

Many mammals, reptiles and birds, including fat-tailed dunnart, bats, carpet python and bush birds live in both the floodplain and terrestrial landscapes. The hollow bearing trees and open grassland within

the Hattah Lakes North provide valuable complementary habitat components to several vertebrate species living with the surrounding mallee (Ecological Associates, 2014).

The bird fauna of Hattah North comprises 15 waterbird species associated with the floodplain and 92 bush bird species associated with the wetlands and adjacent mallee habitat (GHD, SDL Offsets - Fause Survey Hattah North and Belsar Yungera, 2014).

The interface of Mallee and floodplain habitat also supports a range of other vertebrate fauna including reptiles, frogs and bats. Five frog species and seven bat species have been reported at Hattah Lakes, as well as 23 reptile species including four species of conservation significance (Ecological Associates, 2014).

The bats roost in black box trees where they find shelter in hollows and crevices. Their diet is comprised almost entirely of insects derived from the nearby mallee vegetation. When flooded, the wetlands provide an abundant source of prey.

Nine native fish species are expected to regularly occur in Hattah Lakes and to colonise the Hattah North area when it floods. Small fish species that inhabit localised riparian and wetland habitats include the FFG-listed Murray-Darling rainbowfish (*Melanotaenia fluviatilis*), flathead gudgeon (*Philypnodon grandiceps*) and Australian smelt (*Retropinna semoni*).

Current conditions

The lack of connectivity between the lakes and the River Murray and the complete drying of the lakes over the past decade has had detrimental effects on the Hattah lakes ecosystem and its ability to act as a refuge during prolonged drought. The ecological productivity of the system has declined and the habitat value for fauna has been degraded over the last two decades (Cunningham, Griffioen, White, & MacNally, 2011).

In 2010, Cunningham and colleagues (Mapping the condition of river red gum (Eucalyptus camaldulensis Dehnh.) and black box (Eucalyptus largiflorens F. Muell.) stands in The Living Murray Icon Sites. Stand condition report 2010, 2011) found that 79% of the area covered by river red gum and black box communities in TLM Icon Sites were in a stressed condition. Stands of river red gum and black box in good condition were restricted to the river channel, permanent anabranches, creeks and wetlands. Whereas, extensive areas of degraded to severely degraded stand condition occurred away from the river.

The Living Murray (TLM) Initiative was established in response to concerns about the environmental health of the River Murray with the aim to improve the environmental health of the Hattah icon sites chosen for its significant ecological, cultural, recreational, heritage and economic values. To achieve these objectives a package of on-ground engineering structures were constructed to flexibly manage the delivery of environmental water to the lakes via natural inflows from the River Murray or pumping.

The proposed works enabled the lakes to be filled in the absence of flood water and be retained on the floodplain from 43.5m AHD to a maximum of 45.0m AHD to archive inundation over 6,000 ha of floodplain, including wetland habitat for native fish, waterbirds, frogs and reptiles and improve the condition of fringing Red Gum communities, as well as Black Box communities higher up on the floodplain. The Hattah TLM works pumped inundation to fill lakes up to 43.5 m AHD requires 40 - 50 GL of water.

The Hattah Lakes project was designed to provide the flexibility to operate under a range of river conditions and can target various components of the floodplain to maximise the meeting of ecological objectives whilst using minimal environmental water.

Condition monitoring has been undertaken by the Mallee CMA within the Hattah Lakes as part of TLM since 2006. Annual reports have been produced on the conditions of the ecological objectives; river red gum, black box, wetland and floodplain vegetation, lignum, fish and birds (Australia, 2018-19). The latest annual report showed that most ecological objectives were achieved for each project component for 2018–19 where species were observed, except for the Black Box and floodplain vegetation where objectives were only partially being met. These ecological values will benefit from the proposed VMFRP managed inundation.

The condition monitoring has shown an overall positive response in areas where water was delivered using the TLM infrastructure. This includes improved canopy condition and flowering of tree species, wetland species returning to long-dry wetlands, breeding events of waterbirds and the improvement in woodland bird species richness. The Hattah Lakes North floodplain areas are more extensively water-deprived than the central Hattah Lakes area. The woodlands around Lake Boolca are at a relatively higher elevation and remote part of the floodplain that are seriously degraded.

Through the proposed VMFRP structures about 710 ha of the floodplain north of the Bitterang stop bank will be inundated, including Lake Boolca, in addition to approximately 420 ha of Chalka North Floodplain, extending the area of water delivery that will benefit the ecological values in the Hattah North floodplain using a total water volume of 15.8 GL

The proposed VMFRP works would facilitate significantly larger inundation events to the northern Hattah floodplain and therefore deliver extended ecological benefits beyond those currently achievable. Notably, the VMFRP works would provide for better management of the frequency and duration of inundation across the whole of the Hattah floodplain system. It is expected that the ecological condition of the Hattah North area will improve when the water regime better matches its ecological requirements

Overarching ecological objectives

There are two distinct water-dependent habitat areas that will be targeted by works at Hattah Lakes North: Chalka Creek North and Bitterang North.

The overarching objective of water management at Chalka Creek North is:

"to protect and restore the productivity and integrity of floodplain vegetation and its capacity to support floodplain fauna" (Ecological Associates, 2014).

The overarching objective of water management in the Bitterang North area is:

"to provide important flood-dependant habitat components for terrestrial vertebrate fauna when the lakes are dry and to retain the capacity to provide a productive and diverse wetland habitat when the lakes are inundated" (Ecological Associates, 2014).

The objectives are also supported by recommendations arising from the Investigations into Red Gum Forests conducted by the Victorian Environmental Assessment Council (VEAC, 2008). The review recommended that an appropriate environmental water regime be established for the Hattah-Kulkyne National Park.

Predicted ecological benefits of inundation

Inundation maintains the integrity and productivity of floodplain habitats. Inundation promotes the germination of aquatic plants, which provide habitat for a range of aquatic fauna species including fish, invertebrates and frogs (Ecological, 2014; GHD, Hattah Lakes Management Project SDL Adjustment Supply Measure Phase 1 Submission, 2013; Mallee CMA, Mallee Regional Catchment Strategy 2013-2019, 2013; Ecological, 2014). Inundation also helps to maintain the health of woodlands that provide important habitat like nesting sites and hollows for regent parrot and carpet python (GHD, Hattah Lakes Management Project SDL Adjustment Supply Measure Phase 1 Submission, 2013; Mallee CMA, Mallee Regional Catchment Strategy 2013-2019, 2013) and promotes the growth of trees and triggers flowering.

Increased rates of tree growth provide organic matter to the floodplain system, which promotes productivity, and as floodwaters recede this material also enters the River Murray contributing to the energy requirements of the broader river system. Flowering attracts nectar-eating insects and birds and provides abundant insect prey for the nine species of bats and the insectivorous birds found at the Hattah Lakes (Ecological, 2014).

Delivery of Environmental water to Hattah Lakes between 2005 and 2010 provided a drought refuge for the regions of wetland birds, enabling them to survive in the area until the next natural flood. A total of 51 wetland bird species were recorded at Hattah Lakes during this time, including 12 rare and threatened wetland bird species. In the absence of environmental water delivery to Hattah Lakes, the lake system would have dried out completely, providing little attraction for water birds (Cook & Jolly, 2010).

The environmental watering was of considerable benefit to local frog populations. Surveys showed watering in 2010 provided aquatic habitat and resources to support the presence of five frog species and breeding of three species (Robertson, 2011).

Large scale inundation has occurred at Hattah Lakes since construction of the TLM works in 2013, contributing to the trend of increasing ecological condition since the end of the millennium drought (Henderson, et al., 2014).

The TLM works has been successful in delivering water to improve native fish outcomes with recorded movement of larval fish into the lakes and the return of mature fish to the River Murray (I Ellis, 2014, pers comm in Mallee CMA, 2014). Program findings have confirmed the effectiveness of environmental watering, over the past six years, in improving Black Box tree health and reproductive output (Moxham C, 2019).

Fields surveys from October 2018 to march 2019 recorded high bird numbers in spring 2018, mainly on sites that had been flooded in previous years. Analysis of data for the whole 6-year period showed that effects of environmental flows were generally strong and positive, with total numbers of birds being 60% higher on sites that had flooded for up to three years after flooding. The study showed that environmental flows deliver benefits to the black box woodland ecosystem, that are evident in most bird guilds including insectivores that feed in the eucalypt canopy, shrubs and ground layers. This shows environmental flows at suitable frequencies may have wide-ranging benefits within the ecosystem. (Richard Loyn, 2018-19).

The 2018 Icon site monitoring provides a strong evidence base that, where environmental water holders and managers have been able to deliver water for the environment, the health of the southern Murray–Darling Basin rivers, wetlands and floodplains are improving. This monitoring shows the critical role of water for the environment to build on the benefits of natural flooding, maintain and build resilience in dry times and how the operation of environmental works over successive years is helping achieve environmental outcome (Authority, 2018).

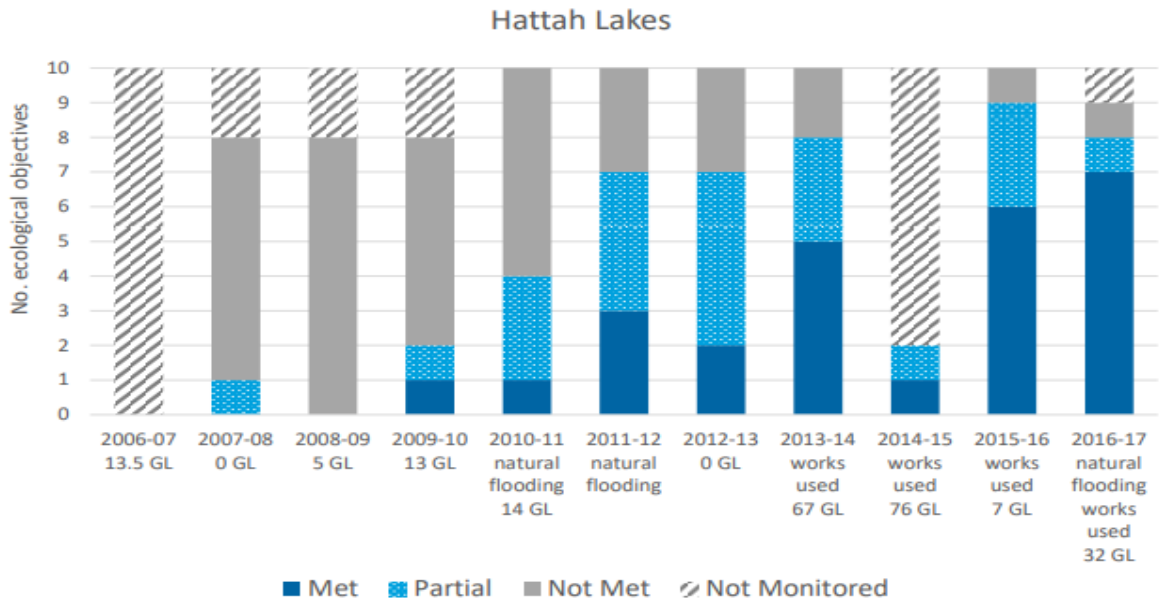


Figure 4: Hattah Lakes – Performance of ecological objectives 2006–07 and 2016–17 (Authority, 2018)

These results provide a high level of confidence that the implementation of the proposed VMFRP supply measure and its associated watering regime will provide the expected benefits.

This project provides a significant opportunity to enhance the important ecological values of the northern and most water-deprived part of the Hattah floodplain system. The Hattah Lakes North project will assist in achieving ecological the site objectives set under the Basin Plan TLM, and will complement environmental improvement already being experienced in the central Hattah lakes areas following environmental watering.

Figure 3: Photo point monitoring at Chalka Creek, Hattah Lakes shows the ecological response to environmental watering (left: 2005; right 2007 – Photos: Parks Victoria)

The proposed VMFRP inundation will restore flooding and productivity to areas of red gum woodland and black box woodland. It will improve quality and extent of habitat for a wide range of native species, including threatened species. The inundation will cause stimulation of seed bank leading to germination

of aquatic and emergent plant species, resulting in greater diversity and abundance of wetland flora. This will in turn provide foraging and breeding habitats for wetland birds, fish and frogs.

The anticipated ecological benefits that are expected for each water regime class as a result of the project are outlined in Table 1.

Table 1: Water regime class, strategy and ecological benefits (Ecological, 2014).

Water Regime Class	Strategy	Ecological benefit
Red Gum Woodland	Restore the inundation of red gum woodland	A long-term net benefit through the maintenance and enhancement in condition of river red gum communities. Quality and extent of habitat for a wide range of native species, including threatened species, would be expected to result from improved flow regimes. In particular, colonial nesting waterbirds that rely on productive inundated Red Gum Woodland and shallow wetlands to forage during breeding would be expected to benefit.
Black Box Woodland	Restore intermittent inundation events	A long-term net benefit through the maintenance and enhancement in condition of floodplain Black Box Woodland communities. The increased inundation regime would provide the appropriate conditions for black box recruitment within the area, maintaining a diverse age structure, including maturation and development of hollows, maintaining habitat in the long-term for native fauna species.
Episodic Wetland	Restore intermittent inundation events	Stimulation of seed bank upon inundation leads to germination f aquatic and emergent plant species, resulting in greater diversity and abundance of wetland flora during inundation and on recession of floodwaters. This will in turn provide foraging and breeding habitats for wetland birds, fish and frogs. Riparian shrubs will potentially demonstrate increased vigour in species such as lignum, and possibly also exhibit and increase in abundance and diversity. Adjacent trees; will likely demonstrate increased vigour and recruitment, therefore leading to an overall improvement in wetland health, maintenance of wetland buffers and maintenance of fauna habitats. Bank and channel edge macrophytes; flows convey seeds and propagules from water source into the wetland resulting in an increased abundance of emergent species. Water quality may improve, wetland banks will be stabilised and habitats for fauna will be provided. In-channel macrophytes; flows convey seeds and propagules from water source into the wetland resulting in an increase in diversity and abundance of aquatic species. Water quality may also improve.

Specific objectives and targets

Specific ecological objectives have been developed to provide some quantification on the degree of environmental benefit expected from the proposed supply measures based on the key water-dependent values of Hattah Lakes North (Table 2). The objectives are consistent with those of the Hattah lakes Icon Site EWMP (MDBA, Hattah Lakes Environmental Water Management plan, 2012) and will contribute to achieving the environmental objectives set by the Basin Plan. Summary of The Basin Plan objectives is attached as Appendix 1.

Table 2: Specific objectives and targets established for Hattah Lakes North (Ecological Associates, 2014) and the relevant water regime classes. This table also shows the contribution of each specific objective to Basin Plan objectives.

Specific objective	Ecological Targets	Water regime class	Associated Basin Plan Objective
Protect and restore floodplain productivity to maintain resident populations of vertebrate fauna including carpet python, lace monitor and bats	Total bat abundance to increase by 25% from 2015 levels by 2030.	Red Gum Woodland, Black Box Woodland	1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14.
Provide occasional breeding habitat for waterbirds	Any species of waterfowl, crake, rail, waterhen or coot to breed in at lease six seasons between 2025 and 2035.	Red Gum Woodland, Episodic Wetlands	1, 2, 4, 6, 7, 8, 9, 10, 11, 12.
Maintain the health and age structure of red gum and black box trees	All red gum and black box stands within the project area achieve a health score of moderate of better under (Cunningham, Griffioen, White, & MacNally, 2011) tree health monitoring for all years between 2025 and 2035.	Red Gum Woodland, Black Box Woodland	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14.
Maintain a plant community of drought-tolerant wetland species in infrequently inundated areas	The drought-tolerant wetland species *Cyperus gymnocaulos* and *Elocharis ecuta* are to be present in vegetative form in 75% of wetlands following any filling event.	Episodic Wetlands	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14.

Contribute to the carbon requirements of the River Murray channel ecosystem	The average annual carbon load (dissolved and particulate) to the River Murray from Hattah Lakes North for the period 2025 to 2035 in double 2015 to 202 levels.	Red Gum Woodland, Black Box Woodland	2, 7.

Ecological targets have also been developed to measure progress towards the specific ecological objectives. It is anticipated that these targets will be tested and refined once the infrastructure is operational. The targets describe an ecological outcome or process and are:

- Quantitative and measurable
- Time-bound, and
- Justified by existing site data or scientific knowledge

It will take some time to realise ecological outcomes due to the time required for vegetation to adapt to the new inundation conditions, for floodplain productivity to increase (e.g. for additional energy and nutrients to be distributed through the food web) and for fauna populations to respond.

Environmental Monitoring

The effectiveness of the proposed managed inundation will primarily be monitored and reported through the well-established monitoring, evaluation and reporting (MER) strategies and protocols by the Mallee CMA. Mallee Catchment Management Authority (Mallee CMA), with The Arthur Rylah Institute for Environmental Research (ARI), is developing long-term monitoring strategies for the ecological component of the Victorian Murray Floodplain Restoration Project (VMFRP). These strategies and protocols will build upon experience and lessons learned through the ongoing TLM ecological monitoring programs, which include condition and intervention monitoring across several sites in the Mallee. The Mallee CMA has been implementing and coordinating TLM annual MER process since 2006.

These provide a routine process to:

- Establish a robust program logic to define the correlation between works and other inputs and identified outputs and ecosystem outcomes. This provides the basis for a suite of quantifiable ecological targets that are relevant to the specific site
- Monitor progress against those targets on a regular basis
- Evaluate the implications of the results for the operational parameters of the scheme
- Amend and adjust the operational arrangements to optimise performance and outcomes

Monitoring data is required to plan watering events, to optimise water delivery, to manage risks and to refine ecological objectives. The evaluation process involves analysing collected data and improving operations accordingly.

A detailed monitoring and evaluation plan for Hattah lakes North has been prepared for the site by Ecological Associates (SDL Floodplain Watering Projects: Monitoring and Evalutaion. Report AL045-1-B. Report for the Mallee CMA, 2014). Monitoring and evaluation will focus on the effects of local watering actions and include:

- Evaluating water use
- Measuring ecological outcomes
- Refining conceptual models and improving knowledge
- Managing risk

The Hattah Lakes North monitoring and evaluation plan identifies the agencies responsible for commissioning, reviewing and acting on monitoring data. The linkages back to decision-making will be described in the MER Plan.

Initial monitoring will provide a baseline of the existing status of the ecological objectives and outcome monitoring will measure progress towards these objectives and their targets. This information will inform the ongoing operations at the site. Over time the results of the outcome monitoring will test assumptions and monitoring data will assist with refining conceptual models and ecological objectives. Measures for each ecological objective of the supply measure for Hattah Lakes North are detailed in the Ecological Associated technical report (SDL Floodplain Watering Projects: Monitoring and Evalutaion. Report AL045-1-B. Report for the Mallee CMA, 2014). Monitoring data will identify emerging hazards and enable operation decisions to minimise risks.

Surface water flow and water quality monitoring will be implemented to ensure the water volume used and the water quality impacts of the project are recorded to appropriate standards and that informs management and operations.

Groundwater monitoring will also be implemented to ensure salinity risks are appropriately managed.

The final MER approach for this project will be informed by broader intergovernmental arrangements for Basin-wide monitoring and evaluation under the Basin plan. This measure is expected to contribute to the achievement of outcomes under two key Chapters of the Plan, namely: (i) the delivery of ecological outcomes under Chapter 8; and (ii) under Chapter 10, meeting the relevant sustainable diversion limit/s (SDLs), which must be complied with under the state's relevant water resource plan/s (WRPs) from 1 July 2019.

Both Chapter 8 and Chapter 10 of the Basin Plan are captured under the Murray-Darling Basin Authority's (MDBA) own monitoring and evaluation framework. Once specific Basin plan Chapters commence within a state, the state must report to the MDBA on relevant matters. This will include five yearly reporting on the achievement of environmental outcomes at an asset scale in relation to Chapter 8, and annually reporting on WRP compliance in relation to Chapter 10.

The participation in MDBA's reporting and evaluation framework will effectively allow for progress in relation to this project to be monitored, and for success in meeting associated ecological objectives and targets to be assessed.

Community Consultation Communication

The Hattah Lakes Icon Site has a Communication and Engagement Strategy and a Targeted Communication Plan specific to the site (The Regional Development Company, 2010). These documents will be developed during Stage 2 works for the Hattah Lakes North project.

Information provided to the media regarding watering actions must be carried out in accordance with The Living Murray Communication Protocol.

As the Icon Site Manager, the Mallee CMA is committed to establishing and maintaining strong relationships within the local community during watering operations. A vital tool in the consultation process is structured engagement with the community through engagement with key stakeholders and advisory groups.

Indigenous Engagement

Indigenous stakeholders are consulted to ensure the Indigenous community has an opportunity to provide input into water management and a chance to raise and identify their cultural and spiritual links to the lakes. These stakeholders are representatives of each of the Aboriginal parties who have a vested interest in the lakes.

Indigenous consultation is managed via the Mallee CMA TLM Indigenous Facilitator and through the Mallee CMA Aboriginal Reference Group. This group provides a valuable single source for Indigenous engagement, advice, input and recommendation.

The reference group has Indigenous representatives who ensure that cultural heritage and values are considered and incorporated by the Icon Site Manager. The representatives also distribute information about Icon Site management into the Aboriginal communities.

The development of an Indigenous engagement framework will be developed during Stage 2 works.

Adaptive Management and Reporting

A comprehensive risk management strategy will be developed for the Hattah Lakes North project. This strategy will cover ecological and socio-economic aspects to provide a structured and coherent approach to risk management for the life of the project (i.e. construction and operation).

Risk assessment and management is not a static process. Regular monitoring and review of the risk management process is essential to ensure that:

- Mitigation measures are effective and efficient in both design and operation
- Further information is obtained to improve the risk assessment
- Lessons are learnt from events (including near-misses), changes, trends, successes and failures
- Risk treatments and priorities are revised in light of changes in the external and internal context, including changes to risk criteria and risk itself
- Emerging risks are identified.

Appendix 1: Basin Plan objectives summary

The Basin Plan objectives have been summarised as follows:

1. To protect and restore a subset of all water-dependent ecosystems in the Murray-Darling Basin ensuring that:

   Declared Ramsar wetlands that depend on Basin water resources maintain their ecological character; and

   Water-dependent ecosystems that depend on Basin water resources and support the lifecycles of species listed under the Bonn Convention, China-Australia Migratory Bird Agreement (CAMBA), Japan-Australian Migratory Bird Agreement (JAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) continue to support those species; and

   Water-dependent ecosystems are able to support episodically high ecological productivity and its ecological dispersal.

2. To protect and restore biodiversity that is dependent on Basin water resources, including by ensuring that ecosystems are protected and, if necessary, restored so that they continue to support those life cycles

   a) Water-dependent ecosystems that:

      Depend on Basin water resources; and

      Support the lifecycles of listed threatened species or listed threatened ecological community, or species treated as threatened or endangered in State or Territory law.

      Representative populations and communities of native biota are protected and if necessary restored.

3. That the water quality of Basin water resources does not adversely affect water-dependent ecosystems and is consistent with the water quality and salinity management plan.

4. To protect and restore connectivity within and between water-dependent ecosystems including by ensuring that:

   a) The diversity and dynamics of geomorphic structures, habitats, species and genes are protected and restored; and

   b) Ecological processes depend on hydrologic connectivity longitudinally along rivers, and laterally, between rivers and their floodplains (and associated wetlands) are protected and restored; and

   c) The Murray Mouth remains open at frequencies, for durations and with passing flows, sufficient to enable the conveyance of salt, nutrients and sediments from the Murray-Darling Basin to the ocean; and

d) The Murray Mouth remains open at frequencies, and for durations, sufficient to ensure that the tidal exchanges maintain the Coorong's water quality within the tolerance of the Coorong ecosystems' resilience; and

e) Barriers to the passage of biological resources (including biota, carbon and nutrients) through the Murray Darling Basin are overcome or minimised

5. That natural processes that shape landforms (for example, the formation and maintenance of soils) are protected and restored.

6. To provide habitat diversity for biota at a range of scales (including, for example, the Murray-Darling Basin), riverine landscape, river reach and asset class).

7. To protect and restore food webs that sustain water-dependent ecosystems, including by ensuring that energy, carbon and nutrient dynamics (including primary production and respiration) are protected and restored.

8. To protect and restore ecosystem functions of water-dependent ecosystems that maintain population (for example recruitment, regeneration, dispersal, immigration and emigration) including by ensuring that;

   f) Flow sequences, and inundation and recession events, meet ecological requirements (for example, cues for migration, germination and breeding); and

   g) Habitat diversity that supports the life cycles of biota of water dependent ecosystems (for example habitats that protect juveniles from predation) is maintained.

9. To protect and restore ecological community structure and species interactions.

10. That water-dependent ecosystems are resilient to climate change, climate variability and disturbances (for example, drought and fire).

11. To protect refugia in order to support the long-term survival and resilience of water-dependent populations of native flora and fauna, including during drought to allow for subsequent re-colonisation beyond the refugia.

12. To provide wetting and drying cycles and inundation intervals that do not exceed the tolerance of ecosystem resilience or the threshold of irreversible changes.

13. To mitigate human-induced threats (for example, the impact of alien species, water management activities and degraded water quality).

14. To minimise habitat fragmentation.

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