
Phase 2 MDBA Analysis - Existing TLM works and measures: Koondrook-Perricoota

Foreword

Under the Basin Plan a measure must meet particular criteria to be considered as a supply measure for the purposes of the SDL adjustment mechanism. Under the Basin Plan (cl.7.03 and (cl.7.15) a supply measure must:

- operate to increase the quantity of water available to be taken in a set of surface water SDL resource units compared with the quantity available under the benchmark conditions of development;
- achieve equivalent environmental outcomes with a lower volume of held environmental water than would otherwise be required; and
- have no detrimental impacts on reliability of supply of water to holders of water access rights that are not offset or negated.

The Living Murray projects have been modelled as part of the MDBA's trial implementation of its ecological elements method, and the results indicate that the projects meet the above criteria.

Koondrook-Perricoota Summary:

In 2003 The Living Murray Program began developing the Koondrook-Perricoota works project. The project is part of the Living Murray Initiative and is funded by the Australian Government, New South Wales, Victoria and South Australia through the Murray–Darling Basin Authority.

MDBA supports the Koondrook – Perricoota works as meeting the Phase 2 criteria.

Koondrook-Perricoota Forest is a highly significant floodplain ecosystem on the River Murray in NSW. The Koondrook-Perricoota Forest is a large mosaic of river red gum (*Eucalyptus camaldulensis*), black box (*E. largiflorens*) and grey box (*E. microcarpa*) communities, interspersed by wetland ecosystems in New South Wales. Covering 32,000ha the state forest (Crown land) is managed by Forests NSW and is listed on the Register of the National Estate. As part of the First Step for the Living Murray Initiative, the following ecological objectives were established for the Koondrook-Perricoota Icon Site:

Maintain and restore a mosaic of healthy floodplain communities as indicated by;

- 80% of permanent and semipermanent wetlands in healthy condition
- 30% of river red gum forest in healthy condition
- successful breeding of thousands of colonial waterbirds in at least three years in 10
- healthy populations of resident native fish in wetlands.

The development and implementation of the Koondrook-Perricoota Forests Flood Enhancement project has proceeded through a number of agreed phases with several plans:

- *The Living Murray - The Gunbower, Koondrook-Perricoota Forest Icon Site Environmental Management Plan 2006-2007.*

- *Note that Ministerial Council 46 endorsed the TLM works special account budget in November 2008 (refinement of the original budget approved in November 2003). The Ministerial Council on 12 June 2009 approved the budget for Koondrook-Perricoota.*
- *NSW Office of Water and Forest NSW – Koondrook-Perricoota Forest Flood Enhancement Project Submissions Report and Preferred Project Report June 2010*
- *Koondrook-Perricoota Forest Flood Enhancement Works Environmental Assessment 2010*
- *Koondrook-Perricoota Environmental Water Management Plan, February 2012*
- *Koondrook-Perricoota Forest Flood Enhancement Works - Operation Plan– 2012*

TLM works are operated in the context of strong co-operative governance arrangements, and control and ownership of the works is clear. Operation of the works is supported by appropriate operational planning, monitoring and reporting. Stable arrangements are in place for on-going resourcing and administration of operation and maintenance costs, with ongoing costs funded through the Joint Venture program, as part of the overall River Murray assets program. Environmental water use at Koondrook-Perricoota is considered in the wider TLM annual water planning process, which is responsive to changes in water resource conditions, opportunities and environmental priorities as the season progresses. Risks have been collectively assessed and addressed through the TLM governance processes and robust treatments and mitigations put in place. Residual risks are acceptable.

In order to assist the Phase 2 evaluation the following and Table 1 describes each work, with key SDL information, variations and status.

The project through its plans has developed the best fit between the hydrologic requirements of the forest and the current broad system operations/opportunities. The operation¹ of the scheme will occur in two modes, or a hybrid of:

- **Mode 1:** *Operation of the structures primarily for ecological outcomes. This occurs during ‘managed’ events where all inflows are directed into the forest from the Torrumbarry weir pool via the inlet channel. The flow downstream of **Torrumbarry Weir will be less than 18,000 ML/day.***
- **Mode 2:** *Operation of the structures to pass flows through the forest. This occurs during ‘overbank’ events where inflows occur via Swan Lagoon and other effluents, primarily downstream of Torrumbarry weir. Overbank events will occur when flows downstream of **Torrumbarry Weir exceed 18,000 ML/day.***

Hybrid events²: *In all likelihood overbank flows may occur in combination with managed flows (Mode 1 and Mode 2). These events are termed ‘hybrid’ events and operation will need to swap between the two modes. Modelling suggests that the majority of flood events will be hybrid events. The largest managed flood event that the Scheme can generate is described in Chapter 6 as ‘Scenario 4’ and is the event upon which the Environmental Assessment (GHD, 2010) was based. This event delivers inflows of 6,000 ML/day and is capable of inundating up to 16,000 ha (approximately 50% of the forest) as a maximum peak with greater than 10,000 ha inundated for over 90 days. The maximum maintainable managed inundation is approximately 41% of the Forest (around 13,100 ha) for a period of about 100 days. More extensive and/or floods of longer duration may be possible in combination with large overbank events.*

¹ Koondrook-Perricoota Operating Plan (P21). This is a working document with modes will be refined over time.

² Koondrook-Perricoota Operating Plan (P22).

Within the two operating modes Koondrook-Perricoota has four scenarios³ that target:

- Scenario 1 WETLANDS- A low flow (2000ML/day x 42 days;) targeting wetland health or targeting refugia. Event water use 90,000ML (gross) with maximum inundation estimate of 8,000ha.
- Scenario 2 REDGUMS – Pulse of water (6000ML/day x 26days) aimed at providing emergency watering to River redgum communities, or as a pre-wetting flow prior to an overbank event. Event water use 216,000ML (gross) with maximum inundation estimate of 16,000ha.
- Scenario 3 BIRD BREEDING /FISH – Low Flow with extended duration of flooding (2000ML/day x 30 days, then 500ML/day for 60days) for waterbird breeding or spawning of native fish. Event water use 101,250ML (gross) with maximum inundation estimate of 6,700ha.
- Scenario 4 REDGUMS – 100 day flood to the forest (6000ML/day x 24 days, with 2600ML/day x 56 days). Event water use 369,100-420,000ML (gross) with maximum inundation estimate of 16,000ha.

The structures have been built and partially commissioned by NSW Water and MDBA River Murray Operations⁴. However, during the development of the scheme outflows were established and approved by NSW planning at: Barbers regulator (250ML/day during regulated conditions, or 500ML/day⁵ during “managed hybrid events”) with Calf, Cow and Thule Regulators (0ML/day). At the time the outflow restriction was aimed at limiting third party impacts downstream, yet these limitations now significantly impact the scheme’s intended function and capabilities. More specifically, during managed periods the scheme’s inflows will be considerably constrained by the scheme’s ability to maintain the required discharge and its ability to manage the associated risks (broadly described in Table 2).

In August 2014, TLM commenced a small commissioning of Koondrook-Perricoota Forest, with 26.6GL (gross) of regulated water being delivered through Inlet above Torrumbarry Weir⁶. The commissioning was successful and environmental outcomes were: inundation of ~4,200ha with a positive ecological response from wetland vegetation and fish passage. During the commissioning, several important lessons were learnt:

- Due to the scheme’s approvals the commissioning had to be reduced to 26.6GL over 60 days (11/8/2014 to 13/10/2014) to avoid low dissolved oxygen and blackwater in the forest and to the Wakool River.
- Flow through the forest progressed slower than initial modelling indicated and losses were higher. As a result outflows to Barbers Creek were lower than expected and did not reach Sandy’s bridge or the Wakool. Refinement of the model has allowed for better calibration with these flows. This learning will need to be understood within SDL modelling.
- As anticipated some small areas of private land were inundated in the upper forest, at an inflow of 500-1,000ML/day. This is being discussed with landholder and will need to be resolved before flows are increased upward to 6000ML/day (Inlets full supply level).

³ For demonstration purposes the information below excludes ramp up and ramp down periods ML/day.

⁴ Koondrook-Perricoota Forest Flood Enhancement Works Operation Plan, P21

⁵ NSW Industry and Investment (Business Case for Downstream Flows, P13)

⁶ Koondrook-Perricoota Commissioning report (in development) & Koondrook-Perricoota Operational Committee (KPOC)

- The forest structures are managed by NSW Water. Some issues around liability during operation have emerged and the MDBA, in conjunction with partner governments, is exploring options to provide for the effective delivery of environmental water.

Given the scheme's restrictions, it is now unlikely that scenario's 1-4 in the operating plan can be achieved, as this water cannot be delivered and released in a timeframe that will not adversely affect the forest ecosystem. It is more likely that much smaller inflows (with shorter durations) will be matched to the current schemes outlet capacity of 250ML/day over several months. In consulting with TLM, a managed event may only be able to increase to approximately 65,000ML and remain within acceptable risk levels. This is well short of the gross volumes indicated in the operating plan scenarios of 90,000-420,000ML per event with 6,700-16,000ha inundated up to 100 days.

There are additional modelling related differences that require recognition in the SDL adjustment process.

- Generally the current SDL adjustment modelling categorises watering events as large over-bank or hybrid events (Scenario 1, 3 or 4) where flows would pass through the system relatively unrestrained. Scenario 2 is assumed within scenario 4.
- Current SDL adjustment modelling has estimated Barbers creek outflows to be 400ML/day, whereas current operations has a restriction to 250ML/day during regulated conditions, or 500ML/day⁷ during "managed hybrid events".
- In the SDL adjustment modelling, it is assumed that managed TLM water will be released up to 400ML/day to Barbers Creek when the Koondrook-Perricoota works are operated in conjunction with any natural overbank flow (which is most of the cases under the Basin Plan) then the release rate will be bigger than 400ML/day.
- The SDL adjustment modelling inundation is between ~ 8,400⁸ to 15,200⁹ha, whereas with the scheme's restrictions this inundation will reduce significantly. In 2014 the first commissioning reduced inflows to manage risks with inundation of approximately 4,200ha.
- In the SDL adjustment modelling, there are no indices that recognise negative environmental impact, such as an increase in inundation to blackbox/grey box occurring at the end of the KP forest, or negative impact from restrictions at Barbers creek.
- The River Murray return flows at Crooked Creek regulator only engages minimally under high flow events or when water backed up from the bottom end (~20kms). It may be that estimated return flows will need to be revised once flows are better known.

It is also important to note that NSW Return Flows policy remains an unresolved issue. This means that in general return flows from the forest cannot be re-credited/re-used back for environmental water holder. Currently this issue is being raised as part of the Pre-requisite Policy Measures.

Incorporating TLM learnings:

Due to the 250ML/day limitation at the downstream outlet and the consequent impact on the scheme's ability to fully realise the potential benefits of the works, MDBA proposes to amend future SDL adjustment modelling for Koondrook-Perricoota. The proposed amendment will recognise that the scheme's inflows will be considerably constrained by the scheme's discharge ability. This change will result in less area inundated over a shorter period than what is represented in the trial SDL adjustment. More specifically, it

⁷ NSW Industry and Investment (Business Case for Downstream Flows, P13)

⁸ Scenario 3 bird breeding event

⁹ Scenario 4 100 day flood event

will reduce modelled scenarios from ~ 8,400¹⁰ to 15,200¹¹ha (90,000ML-420,000M up to 100 days) to approximately 4,200ha (60-90days 65,000ML).

In order to maintain the current estimate of the SDL adjustment potential for this project NSW will need to revise the proposal to include actions to address the issues that constrain outflows to below the modelled level of 400 ML/day.

However, it is also the view of the MDBA that NSW could contemplate developing a broader project which would allow higher outflow rates out of Koondrook-Perricoota forest (specifically at Barbers¹², Cow, Calf and Thule creeks estimated at up to 3000ML/day or more). By relaxing the constraint on inflow rates (by lifting the rate of allowed outflows) this could substantially improve connectivity and result in significant ecological benefits to the wider Edward-Wakool system. This would appear to create an opportunity to obtain a higher SDL adjustment from this project.

If this broader project is to be pursued the value of increasing outflows would need to be fully explored. Currently, there are a range of investigations underway looking at possible ways to improve the configuration of this project. This highlights:

- The importance of a package that investigates the project's optimised objectives and coordinates this with existing and future structures (regulators, fishways, road infrastructure easements, bank works) and water planning rules between systems.
- The need to have consistent public messaging through the development process with landholders and relevant agencies.
- The scoping of the project will need to consider:
 - The report *Business Case for Downstream Flows - Issue and option associated with third party impacts and fish passage from increased downstream releases*.
 - Current work being undertaken with MDBA on constraints and the broader constraint objectives.
- Any relaxation of the downstream constraints at Barbers, Cow, Calf and Thule regulators will need to offset impacts such as maintenance of private property access and inundation of low lying land.
- Impacts on upper forest landholders will also need to be resolved.
- Providing fish passage with investigations to determine the most appropriate structures that assist connectivity of small and/or large bodied fish.

¹⁰ Scenario 3 bird breeding event

¹¹ Scenario 4 100 day flood event

¹² Includes Barbers creek and Runner A of Barbers creek.

Table 1: List of TLM structures for SDL adjustment

Package	Works	Key purpose	Built under TLM program, commissioned	Variations or key comments for modelling	Key Links to other SDL projects
Koondrook-Perricoota (Upper forest)	Upstream Structure – Inlet Regulator	The Inlet Regulator was designed to deliver up to 6,000 ML/day from Torrumbarry Weir pool with a design pool level of RL86.05 m AHD +/- 0.05m.	Yes, partially commissioned.	See discussion in advice above.	Not at this stage unless projects submitted later.
	With Inlet regulator's fishway	The dual 'vertical slot' and 'Denil' structure provides functionality both for small fish which are expected from spawning events promoted by the watering of the Forest plus sufficient attraction flows through the Denil structure to allow the larger fish to also exit.	Yes, partially commissioned.	No comments post first commissioning.	Not at this stage unless projects submitted later.
	Inlet Channel and Turtle Ramp	The inlet channel carries inflow 4km into the Forest where it intersects Bullock Head Creek, which then conveys water through the Forest into the many smaller creeks, runners and channels. The channel is designed to convey a maximum of 6000 ML/day, and is also designed to shed water into the Forest north (downstream) of the River Road bridge to promote further distribution of flows to the Forest.	Yes, partially commissioned.	No comments post first commissioning.	Not at this stage unless projects submitted later.
	Swan Lagoon Regulators	<ul style="list-style-type: none"> Swan Lagoon Upstream – forms a control at its upstream connection to the Murray River with overshoot fish passage Swan Lagoon Downstream – forms a control at its downstream connection to the Murray River with overshoot fish passage 	Yes, partially commissioned.	No comments post first commissioning.	Not at this stage unless projects submitted later
Koondrook-Perricoota	Levee	A 40km levee of approximately 1.5m. The position of the downstream levee was selected to maximise the area of forest that will be	Yes, waiting on further commissioning	No comments post first commissioning.	Not at this stage unless projects submitted later.

(Downstream structures)		inundated, and minimise the area of private property affected. The western portion of the levee is located in the vicinity of the existing licensed levee protecting the town of Barham from floodwaters.	events to test levee.		
	Stop log regulators and by-washes	Located on Barber Creek, Cow Creek, Calf Creek, Runner A and Thule Creek. Close access across downstream floodways, but maximise water area for a natural flood.	Yes, partially commissioned. By-washes not constructed.	No comments post first commissioning.	Not at this stage unless projects submitted later.
	River Murray Return regulator and channel – Crooked Creek	The return regulator and channel conveying water back to the Murray River.	Yes, partially commissioned.	Barber’s Creek outlet limited to 250ML/day by NSW. Thule outflow 0ML/day under NSW planning	Not at this stage unless projects submitted later.

Table 2. Ecological risks described in project – Business case for downstream flows (Issues and option associated with third party impacts and fish passage from increased downstream releases – Report to the Koondrook-Perricoota Project Board Dec 2014.

Ecological risks arising from ponding on the floodplain

Natural flooding transports carbon from the floodplain into the river system. Carbon-rich water can become oxygen-depleted and cause death to fish and other aquatic fauna. Hypoxic water (also known as blackwater) is more likely to develop under limited outflow scenarios due to increased water depth, higher water temperatures and an increased concentration of organic material. Local communities are particularly sensitive to blackwater due to their interest in recreational fishing, and the occurrence of fish deaths in recent years.

Natural floods benefit native fish by providing connectivity between river systems and between rivers and the floodplain. This enables fish to access additional foraging and breeding habitat. When the downstream regulators are used to control outflows, fish are unable to pass upstream through the structures, despite the cue provided by the flooding. Structures that are closed prevent fish passage in both an upstream and downstream direction.

Floodplain flooding benefits exotic fish species such as Common Carp by providing suitable breeding and foraging conditions. Holding water on the floodplain for extended periods is expected to provide more favourable conditions for Carp than would occur in a natural flow-through event.

Regular, deep pooling within the forest is likely to drown understorey plant species and replace them with wetland species. River Red Gum seedlings and flood-dependent understorey species germinate naturally in spring and early summer following the recession of floodwaters. Understorey vegetation is not expected to grow in the parts of the pool that persist into late summer.

Natural flows rise and fall. Despite the relatively stable status of the Barber Creek, release of flows at a constant rate over many months is likely to contribute to notch development and channel widening along the length of the creek. Geomorphic assessments of the Barber Creek in 2010 and 2011 have already identified minor notch development and channel widening occurring within the regulated section of the Creek. Geomorphic consultants have recommended that the release rate from the Forest be varied to mitigate the risk.

Finally, ponding water within a natural flow-through system constitutes a major obstruction to the natural carbon dynamic processes. Ponding on the floodplain is likely to deprive downstream systems of essential carbon and nutrients as these will be processed within the forest rather than being exported downstream.