Australian Government

MURRAY–DARLING BASIN AUTHORITY

River management–
challenges and opportunities

25 November 2011

Disclaimer

This document has been prepared by the Murray-Darling Basin Authority for general use and to assist public knowledge and discussion regarding the integrated and sustainable management of the Basin's natural water resources. The opinions, comments and analysis (including those of third parties) expressed in this document are for information purposes only. This document does not indicate the Murray-Darling Basin Authority's commitment to undertake or implement a particular course of action, and should not be relied upon in relation to any particular action or decision taken. Users should note that developments in Commonwealth policy, input from consultation and other circumstances may result in changes to the approaches set out in this document.

Introduction

Central to the implementation of the Basin Plan in the lead-up to the 2015 review point is consideration of how existing river management arrangements and environmental works and measures could be addressed to improve the efficiency and effectiveness of delivering environmental water.

The purpose of this paper is to facilitate a common understanding of some of the challenges and opportunities related to river management identified by the MDBA and to initiate discussion on a way forward to further develop some or all of the opportunities presented.

Currently there are a number of barriers – some physical, some policy based - that constrain the outcomes that could otherwise be achieved by the Basin Plan when it is in place. The modelling undertaken to inform the draft Basin Plan's development indicates that while, generally instream and riparian objectives can be achieved, in some cases those that involve watering on floodplains cannot be fully met under current operating arrangements due to physical and operating constraints. Moreover, the entitlement framework currently in place in the Basin has been developed around the characteristics needed to achieve consumptive outcomes, whereas those needed to achieve environmental health are quite different.

This paper presents some strategic opportunities where focused effort could overcome these challenges. These opportunities can be divided into two categories - integrated solutions at strategic locations in the Basin and issues related to the current entitlement framework. Some of the opportunities identified in this paper may also have the potential to deliver water savings through enabling the same or better environmental outcomes to be achieved with less water. The period leading up to the implementation of sustainable diversion limits in 2019 provides time to explore opportunities for water savings that might provide a basis for increases to sustainable diversion limits (SDLs) ahead of their implementation. There would however be a need for a robust verification process to ensure changes to SDLs are not to the detriment of the environmental outcomes targeted by the plan.

In identifying opportunities, the MDBA is not advocating particular solutions. Rather it is intended that this paper assist the consideration of the various bodies of work underway, as well as discussions about what measures might complement the Basin Plan (when made) through a broader strategy for the basin.

Examination of the opportunities identified would need to include careful consideration of any implications for consumptive users, for land managers and residents that could potentially be affected by changes to river management and for the environment. Communities and state governments may wish to be able to explore options that potentially change some characteristics of entitlements, particularly where the result is that less water would need to be recovered. To do so broadens the choices that are available. This exploration should however be undertaken within the context of the Commonwealth's commitment to bridge the gap without impacting on entitlement reliability.

The implications for and interaction with water trade and water purchase would also need to be carefully considered, as would the interaction with any future market-based reforms that may occur.

Examining these opportunities further should involve close consultation with stakeholders. The proposed Basin Plan implementation timetable means that there is now an opportunity for this to occur ahead of implementation of SDLs in 2019 - enabling a solution focussed 'localism' approach.

This paper is not intended to duplicate the significant current efforts of all parties involved in ensuring that river management arrangements deliver environmental and consumptive outcomes and the demonstrated ability to respond to new challenges.

It is suggested that progressing the opportunities identified should not be a new body of work, rather that this occur through existing reviews and programs. There are already significant work programs underway related to dimensions of the challenges and opportunities identified in this paper - not least the current review of the Murray-Darling Basin Agreement, the River Murray System Operations Review and the work involved in managing The Living Murray portfolio. In examining challenges and potential opportunities, these linkages to existing work have been identified.

This paper is divided into the following sections:

- Context
- Challenges
- Opportunities for discussion
- Considerations
- Progressing the opportunities identified

Context

This paper was developed as background information for initial discussions between MDBA, Commonwealth and state and territory governments on the potential for changes in river management arrangements to achieve better consumptive and environmental outcomes, including potential increases to the Basin Plan's SDLs. This issue was identified by the Windsor Inquiry[1], Productivity Commission[2] and during feedback on the *Guide to the Proposed Basin Plan*.

At the first meeting of the Legislative and Governance Forum of the Murray-Darling Basin held on 4 November 2011, Murray-Darling Basin water ministers discussed this paper and noted that a work program to assess the potential for new and revised arrangements would now be developed.

To the extent that the opportunities identified in this paper would enable the same or better environmental outcomes to be achieved with less water, the proposed 2015 review of SDLs would enable this to be taken into account through increases to SDLs before their implementation in 2019. Any amendment to the plan would need to be made in accordance with the statutory consultation processes outlined in section 46 of the *Water Act 2007 (Cth)*.

[1] House of Representatives Standing Committee on Regional Australia 2011, *Of drought and flooding rains: Inquiry into the impact of the Guide to the Murray-Darling Basin Plan*, The Parliament of the Commonwealth of Australia, Canberra, available online at: http://www.aph.gov.au/house/committee/ra/murraydarling/report.htm

[2] Productivity Commission *(2010), Market Mechanisms for Recovering Water in the Murray-Darling Basin - Research report,* available online: http://www.pc.gov.au/projects/study/water-recovery/report

Actual increases to SDLs would need to be verified through a robust process to examine the interaction with environmental outcomes.

Challenges

In developing the draft Basin Plan, the MDBA has been cognisant of the tension between different elements of the plan and what can be achieved within the current water management arrangements in the Basin. The extended implementation timetable now provides an opportunity to examine some of these challenges.

Physical and operating constraints

Under current operating practices, overbank flows are treated as a problem to be avoided, due to the third party impacts that can occur and also due to the 'loss' of water that flows overbank that could otherwise be used for consumption. On the other hand, achieving overbank flows are critical to achieving environmental outcomes particularly those associated with floodplain connectivity.

Modelling of the environmental watering requirements on which the SDLs are based indicates that, in some cases, the environmental objectives that would otherwise apply at particular locations cannot be fully met due to constraints. As a result, not all of the environmental outcomes targeted by the draft Basin Plan can be fully realised under the SDLs currently proposed, and may not be fully achievable even with higher volumes of environmental water.

Constraints also limit connectivity between rivers, for example the connectivity of the Goulburn and Murrumbidgee Rivers to the River Murray. These constraints have implications for trade and water recovery.

Many of these constraints are based on physical obstacles such as headwork and channel capacity parameters. The adaptive management approach generally applied by river operators through the trialling and testing of different settings ensures the operating rules are optimal in terms of enabling water delivery within these physical constraints. This is supported and enabled by the codification of operating rules for the River Murray System.

However, in the absence of works and measures to enable delivery of large flows and the implementation of strategies to manage third-party impacts, as well as the reflection of changes in operating practices, not all environmental outcomes targeted for achievement through the draft Basin Plan can be fully realised.

One of the drivers for constraints is the risk of third-party impacts associated with overbank flows and resultant inundation of private land. Clearly it would not be acceptable for private property to be damaged as a result of active intervention without appropriate arrangements to manage that impact. At the same time however, not allowing overbank flows in some parts of the Basin limits the environmental outcomes that can be achieved.

The implications for and interaction with water trade and water purchase would also need to be carefully considered, as would the interaction with any future market-based reforms should it occur.

Given the potential environmental benefits of enabling increased overbank flows, opportunity may exist for arrangements that deliver integrated landscape-scale changes that support better integration between economic production and environmental outcomes. The use of easements may provide one mechanism to achieve this. Opportunities at specific locations are considered later in this paper.

Policy constraints

The current entitlement regime has its origins in the characteristics needed for consumptive use, namely regular, secure supply from year to year. The characteristics needed for environmental outcomes are quite different as they are based on annual and seasonal variability. The multiple site environmental watering trial undertaken in 2010-11 using The Living Murray portfolio highlighted some of the challenges of achieving environmental outcomes using the existing entitlement framework. Current modelling assumes the ability to order a flow height from a specific storage for environmental watering and some ability to protect environmental flows instream so they can be used to water multiple sites. If these arrangements are not implemented, this will increase the risk of targeted environmental outcomes not being achieved. Strategies that provide for other characteristics, such as annual variability, would enable environmental outcomes to be achieved with the same or less water.

Opportunities

One way of approaching the challenges identified above is to consider areas where a focus of effort might deliver significant improvements in environmental outcomes. This could occur through an integrated package to address system constraints at strategic locations, and changes to the entitlement regime to provide for the characteristics of an environmental water portfolio.

It is suggested that central to any examination of potential opportunities should be consideration of the following broad objectives:

- increasing the degree to which the Plan's SDLs achieve their intended outcomes with the same amount of water (i.e. improving the effectiveness of environmental watering per given volume); and/or
- reducing the amount of water that needs to be recovered to achieve the targeted environmental outcomes and thereby increase the amount of water available for consumptive use.

While the MDBA is not advocating a particular solution, it has undertaken an initial examination of some of the opportunities that could be explored. The MDBA's view is that the following locations provide significant opportunities to explore integrated changes to operational rules, physical constraints or works and measures which may contribute to these objectives:

- Goulburn River (Vic)
- Lower Balonne (QLD)
- Murrumbidgee River (NSW/ACT)

- River Murray System, including:
    - Lower Lakes (SA)
    - The Riverland including the Chowilla floodplain (SA)
    - Menindee Lakes (NSW)
    - River Murray channel (SA/NSW/Vic)

The MDBA has identified these locations as having one or both of the following characteristics pertinent to achieving the broad objectives:

- their potential for changes to management settings to deliver significant water savings; and
- they contain constraints that are limiting factors on achieving environmental objectives.

Considerations relevant to each of these locations and some initial suggestions as to the potential opportunities that could be examined further are provided below.

A number of current work programs are examining the policy constraints relating to entitlement characteristics. This paper examines the opportunities to overcome these policy constraints in the context of the objectives identified above.

Murrumbidgee

Mundarlo Bridge

Issues

Releases from Burrunjuck and Blowering reservoirs are limited to a flow of 30,000 megalitres per day (ML/d) at Gundagai based on the risk of flooding Gundagai and Mundarlo Bridge. Because of this limit, held environmental water cannot be used to contribute to flows above 30,000 ML/d.

Overbank flows of 30,000 ML/d or more are important for local environmental needs and in-catchment health. Without being able to contribute to these high overbank flows, some of the environmental outcomes of the draft Basin Plan cannot be fully achieved. This constraint also limits the effective delivery of water from the Murrumbidgee to the Murray to meet downstream environmental needs.

If this constraint was addressed, there may also be a need to increase the valve capacities to allow for greater releases from the dams.

Opportunities

Raising Mundarlo Bridge and taking actions to protect Gundagai from flooding could allow for increases to the maximum flow that is permitted to be released from Burrunjuck and Blowering reservoirs. Ordering higher flows would improve the environmental outcomes achievable within the Murrumbidgee catchment.

As is the case throughout the Basin, raising the bridge might remove one channel capacity constraint, but further constraints along the river reach, such as the impacts of inundating private land, may subsequently need to be resolved before higher flows can be delivered to achieve better environmental outcomes in the Murrumbdigee. Further environmental issues such as the impacts of higher flows on riparian erosion and bank slumping would also need to be considered when addressing this issue.

In order to achieve a flow of 9,000 ML/d or more at the junction with the Murray under regulated conditions, river operations must maintain flows of 30,000 ML/d for four days from Gundagai, depending on the antecedent conditions. This is the maximum that can currently be delivered. If issues downstream of Balranald were also addressed, and environmental water could be protected as it flows from the Murrumbidgee into the Murray, this could effectively increase the rate at which water can be delivered through regulated releases to the Murray for watering of downstream sites.

The Works and Measures Feasibility Program for the Upper Murrumbidgee incorporates an environmental flow enhancement sub-project. This sub-project has been given in principle support and will investigate the feasibility of raising the operational flow limit at Gundagai to allow improved environmental outcomes for mid-river wetlands from Wagga Wagga to Hay. The investigation will include the potential for this to provide environmental water efficiencies and will identify the need for complementary actions such as the purchase of easements. Upon execution of a formal agreement there will be 16 months to complete the feasibility project. Preliminary work has commenced with the development of a scoping paper. The project will consider the opportunities for a range of flows above 30,000ML/day to be considered depending on consideration of costs and benefits.

Potential outcomes
Raising Mundarlo Bridge could allow higher flows to be delivered in the Murrumbdigee catchment, significantly improving the environmental outcomes achievable by the Basin Plan, if this was combined with the protection of environmental flows from the Murrumbidgee to the Murray.

Lowbidgee Floodplain: Redbank to Balranald

Issues

Delivery of environmental flows from the Murrumbidgee to the Murray to contribute to outcomes at downstream sites, such as the Chowilla floodplain and the Murray Mouth, is limited to 9,000 ML/d, representing channel capacity. This is largely due to significant evaporation and seepage to the floodplain around Chapton's Cutting, and in the areas around Redbank and Balranald. While these large flows can be very beneficial to the local environment, the constant wetting which would be needed to deliver substantial volumes of water from the Murrumbidgee to the Murray would lead to inundation beyond that which may be desirable for local environmental needs. Constant watering could lead to water-logging of floodplain which requires a natural wetting and drying regime and other negative outcomes for the local environment.

Increasing the deliverable flow rate would allow more of the shared reduction for the southern Basin to be delivered from the Murrumbidgee, improving the environmental outcomes achievable downstream in the Murray.

Opportunities

Increasing the flows that can be delivered from the Murrumbidgee for use at downstream sites would require substantial changes along the Murrumbidgee. Works and regulators to raise the channel from Redbank to Balranald could conceivably increase channel capacity to 12,000 ML/d. However this would disconnect the Murrumbidgee River from its floodplain, reducing lateral connectivity in all but extremely large floods. Regulators may help to ensure the Lowbidgee floodplain can be watered at appropriate times, while water can be delivered past the Lowbidgee at other times.

However, reducing natural spilling onto the floodplain would still impact on the interaction between the biota of the floodplain and river. It may also impact on the graziers, private owners of red gum forest and organic farmers in the area, who rely on beneficial overbank flows. Any works which do not adequately mitigate these impacts risk undermining the outcomes for the local environment. In practice, any such works or measures would need to give thorough consideration to the risk of making significant local impacts for modest downstream environmental outcomes. If these impacts cannot be addressed, this option might not be practicable.

Water for Rivers, in conjunction with State Water and the NSW Department of Water and Energy, is undertaking a Murrumbidgee River Efficiency Project to examine river management and operations in the Murrumbidgee. The project will "investigate a range of options aimed at improving the measurement and monitoring of water flows and water use to a standard appropriate to the value of the water resource. It will also look at ways in which evaporation can be reduced, levels of service delivery can be enhanced and agricultural production and environmental river health can be sustained." [3] This project has already indicated that it will consider the protection of environmental flows in the Lowbidgee[4]. However, it may be beyond the scope of the project to examine effective delivery of water from the Murrumbidgee to the Murray to meet downstream environmental outcomes of the Basin Plan.

Any project which hopes to improve delivery of beneficial environmental flow regimes from the Murrumbidgee to the Murray would also need to consider policies for the protection of environmental flows to prevent held environmental water from being re-regulated into the consumptive pool once it reaches the Murray.

---

urrumbidgee River Efficiency Project, 2011, accessed online on 6 September 2011, available at: http://www.waterforrivers.org.au/projects/current/murrumbidgee.asp

[4] Murrumbidgee River Efficiency Project, 2011, accessed online on 6 September 2011, available at: http://www.waterforrivers.org.au/projects/current/murrumbidgee.asp

Potential outcomes
Controlling the amount of water which flows to the floodplain between Redbank and Balranald could improve connectivity between the Murrumbidgee and the Murray. If combined with policies for protection of environmental water, this may improve the flow regimes that could be delivered to meet downstream environmental outcomes. However this would need to include careful consideration of the potential negative impacts on the local environment associated with any works which disconnect the Lowbidgee floodplain from the river.

Goulburn

Eildon

Issues

Release of environmental water from Eildon Dam is formally limited to 10,000 ML/d to minimise inundation of private properties.

In addition, the releases from Eildon are limited, so that the sum of the natural inflows between Eildon and Seymour and the regulated release from Eildon cannot exceed 12,000 ML/d, also to minimise inundation of private property. Pre-releases to prevent the reservoir from spilling may sometimes exceed this limit.

High overbank flows are necessary for achieving many environmental outcomes, particularly for floodplain and riparian health. The hydrologic modelling used to assess the expected environmental outcomes of the draft Basin Plan assumes the limit of 10,000 ML/d on flows from Eildon will remain and that the sum of inflows between Eildon and Seymour will remain limited to 12,000 ML/d. This limits the environmental outcomes that can be achieved within the Goulburn and limits the environmental flow regimes that can be delivered from the Goulburn to the Murray for downstream watering requirements.

Opportunities

Easements or other arrangements with landholders could allow flows to increase significantly, at least up to 22,000 ML/d. This could significantly improve the environmental outcomes which could be achieved within the Goulburn catchment.

Flows for downstream environmental watering may still be limited by the constraint at Shepparton, as outlined below, unless this constraint was also addressed.

Potential outcomes
Increasing maximum release rates in the Goulburn to allow delivery of higher environmental flows could substantially improve the environmental outcomes achievable by the Basin Plan.

Shepparton

Issues

Delivery of environmental flows from the Goulburn to the Murray to contribute to outcomes at downstream sites such as Gunbower–Koondrook–Pericoota and Hattah are limited to 20,000 ML/d. This represents a minor flood level at Shepparton.

Flow requirements for the Lower Goulburn of 30,000 ML/d, 45,000 ML/d and 60,000 ML/d cannot currently be met in part due to this constraint. These flows are needed to maintain the current extent of red gum forest and red gum woodland in good condition.

A recent study published by the Victorian Department of Sustainability and Environment suggests that, recognising the need to manage third-party impacts, flows of up to 40,000 ML/d may be possible. Flows of this magnitude would inundate "almost the full extent of each flood dependent EVC [Ecological Vegetation Class] in the study area, while avoiding the major risks and liabilities associated with environmental flow releases above this rate (such as inundation of private land)."[5]

Opportunities

Increasing flows past Shepparton may require works such as levees to prevent damage to the town, or raising flood-vulnerable roads. However the recent DSE study suggests that flows up to 40,000 ML/d would still avoid the major risks of inundating private land. [6]

Addressing the constraint at Shepparton would allow higher flows to be delivered, significantly improving the local environmental outcomes for the Lower Goulburn achievable under the Basin Plan. Higher flows would also improve the flows which could be delivered from the Goulburn to the Murray for environmental watering of downstream sites.

> ***Potential outcomes***
> Increasing the maximum flow past Shepparton would significantly improve the local environmental outcomes which could be achieved.

Murray

Hume Dam

Issues

Flow downstream of Hume Dam is limited to 25,000 ML/d under regulated flow conditions to minimise overbank flows. Overbank flows at this location would result in the inundation of agricultural land. The MDBA has, in managing the passage of floods in the past, inundated properties with flows above 25,000 ML/d without easements in close consultation with landholders, particularly in conjunction with pre-releases to avoid higher levels of flooding.

[5] DSE 2011, Overbank flow recommendations for the lower Goulburn River, Final Report by the Victorian Department of Sustainability and Environment, February 2011
[6] DSE 2011, Overbank flow recommendations for the lower Goulburn River, Final Report by the Victorian Department of Sustainability and Environment, February 2011

This constraint prevents the release of flows, or adding water to top up or enhance natural flows, above 25,000 ML/d to achieve environmental outcomes that require higher flow volumes. Floods cannot be actively enhanced above channel capacity without the third party impacts associated with inundating agricultural land.

As a result, under the current operating constraint flow requirements of 40,000 ML/d and 50,000 ML/d for watering the Gunbower–Koondrook–Perricoota and Barmah–Millewa Forests cannot be delivered through regulated releases of environmental water. Not being able to deliver high flows from Hume Dam also makes it harder to water downstream assets such as the Chowilla Floodplain or maintain appropriate flows at the Murray Mouth.

The modelling used to assess the draft Basin Plan's proposed SDLs assumes that this 25,000 ML/d limit on flows downstream of Hume Dam will remain.

Opportunities

Strategies to manage third party impacts such as purchasing easements and negotiations with landholders could increase the high-flow environmental outcomes achievable along this reach. However, there may still be constraints downstream to be addressed before environmental flows of 40,000 ML/d could be delivered to water sites downstream of Yarrawonga. For example, stretches of river downstream of Yarrawonga may have similar issues with inundation of agricultural land by environmental releases and may also need easements or agreements with landholders.

Preliminary MDBA investigations have indicated that purchasing easements between Hume and Yarrawonga to increase the flow from Hume Dam to 40,000 ML/d for environmental flows would be achieved at relatively modest cost.

Held environmental water could then be used to enhance events. Other options could include holding environmental water in storage in the Hume Dam to encourage Hume Dam to spill more frequently by increasing the water kept in storage.

Potential outcomes
Increasing maximum release rates from Hume Dam to allow higher environmental flows to be delivered could substantially improve the environmental outcomes achievable by the Basin Plan.

Menindee Lakes

Issues

Evaporation in the Menindee Lakes area is approximately 2.5 metres (average evaporation loss of 426 GL/y) a year.[7] The wide shallow areas of Lakes Menindee and Cawndilla are responsible for 60 per cent of the total evaporation loss from the Menindee Lakes storage.[8] Keeping water out of these

[7] SKM 2010, Darling River Water Saving Project Part B, Final Report to the Commonwealth Department of the Environment Water Heritage and the Arts and the NSW Office of Water, March 2010
[8] Podger and Close, 2010, Revised Darling Water Savings Options, Report to the Department of the Environment Water Heritage and the Arts, July 2010

two lakes, or minimising the time water is stored in these lakes, can provide significant water savings.[9]

However, simply cutting these lakes off and not storing water in them at all has impacts on entitlements and the security of town water supply for Broken Hill. This would also expose Indigenous remains in the area to wind erosion, and would not meet the environmental requirements of the draft Basin Plan for watering Lakes Menindee and Cawndilla as part of the Menindee Lakes key indicator site.

The draft Basin Plan assumes that current operating arrangements for the Menindee Lakes will remain in place.

Any change to how the Lakes are operated would be likely to affect the water sharing arrangements for the Lakes in the Murray-Darling Basin Agreement, particularly the point at which control of Menindee Lakes switches between NSW and MDBA control.

A number of options for reducing evaporation losses in Lakes Menindee and Cawndilla have been explored as part of the Darling River Water Saving Project. The options range from never filling either lake through to reducing use of Lake Cawndilla and using regulators and changes to the operation of the lakes to use them more efficiently. These options could lead to water savings in the order of 31-125 GL.[10]

Several of the options initially investigated include serious environmental consequences for the area around the lakes as well as for the supply of environmental flows to the Darling Anabranch. However there has been considerable work done since this original research. A 2011 CSIRO report[11] indicates that an option could be developed which may satisfy the environmental water requirements for Menindee Lakes targeted by the draft Basin Plan and create evaporative savings which could lead to an SDL increase for the Lower Darling of up to 174 GL. This option would need to include mechanisms for offsetting some impacts on downstream water users and providing secure water supply for Broken Hill.

Opportunities

Some of the options explored in the Darling River Water Saving Project may have unacceptable impacts on the environment, Indigenous values and water supply for irrigators and the local community. However, there are worthwhile options which are still being explored.

Another option could involve not using the lakes for water storage, but still allowing water to enter the lakes for environmental benefit and then flow out again to be reused for further environmental watering downstream.

---

[9] Podger and Close, 2010, Revised Darling Water Savings Options, Report to the Department of the Environment Water Heritage and the Arts, July 2010

[10] SKM 2010, Darling River Water Saving Project Part B, Final Report to the Commonwealth Department of the Environment Water Heritage and the Arts and the NSW Office of Water, March 2010

[11] Podger 2011, 'Darling Water Savings: Options for Environmental filling, No Impacts, Version 2', CSIRO, available online at: http://www.environment.gov.au/water/publications/action/pubs/darling-water-savings.pdf, accessed on: 17 Nov 2011

A further option could be to largely decommission Menindee Lakes as a storage for consumptive use and allow them to return to a largely natural wetland. This would affect those consumptive entitlements that rely on the Menindee Lakes Storage. However, it may be possible to offset these effects by purchasing these entitlements entirely or supplying these users using entitlements purchased in other storages. The urban water needs of Broken Hill may be able to be supplied from a pipeline from the River Murray instead of from Menindee Lakes.

An operating strategy that considers the environmental outcomes targeted by the draft Basin Plan could generate water savings through both reduced evaporation loss and enabling improved environmental outcomes to be achieved. It may also be possible to use water savings and improved operations at Menindee Lakes to increase contributions from Menindee and the Darling River for watering of downstream sites such as the Riverland floodplain and the Murray Mouth.

Potential outcomes
The water saving options explored in the recent reports that still meet the environmental outcomes of the draft Basin Plan could save in the order of 31-125 GL or more. This would be dependent on the option implemented and would still be subject to a full verification process.

Weir 32

Issues

Delivery of water from the Lower Darling is constrained by an operating rule that limits the maximum flow at Weir 32 to meet Murray and Lower Darling demands to the channel capacity of 9,300 ML/d. This rule is intended to prevent water entering the Great Darling Anabranch. This is because this is treated as a loss under current arrangements for the purposes of the delivery of consumptive water.

The modelling that has informed the draft Basin Plan assumes the limit of 9,300 ML/d on releases from Weir 32 will continue to apply, even for delivery of environmental water. This prevents environmental managers from ordering water to top up or enhance natural flows above 9,300 ML/d to achieve environmental outcomes which require higher flow volumes (e.g. inundation of floodplain). This constraint also limits the water that can be supplied from the Darling River to the Murray for watering of downstream sites such as the Chowilla floodplain and Riverland areas, and ultimately the Murray Mouth.

If the limit of 9,300 ML/d were to be removed, a further limit of 18,000 ML/d would apply. Flows of 18,000 ML/d or more could affect some properties, access routes and houses in the area. While these properties may be affected periodically by natural floods, actively releasing environmental water to enhance a flood is not possible as it would make the MDBA liable for increased damages caused by inundation of private land.

There are flow requirements for the Lower Darling of 17,000 ML/d for watering riparian river red gums, 20,000 ML/d for maintaining connectivity with the Great Darling Anabranch and 25,000 ML/d for floodplains, wetlands and lakes in the Darling Anabranch and Lower Darling River which could be achieved if this constraint was resolved.

Opportunities

The operating practice limiting flows to 9,300 ML/d could be ignored for environmental flows allowing releases of up to 18,000 ML/d. Flows up to 20,000 ML/d or more could be delivered if impacts such as inundation of private land, including impacts on houses, could be addressed through purchase of easements or agreements with landholders.

The 9,300 ML/d constraint is driven largely by the desire to avoid evaporation and seepage to the environment in the delivery of flows for consumptive use. However, evaporation and seepage to the environment is not necessarily a negative when delivering large environmental flows.

Managing water in this way would push water out of the channel onto the floodplain, so some water would benefit the local environment through seepage and evaporation on the floodplain, rather than being delivered to the Murray for downstream environmental watering.

At flows of 12,000 ML/d or more, some would also flow to the Great Darling Anabranch. For a large-scale environmental watering event, however, this might not necessarily be a problem, particularly as there is some requirement to provide environmental flows to the Great Darling Anabranch anyway.

In addition to the benefits to the local environment, increasing the flow height in this way would allow more water to be delivered to the Murray for watering of downstream sites, provided that water could be protected from reregulation to consumptive use when it reaches the Murray.

There is a risk that such large releases might affect availability for other water users. This risk could be mitigated if releases are timed with natural flow events to replace the water released from storage, or if only held environmental water is released.

Pushing water on to the floodplain by releasing flows above 18,000 ML/d may also introduce the risk of inundating agricultural land, access routes and houses. Easements or agreements with landholders might need to be negotiated with landholders to allow the inundation of properties. Levies or other flood-proofing measures may also be needed to protect houses from the effects of overbank flows and alternative access paths provided during periods of high flow.

Potential outcomes
Increasing the maximum flow permitted in the Lower Darling could substantially improve local environmental outcomes. If combined with protection of environmental water it could also allow higher environmental flows to be delivered from the Darling to the Murray, improving environmental outcomes downstream.

Riverland including the Chowilla floodplain

Issues

The Chowilla Floodplain and the larger Riverland Floodplain represent significant environmental demands under the draft Basin Plan, requiring substantial amounts of water from upstream for effective watering and inundation of the large areas of floodplain and wetland.

Modelling undertaken in preparing the draft Basin Plan indicates that flows for the Riverland–Chowilla floodplain of 45,000 ML/d, 80,000 ML/d, 100,000 ML/d and 125,000 ML/d are required. Under current arrangements it is difficult to achieve all but the lowest of these flows.

Delivering such large volumes of water from upstream storages is difficult. The most immediate upstream storage is Lake Victoria, whose capacity of only 600 GL compared with the 1,700 GL capacity of Menindee Lakes and the 3,000 GL capacity of Hume Dam. It is not practical to attempt to provide flows of 40,000 ML/d or more from Lake Victoria alone. There is also an outlet capacity constraint at Lake Victoria of approximately 10,000 ML/d.

A regulator at Chowilla to aid in the watering of the Chowilla Floodplain is under construction through The Living Murray Works and Measures program. This would hold water in Chowilla Creek and the Lock 6 weir pool. It is expected this will enable inundation of approximately 5,000 hectares of the Chowilla floodplain (out of a total floodplain area of 18,000 hectares), through regulated flows as small as 10,000 ML/d. This will be highly beneficial during long dry periods, where providing small maintenance flows for small areas is the only option available.

Works currently under consideration as part of the Lindsay Stage 2 project may also contribute to maintaining areas of floodplain during long dry periods.

Opportunities

Timing releases from several upstream storages such as Menindee Lakes, Lake Victoria and Euston Weir to arrive at the Riverland together could greatly help to achieve the high flows needed for the targeted environmental outcomes of the Riverland floodplain. This could be given effect through a strategy that includes Lake Victoria, Hume Dam, Euston Weir and Menindee Lakes, complemented by resolving constraints and providing increased connectivity between the Murray and its tributaries.

Any impacts on third parties would also need to be resolved before the Riverland floodplain could be inundated through release of held environmental water.

Potential outcomes

Resolving upstream constraints to allow higher flows to be delivered through the Murray and to increase connectivity between the Murray and its tributaries, combined with a strategy to coordinate releases from several upstream storages could potentially help to achieve the higher flows needed for achieving the environmental outcomes of the Riverland floodplain.

Some works currently under consideration, such as Lindsay Stage 2 and the Chowilla regulator may be able to help achieve environmental outcomes at low flows with a higher SDL.

Coorong, Lower Lakes and Murray Mouth

Issues

The modelling that has informed the current SDL proposal is based on water requirements for the Lower Lakes being met through the delivery of the upstream environmental watering. In this way, changes to the operation of the CLLMM are not likely to result in water savings.

As the current premise is that outcomes targeted for the CLLMM will be met in most years through flows delivered to achieve outcomes upstream, implications for the CLLMM should be examined in considering changes to arrangements upstream and return flow related policy changes, including environmental works and measures.

Consideration of greater variability of lake levels has been identified as a potential change in management for the Lower Lakes[12]; however, maintaining the lakes at particular levels has not been a driver for SDLs. Similarly, while the Lower Lakes pipeline has established an alternative water supply for irrigators and domestic users who were previously reliant solely on the Lower Lakes as a source of water supply, possibly relieving the need to maintain salinity in the lakes at levels suitable for consumptive use. However the salinity objectives for the lake for environmental purposes still apply.

The positive effect of the redirection of water from the Upper South East Drainage Scheme to the Coorong has been taken into account in the modelling.

Opportunities

The initial analysis outlined above indicates that there would be very limited opportunity to realise increases to SDLs as a result of changes to the management arrangements for the CLLMM.

Nonetheless, improved environmental outcomes may be realised through strategies such as increasing the number of automated barrage gates, which would enable gates to be open for longer when lake levels are lower to enable fish passage or large intensive flows in spring that could enable the barrages to be opened for longer.

[12] Government of South Australia, *Securing the Future - a long-term plan for the Coorong, Lower Lakes and Murray Mouth* (June 2010)

Implementation of the South Australian Government's plan for the CLLMM is progressing a range of management actions to improve environmental outcomes. The proposed development of the Lower Lakes (Barrage) Operating Strategy as part of the Operations Review may also provide an opportunity to examine these issues further.

Potential outcomes
Examining the operation and management of the CLLMM could help to improve environmental outcomes achievable by the Basin Plan, particularly if this was combined with the protection of environmental water in-stream to ensure that environmental flows travel all the way to the Murray Mouth and are not re-regulated for consumptive use along the way.

Lower Balonne

Issues

The Lower Balonne floodplain and the Narran Lakes represent some significant environmental demands in the draft Basin Plan. Narran Lakes is a Ramsar-listed wetland and is an internationally significant breeding ground for waterbirds. Watering Narran Lakes and the Lower Balonne floodplain are major environmental watering targets for the Basin Plan, requiring a relatively high level of reductions locally to achieve the Basin Plan's SDLs.

The Condamine–Balonne is characterised by high evaporation and relatively low connectivity. It is a largely unregulated system, with few instream dams to capture and store water. As a result of the low connectivity in this system, and the limited opportunity to re-regulate water from upstream in a downstream storage, water recovered in the upper reaches of the Condamine is unlikely to contribute significantly to environmental outcomes at Narran Lakes or the Lower Balonne floodplain. Consequently reductions from the Condamine–Balonne catchment will probably need to be concentrated in the Lower Balonne area, resulting in the recovery of a higher proportion of entitlements in this area.

Opportunities

Given the largely unregulated nature of the northern basin rivers, such as the Condamine-Balonne, it may be more important to target ecologically significant portions of flows in these rivers. This might be implemented by acquiring portions of entitlements within given flow windows, rather than recovering whole entitlements, with the agreement of entitlement holders.

Potential outcomes

It may be possible to lessen the economic and social impacts of a high density of water recovery in the Lower Balonne area by targeting the flow thresholds needed for environmental watering.

Entitlement framework

The entitlement framework of the basin is more than simply the conditions of the water entitlements themselves. The way storages and rivers are operated and managed, and the rights entitlement holders have to order water from storage when they want it, affect the utility of the entitlements. Currently this framework is designed primarily to meet the needs of consumptive water users. The environment uses water differently from traditional consumptive users, and as a result has needs that differ from those that underpin the current entitlement framework.

It is difficult to achieve flow regimes for environmental watering using only retail entitlements. Demands created by retail accounts have a limited capacity to drive river operations to achieve flow heights and duration of flow events as there is no obligation under the Murray-Darling Basin Agreement for river operations to consider retail entitlements during delivery.

If more permanent changes were made to improve the utility of environmental water entitlements, and this was combined with resolving some of the constraints and limitations mentioned previously in this paper, there could be a significant opportunity for improved environmental outcomes and increased SDLs. However, the Basin Plan modelling already assumes that some of these improvements, particularly the ability to order flow regimes, will be made. Without this ability there is a risk that some environmental outcomes will be difficult to achieve.

Currently, State government approval is required to deviate from historical river operations practice to provide these environmental watering characteristics. This approval has been obtained in some instances for watering under The Living Murray program, particularly the recent 'Achieving Multiple Site Environmental Waterings' program. However, the number of environmental uses for water recovered for the Basin Plan will make obtaining approval for every environmental watering event impractical.

Since April 2011 State governments, in conjunction with the MDBA, have been further researching and developing short, medium and long-term options and draft policies for multi-site watering while pursuing a limited number of practical short-term options that achieve the best possible outcomes.

In relation to the River Murray System, consideration of these issues is already being progressed through the 'Achieving Multiple Site Environmental Waterings' program and through the proposed project, 'Review of the management and delivery of environmental water under the Murray–Darling Basin Agreement', currently being considered by the Review of the Murray–Darling Basin Taskforce's committee.

To assist discussions about 'Basin reform', some of the key issues that have been identified through the 'Achieving Multiple Site Environmental Watering' program are outlined below, together with an examination of those particularly relevant to the objectives outlined earlier in this paper in relation to the draft Basin Plan.

The MDBA has been requested to identify characteristics that the environmental entitlements might ideally possess.. Recognising that solutions are likely to be different between valleys and river systems, the broad characteristics that the environment will require across locations are:

1. Environmental water available when, where and how it is needed;
2. Protection of water available for the environment; and
3. Water regulation and management which does not cause sub-optimal environmental outcomes.

Ensuring environmental water is available when, where and how it is needed will require:

a. River operations which can deliver environmental water effectively;
b. A suitable flow regime;
c. Increased variability between years;
d. Availability of water at different times of the year; and
e. Overcoming delivery impediments.

Protection of water available for the environment will require:

a. Protecting reliability of entitlements recovered for the environment;
b. Protection of environmental flows in-stream; and
c. Protection of held environmental water from the consumptive pool.

Establishing new rights, rules and or practices for environmental water may be required to achieve effective and efficient environmental watering with the water available.

Recognising the high level of inter-dependency between these characteristics, three opportunities have been identified as being able to deliver environmental outcomes and, in some cases, to provide water savings:

- inter-annual arrangements to provide for variability and for water to be available at the right time of year
- flow regimes
- protection of environmental flows in-stream

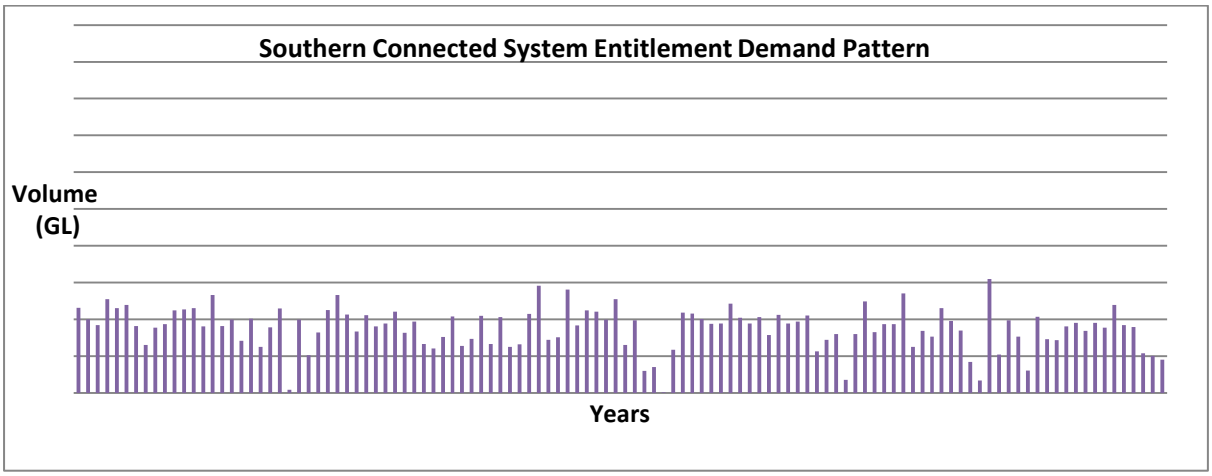
While the remainder of this paper focuses on these three dimensions due to their interaction with the draft Basin Plan, there is a significant degree of interaction with the other characteristics identified.

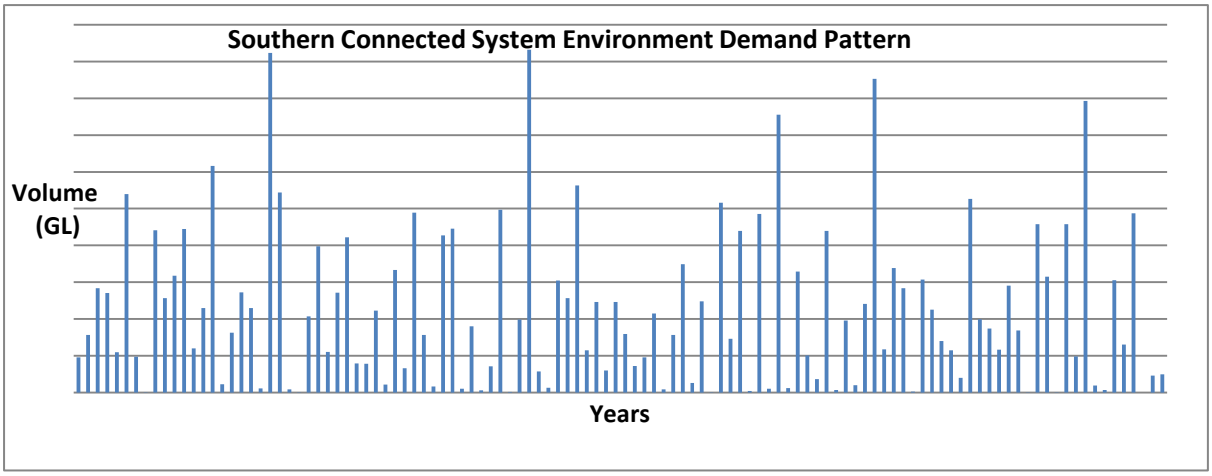
Inter-annual variability

Issues

Water entitlement regimes are designed to provide a regular, annual amount of water. However, the environment requires water episodically in large amounts. Effective environmental outcomes will require the reintroduction of variability.

The environment will typically require large amounts of water episodically in winter or spring. Irrigation typically requires water consistently in summer or autumn. The two graphs overleaf show the regular demand pattern that the entitlement framework is optimised for (in purple) and the more variable natural environmental demands (in blue).





The allocation year starts in July, with allocation announcements made cumulatively throughout the year to coincide with maximum allocation available to meet irrigator peak demand in summer and autumn. However, this leaves environmental water holders with little environmental water allocation in winter and spring, when the environment needs it most. Without carry-over or similar arrangements, at the end of the water year, any water which has been allocated to the held environmental water entitlements but has not been used (which may be because it was allocated too late in the year to be of use for environmental watering) is socialised back into the consumptive pool to be allocated across all entitlements in the next water year.

Opportunities

The 'banking and borrowing' arrangements currently in place for the Barmah–Millewa Forest Environmental Water Allowance provides an example of how arrangements that enable portfolio management from year to year can support improved environmental outcomes.

Current hydrologic modelling used to assess the environmental outcomes of the draft Basin Plan does not include any arrangements for inter-annual portfolio management. The spillable water accounts recently introduced in Victoria, the restricted carry-over arrangements available in some catchments in NSW and the operation of the new storage right for South Australia have not yet been included in the modelling or considered in the development of SDLs. However, it is expected that expanding the flexibility for inter-annual portfolio management, beyond that currently provided, and considering in more detail how current arrangements could be used, could allow for environmental outcomes to be met, without requiring as much water to be recovered from consumptive users, provided adequate environmental requirements could still be met during dry periods.

If changes to inter-annual portfolio management involve changes to how airspace in dams is managed, any resulting impacts on the reliability of existing entitlements would need to be discussed and resolved carefully.

Potential outcomes
The benefits of improved inter-annual flexibility for the management of environmental water portfolios, beyond that provided through existing limited carry-over arrangements, could deliver improved environmental outcomes. This is particularly true in the case of outcomes that require high flows in late winter and spring. This may provide a basis for SDL increases in the order of hundreds of gigalitres. Note that this would be dependent on what combination of arrangements is implemented, and SDL increases would be subject to final verification through a process to ensure that other environmental outcomes are not undermined.

Achieving flow regimes with environmental water

Issue

Entitlements are a volumetric extractive right; irrigators order a volume to be extracted at a location. The extraction can be taken regardless of the flow height (except under very dry conditions). However, the environment will require a suitable flow regime; that is the ability to create, maintain or extend a hydrograph for a specified duration.

But volumetric entitlements alone are a poor manipulator of river operations to achieve flow regimes, as the entitlement holder does not have the right to specify how the water is delivered. Under existing river operations, no entitlement holder has the ability to order water from their entitlement to be released on top of an unregulated flow, at a specific flow height or from a specific storage.

However, in the past some environmental watering has ordered a flow regime in this way with upfront, without-prejudice, agreement from the Basin states.

The ability to order a flow regime (including flow rate, duration and a specific storage) rather than a specific volume would allow environmental water holders to use environmental water more effectively by combining the release of held environmental water with natural unregulated flow events. Topping up a flow event in this way is a much more effective way of achieving floodplain and wetland inundation than attempting to create such high flows purely through the release of held environmental water.

Environmental water holders currently obtain flow regimes in a variety of ways:

- Agreement between the river system operator and the environmental water holder (e.g. 2011 environmental watering on the Goulburn).
- Debit flows on release from storage and risk re-regulation to consumptive users (e.g. 2010 environmental watering on the Murrumbidgee).
- Bilateral government agreement (e.g. memorandum of understanding on Shepherding in the Darling between the Australian Government and New South Wales).
- Agreement between governments on an event-by-event basis.

Opportunities

The hydrologic modelling used to assess the environmental outcomes of the draft Basin Plan assumes that it will be possible for environmental water to be ordered on top of an unregulated flow event. The model also assumes some ability to order flow heights rather than volumes and to order water from a specific storage. If these characteristics cannot be implemented, it could be very difficult to achieve some of the desired environmental outcomes of the Basin Plan. .

In addition to the current approaches outlined above, the following ideas have also been identified:

- considering passive environmental flow rules, which would increase natural flows in the Basin without requiring active management of each individual flow event. This could include translucency rules on storages, where a certain proportion of inflows are always released at certain times of year
- lowering the full supply level of storages could achieve much the same effect by allowing storages to spill more often due to natural inflows. These approaches would also require consultation with water users and negotiation between jurisdictions to determine how to address any impacts on the remaining entitlements.

Potential outcomes

The ability to order a flow regime rather than a volume and to combine this water with natural unregulated flows has already been assumed in the development of SDLs. If these characteristics cannot be implemented, it could be very difficult to achieve some of the desired environmental outcomes of the Basin Plan.

Protection of environmental flows in-stream

Issues

When held environmental water is released from a dam and used to water a site, some of the water will return to the river as outflows. Protecting these flows from re-regulation[13] to the consumptive pool and allowing the watering of multiple sites as the flow travels downstream could provide significantly better environmental outcomes and be a more efficient and effective use of environmental water.

The multiple use of environmental water was a presumption of The Living Murray First Step when that was agreed by partner governments. Multi-use watering is being explored in more detail through The Living Murray 'Achieving Multiple Site Environmental Waterings' program. Many of the issues arising through this program will apply equally to environmental watering under the Basin Plan.

The re-regulation of return flows is standard practice for River Murray Operations and is a component of the efficient regulation of the River Murray System for consumptive use. Deviation from this historical river operations practice requires approval from Basin states.[14]

Recent trials have attempted to use trade as a mechanism to protect return flows. Trade moves the extraction point for the water from one point to another, but it does not protect that water as it moves downstream. A more lasting solution needs to be agreed by Basin governments.

The Victorian entitlement framework provides for re-crediting of return flows which allows for some multi-site watering within the Victorian catchments. However the interaction of the Victorian framework with those of other states would need to be resolved for watering of sites in multiple jurisdictions to occur.

As a consequence of these issuesis the current characteristics of held environmental water portfolios will make it challenging to meet the environmental outcomes of the Basin Plan. In considering what SDLs are needed to provide an environmentally sustainable level of take, the MDBA has assumed that protection of environmental water will be possible. If some degree of protection is not agreed, it might be difficult to achieve the targeted environmental outcomes of the Basin Plan with the proposed SDLs.

Opportunities

Protecting environmental water as it moves through the system would allow it to be used more effectively to water multiple sites. If this was combined with addressing system constraints and inter-annual portfolio management, it may be possible to reduce the volume of water that needs to be recovered for the environment to achieve an environmentally sustainable level of take.

[13] Re-regulating refers to using return flows from any source (environmental or irrigation) to meet downstream demand or recapturing / holding it in a downstream storage.
[14] Clauses 30-33 of the Murray-Darling Basin Agreement

The 2010/11 multi-site environmental watering trial for The Living Murray (the multi-site trial) involved releases from Hume Reservoir to meet demand at South Australia, while achieving environmental watering en route. However, many of the issues arising from that trial are relevant to other multi-site watering scenarios, such as flows via Menindee or Lake Victoria, and will be relevant to environmental watering under the Basin Plan. The Australian and New South Wales governments are also collaborating on overcoming issues relating to multi-site watering (shepherding) in the Darling River.

Potential outcomes
Protection of environmental flows for reuse at multiple environmental watering sites as the water travels downstream has already been assumed in the development of SDLs. Without these characteristics it will be difficult to achieve the environmental outcomes of the Basin Plan.

Possible rules based and entitlement based treatments - some ideas to consider

Each of the three priority characteristics — inter-annual portfolio management, ordering flow regimes and protecting environmental water — could be addressed by a spectrum of improvements including:

- creating new entitlement products with new characteristics which apply to both consumptive and environmental entitlements
- changing the rules framework governing how entitlements can be used for environmental watering
- retiring retail entitlements in exchange for rules based environmental flows
- quarantining environmental water in storage and allowing it to spill.

An actively managed retail entitlement portfolio is the approach which is currently being assumed. This is the approach which most obviously and closely resembles the commitment to bridging the gap through water recovery from infrastructure savings and purchases from willing sellers. While this is an effective method to recover water, it is not necessarily the only, or the most effective, approach to using environmental water.

One advantage of this approach is that held environmental water entitlements can be traded in the same way as retail entitlements. Because environmental managers will mostly want large volumes of water during wet years when water prices are low, and smaller volumes in dry years when prices are high, there is some scope for counter-cyclical trade to provide a degree of flexibility in managing held environmental water portfolios.

However, there are a number of issues with characteristics of retail entitlements which limit their suitability for environmental watering. While some of these issues could be resolved by making changes to the entitlement products available, this may create perverse outcomes for the market if environmental entitlements are permitted to have more rights than consumptive entitlements. For example if environmental entitlements are permitted access to unrestricted carry-over, but consumptive entitlements are not. Making changes to rights for all water entitlements, both consumptive and environmental, may help resolve this issue but could still affect water use patterns and the water market and would need to be carefully considered.

One option which may be difficult to implement but could provide substantial benefits and resolve some of these issues would be to re-negotiate state water shares in the Murray-Darling Basin Agreement to provide a bulk water share for the environment. This would raise a number of issues which may be difficult to resolve, such as how to convert purchased entitlements into a share of flows and storage space without affecting existing entitlements while still preserving the security of environmental water entitlements. Issues such as how much of the unaccounted-for loss in the accounts should be shared with the environment would also need to be addressed. Recognition of the historic rights of consumptive users to access unregulated flows would also need to be recognised and addressed. However, if these issues could be worked through and resolved, the environmental water entitlements could then be managed in an integrated way at the bulk level, without being subject to the restrictions on retail entitlements that are designed for consumptive use. This could be a way of achieving some of the same outcomes that creating new market products would achieve, without as many perverse impacts on the market.

Another approach might be to allow the operational rules for environmental watering to differ from the rules for delivering water for consumptive use. Rules for environmental watering could be changed without changing the details of the retail entitlement. However, it should be recognised that changing the operational rules will change the framework in which the entitlement exists and may change the utility and value of the entitlement, depending on how these changes are made. While this is potentially very useful from an environmental watering perspective, it could reduce the ability to trade these entitlements. To maintain consistency with the National Water Initiative, some ability to trade between environmental and consumptive uses may need to be preserved. Rule changes may also affect some characteristics of other retail entitlements, for example reducing or improving reliability. Impacts on third parties, both positive and negative, would need to be considered and agreed to be acceptably addressed before any rules could be changed.

At the fully rules-based end of the spectrum one option might be to retire retail entitlements in exchange for rules-based environmental watering. This could include introducing translucency rules to storages to release a proportion of all inflows, or lowering the full supply level of storages or changing pre-release rules to increase the occurrence of spills or introducing flow event rules to restrict access to environmentally significant flows similar to those used in the Gwydir, Namoi, Border Rivers and Condamine–Balonne catchments. This approach would re-introduce a degree of naturalness to the river systems and encourage natural unregulated flow events that achieve environmental outcomes but do not need to be actively managed. This would need to be done in conjunction with resolving constraints and liability issues associated with increased overbank flows.

Environmental flow rules would also need to be agreed in a way that protected taxpayer investment in environmental water from pressure to suspend the rules during very dry or very wet periods when impacts on third parties are likely to be greatest.

The major limitation of this approach is the need for River Operations to mitigate floods through pre-releases, which results in less water being held in storage and fewer spills. Rather than pre-releasing water to prevent spills, an alternative way to address inundation caused by spills is to purchase easements, make agreements with landholders and flood proof towns.

However, such an approach may increase the risk to the environment during extended dry periods, especially in cases where dry periods are longer than would occur without diversions and storages. A portfolio of held environmental water entitlements may be able to assist during extended dry periods to help maintain refugia sites.

In practice, a combination of rules-based approaches and actively managed held entitlements is likely to offer the best environmental outcomes for the least amount of water to be recovered from the consumptive pool.

Considerations

Reliability of entitlements

The ongoing recovery of water through measures such as buyback is progressively decreasing consumptive demand for water. This has the potential to mitigate or offset reliability impacts for consumptive users if changes are made to the management of storages, and also provides the opportunity to explore alternative strategies for ensuring security of supply.

Nonetheless, many of the challenges identified above have a strong nexus with the reliability of existing entitlements. While the Commonwealth has made a commitment to not affect reliability, it is suggested that this need not preclude states and communities from examining options and choices that have reliability implications. Rather it is suggested this examination needs to be undertaken within the context of the Commonwealth government's commitment and that potential implications for reliability could be explored and consulted on with affected parties as part of any more detailed examination of the opportunities outlined later in this paper.

Transition

Interactions between the opportunities identified and other transitional measures, including water trade or the introduction of other market-based reform measures, would need to be carefully examined to ensure outcomes are not perverse from a social and economic perspective.

Basin features

Most of the opportunities considered in this paper are associated with the operation of storages. Due to the highly regulated nature of the Southern Basin, most of these opportunities are focused in the Southern Basin. By comparison, the Northern Basin has more natural flow regimes with less operational and physical constraints.

Due to the less regulated nature of the Northern Basin, a higher proportion of environmental water in the Northern Basin is likely to be planned environmental water or held environmental water in the form of unregulated entitlements. This water cannot be called from a storage to actively manage or create an environmental flow. As such, some of the entitlement framework issues, such as the need to order a flow regime, will not be as relevant in the Northern Basin. Others, such as the protection of environmental water instream will be just as important, if not more important. Conversely some opportunities, such as passive environmental watering based on environmental flow rules, might be easier to implement in the Northern Basin.

Interconnectivity is also a key consideration. Examination of these opportunities should include consideration of potential impacts on other environmental assets in the system. Reducing the flows required for one key ecological indicator site, might not reduce the requirements of other ecological assets and functions. In this way, consideration of the costs and benefits of a given opportunity would need to take into account the requirements of the whole system, not just a single location.

Work underway to examine these issues

Some work is underway which has the potential in part to achieve these aims. As part of work underway for a Basin state initiated review of the Murray-Darling Basin Agreement, the River Murray Systems Operations Review is currently undertaking the codifying of existing operating practices for the River Murray System, as well as examining specific operations at sites such as the Barmah Choke, Menindee Lakes Storage and Lower Lakes. This work also includes developing Operational Environmental Guidelines for the River Murray System. The guidelines provide the 'how' of river operations in terms of exercising operational flexibility to achieve specific environmental outcomes within agreed boundaries established by State governments to meet multiple objectives simultaneously. The review of the Murray-Darling Basin Agreement is also examining several issues identified by the states, as well as 'existing gaps, problems and anomalies' within the Agreement. The effective delivery of environmental flows is one of the issues under consideration in this context.

Concurrent with, but separate to, the existing review of the Murray-Darling Basin Agreement, the MDBA is also conducting reviews of the Agreement and several schedules as mandated by clause 142 and clause 152 of the Agreement.

Much work is also being undertaken by Basin governments to examine the management arrangements needed for strategic locations in the Basin, including investigation and consultation on options for changes to the operation of the Menindee Lakes System and review of the operations in the Murrumbidgee River.

In the River Murray System, experience in managing The Living Murray Program portfolio has enabled the development of a collective understanding of some of the limitations and issues related to entitlement characteristics. Consideration of this issue is being progressed in the River Murray System through the Achieving Multiple Site Environmental Waterings program.

To support the implementation of the draft Basin Plan's environmental watering plan when it is in place, the MDBA has commissioned a Review of Current Approaches to Managing Water for Environmental Benefit under the environmental watering plan program. This will assist in developing understanding of the arrangements both within and outside the River Murray System.