The Australian Murray–Darling Basin Plan: challenges in its implementation (Part 2)

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ABSTRACT
The most recent major water reform in the Australian Murray–Darling Basin occurred in November 2012 with the development of a new integrated water resources plan for the region (the Basin Plan). This occurred over a four-year period (2009–12). An equally challenging part of this reform is occurring now with the implementation of the Basin Plan between 2012 and 2024. This paper discusses the challenges in implementing the key tasks that must be completed in the longer term by 2024. A companion paper discusses the challenges in implementing the more immediate tasks that must be completed by June 2016.

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Introduction
The Murray–Darling Basin is one of the most productive agricultural regions in Australia covering one-seventh of the land area of the country. However, over the past century the increasing regulation of the river system, coupled with over-allocation of water for consumptive uses, has resulted in unacceptable ecological degradation, particularly in the southern part of the basin.

Recognition of this ecological degradation has lead to a number of water reforms in the basin, the most recent being the development of the Murray–Darling Basin Plan (Basin Plan), which became law in November 2012 (Australian Government, 2012). The Basin Plan represents an important advance in the integrated management of the basin’s water resources, and was the culmination of over four years of intensive work, capping off a long process of major water reforms in Australia (Hart, 2015).

When implementation of this first Murray–Darling Basin Plan is completed in 2019 (although some projects may not be completed until 2024), Australia will have achieved a remarkable transformation in the way the basin’s water resources are managed, and have achieved water reform the scale of which has not been accomplished elsewhere in the world. Overall, around 21% of the consumptive water will have been recovered for the environment. This is, however, not equally distributed over the basin, with 25% to be recovered in the
highly developed and regulated southern basin and 12% recovered in the less developed northern basin (Figure 1).

Details on the climate, water resources, agricultural production and ecology of the Murray–Darling Basin are provided in Hart (2015) and associated references.

Also the policy changes in the management of the basin’s water resources over the past 30 years, which ultimately lead to the development of the Basin Plan, are summarized by Hart (2015).

This and a companion paper (Hart, 2015) discuss the tasks involved in implementing the Basin Plan and comment on the major challenges in implementing these tasks. Also Hart, Johnson, Kneebone, and Wilson (2015) discuss the implementation of the Basin Plan in the context of a major ecological restoration of the Murray–Darling Basin.

This paper covers the challenges in implementing the tasks that must be completed in the longer-term by 2024. These are the basin-wide environmental watering plan; the water quality and salinity management plan; the water trading rules; the regional water resource plans; and the monitoring and evaluation programme. Also discussed are the challenges associated with establishing an ongoing relationship with the community, implementing

Figure 1. Location map of the Murray–Darling Basin – it encompasses parts of four Australian states.
indigenous cultural flows, establishing a robust research programme and establishing a programme leading to a review of the Basin Plan in 2022.

The companion paper (Hart, 2015) covers the challenges in implementing the short-term tasks that must be completed by June 2016. These include a one-off sustainable diversion limits (SDLs) adjustment process for the southern basin, a constraints management strategy and a review of the SDLs set for the northern basin.

The Murray–Darling Basin Plan

Background to the basin plan

As noted above, the need for a basin plan grew out of concern that the Murray–Darling River system was over-allocated with too great a proportion of the water resource allocated for consumptive uses (mostly irrigation), this being particularly so in the southern basin, which is the most regulated. This concern had been growing since the early 1990s (Bark, Kirby, Connor, & Crossman, 2014; NWc, 2009).

The major policy changes to the management of the basin’s water resources that have occurred over the past 30 years have been discussed by Connell and Grafton (2011a, 2011b) and Hart (2015). These included: a cap (an upper limit) on the surface water diversions in the basin in 1995; the National Water Initiative (NWI) established in 2004, the aim of which was to phase out overuse of water, reform the water entitlement system, and develop an active water trade market (NWC, 2004); the A$10 billion, 10-point National Plan for Water Security to improve water efficiency and address over-allocation of water in rural Australia, particularly in the Murray–Darling Basin in January 2007; and in August 2007 the passing of the new Commonwealth Water Act (Australian Government, 2013), with basin governments agreeing that the Australian government take a larger coordinating role in the integrated management of the basin’s water resources.

This Commonwealth Water Act (Australian Government, 2013) established a new independent Murray–Darling Basin Authority (MDBA), with a mandate to rebalance water allocations between the environment and consumptive uses, through the development and implementation of a Basin Plan. Horne (2013a) provides a very useful discussion of Australian water reform in a climate change context over the period between mid-2006 and the end of 2011.

Key elements of the basin plan

The basin plan is a high-level plan aimed at ensuring that the water resources of the Murray–Darling Basin are managed in an integrated and sustainable way, with the vision being to achieve “a healthy working Murray–Darling Basin that supports strong and vibrant communities, resilient industries, including food and fibre production, and a healthy environment”. The MDBA (2011) defined a healthy working river as a managed river in which the natural ecosystem has been altered by the use of water for human benefit, but in which the altered system retains its ecological integrity while continuing to support strong communities and a productive economy.
Importantly, much of this integrated management will occur through regional water resource plans developed and administered by relevant state governments, who will develop and implement their water resource plans in the period leading up to 2019 (MDBA, 2013). The key elements of the Basin Plan are provided by Hart (in press) and on the MDBA website.¹

Challenges in implementing the basin plan

There is now considerable evidence emerging that the implementation task is often significantly underestimated. For example, Daniell, Coomes, and White (2014) have discussed examples around the world of innovative water policies being developed that have been slow to implement. They identified a number of factors that can slow (or derail) the implementation process including complex politics and powerful interest groups across multilevel governance systems and scales of interest. These factors are all present in the Murray–Darling system.

Initially, it was expected that the Basin Plan would be implemented in the seven-year period 2012–19. Certainly, much of the implementation should occur by June 2019. However, some elements, for example completion of the projects associated with the SDL adjustment mechanism and the constraints management strategy, have now been extended to 2024 for completion. Figure 2 provides a simplified timeline for the implementation of the Basin Plan.

Figure 2. Timeline showing the key dates for implementing the basin plan to 2024.
**Basin-wide environmental watering**

The introduction of SDLs and other reforms is currently estimated to return 2750 GL/year long-term average to the environment. However, this in itself will not be enough to ensure the expected environmental outcomes. The Basin Plan requires that there is a strategic approach to the use of this environmental water. Thus, the MDBA is required to develop a basin-wide environmental watering strategy (BWS) to ensure that the environmental watering (size, timing and nature of river flows) maximizes the benefits for the environment.

The first BWS was published in November 2014 (MDBA, 2014a). This identified how the desired environmental outcomes in the basin can be achieved through better coordination and cooperation between agencies and across borders, and wise use of environmental water to maintain the river system in a resilient and healthy state. The BWS also requires the MDBA to establish basin watering priorities annually. For 2014–15, the priorities are focused around three themes (1) connecting rivers and floodplains, (2) supporting in-stream functions, and (3) enhancing and protecting refuge habitat (MDBA, 2014b).

The states will also be required to develop environmental watering plans for individual rivers and their catchments. Priorities for annual environmental watering events will be set by the relevant governments (federal and state), and achieved in collaboration with environmental water holders (Docker & Robinson, 2014); local communities and indigenous people. The BWS will be reviewed every five years.

**Challenges**

Two types of environmental water are recognized in the Water Act 2007. *Held environmental water* refers to water entitlements that are to be used exclusively for the environment. When the Basin Plan is fully implemented there will be approximately 3500 GL of ‘held’ environmental water in the basin, mostly held by commonwealth and state environmental water holders. In general, this has the same ‘rights’ as irrigation entitlements, and is subject to the same rules (allocations, carry over) as irrigation entitlements. *Planned environmental water* refers to (non-entitlement, carry over) water for the environment specified in some way in a water resource plan. Currently, although there is a large volume of planned environmental water in the Murray–Darling Basin (perhaps around 15,000 GL/year on a long-term average basis), it is poorly managed. A major challenge will be for the new regional water resource plans to protect and manage this planned environmental water better, and to ensure there is no less planned environmental water than is currently the case.

Although the Basin Plan requires the establishment of watering plans at both basin and catchment scales to provide the underpinning strategies for the use of environmental water, there still exists the annual and long-term challenge of delivering this water to the priority assets in a system that is inherently variable. The commonwealth environmental water holder and state water holders now have considerable experience in this task, and appear to be working together in a coordinated and cooperative manner.

But despite the fact that the environmental water holders are working well together, there are still a number of constraints that challenge their effectiveness. Some aspects of these (e.g. river operations) will be addressed as part of the constraints management strategy, while others will require policy changes. In particular, the question of how best to shepherd environmental water though the system needs to be resolved. Shepherding of environmental
water involves ensuring that this water travels through the system for environmental outcomes and is not taken for consumptive uses.

A final challenge will be to establish a robust monitoring and evaluation system to show that the environmental watering is benefiting the environment. This is covered more fully below.

**Water quality and salinity management plan**

The Basin Plan also includes an integrated water quality and salinity management plan that provides a basin-wide framework of objectives and targets for ensuring basin water is ‘fit for purpose’; that is, suitable for irrigation and recreational uses, maintaining aquatic ecosystems, and for drinking water after treatment.

This plan will be implemented over the period 2013–19, with the initial focus on implementing salinity and flow management targets.

**Challenges**

It is not expected that the implementation of the water quality and salinity management plan will present any particular problems. This part of the Basin Plan builds upon the very successful, collaborative basin salinity management strategy (BsMs) that has tackled salinity issues across the basin for the past 15 years (2001–15; MDBA, 2014c).

**Water trading rules**

A water market – the buying and selling of tradable water rights – has been in place in the Murray–Darling Basin for over 30 years (NWC, 2013). Most activity is in the southern connected system, with trading of both permanent and temporary water entitlements occurring (MDBA, 2014d). The introduction of a water market is generally regarded as a major success in helping to ensure that water reaches its highest value use (Grafton & Horne, 2014; Grafton, Libecap, Edwards, O’Brien, & Landry, 2012; Horne, 2013b; NWC, 2011, 2013), and was very important in assisting many irrigators to survive the recent Millennium drought (2000–10) (Grafton & Horne, 2014; NWC, 2013).

New water trading rules foreshadowed in the Basin Plan commenced on 1 July 2014 (MDBA, 2014e). They are aimed at ensuring that all the basin’s water markets will function consistently, fairly, efficiently, effectively and transparently. These new rules will reduce restriction on trade, improve transparency of information and improve market confidence. The MDBA is responsible for regulating and enforcing the water trading rules. MDBA have published its compliance strategy (MDBA, 2014f).

In preparing (and amending) water trading rules under the Basin Plan, the MDBA must obtain and have regard to the advice from the Australian Competition and Consumer Commission (ACCC). The ACCC released a series of papers in preparing its initial advice to the MDBA.4

**Challenges**

An immediate challenge is for the MDBA to work with basin states to ensure all trade restrictions are compliant with the water trading rules. Basin states have typically developed and expanded trade gradually over time. Now, for the first time, free trade of surface water is a...
default right, subject to some limitations. These limitations will include acceptable restrictions such as (1) where there are physical constraints in the river system (e.g. the Barmah choke), (2) where transmission losses would be too great, (3) where there would be unacceptable impacts on third parties, or (4) where there would be a negative impact on the environment. This represents a shift in mindset for the right to trade and the role trade plays.

In the longer-term, perhaps for the next Basin Plan, there exists an opportunity to develop further the water market to make it more competitive and to provide more incentives for innovation. This may see the emergence of complex derivative products such as futures.

**Regional water resource plans**

A very important component of the implementation of the Basin Plan will be the development and accreditation of regional water resource plans. These state-administered plans set out how a region’s water resources will be managed, usually for a 10-year period. Thirty-six plans are being developed by the basin states and will need to be approved by the commonwealth water minister.

These new plans, which must all be in place by 2019, will be largely built on the water resource plans already in place in the states. But the existing plans will need to be updated so they are consistent with the basin-wide planning framework, including the SDLs. The MDBA has published a *Handbook for Practitioners* (MDBA, 2013) to assist states in updating their water resource plans.

**Challenges**

The first challenge regarding the development and accreditation of water resource plans is the sheer number (36) that must be completed by June 2019. The task is a daunting one for the water planners in both the MDBA and state agencies. The success of the process will be partially dependent upon the collaboration between the MDBA and state agencies. It is to be hoped that there is no ‘gaming’ of the process to extend the deadline beyond June 2019.

There are also a number of challenges related to specific components of the water resource plans, including (1) how to identify and manage risks to a region’s water resources, (2) how to handle both held and planned environmental water, (3) how to identify and include indigenous values and uses effectively, (4) how to account for interceptions (e.g. farm dams and plantations), and (5) how to plan for the inevitable droughts that will occur in future, particularly by ensuring that the plans do not need to be suspended as occurred during the Millennium drought.

Two particular challenges for the MDBA will be to ensure: (1) that individual water resources plans adequately consider the links to other water resources plans, where appropriate, to ensure the required system connectivity is achieved, and (2) that there is no ‘back sliding’, i.e. that the new water resources plans are an improvement on the existing water resources plans.

For the states, the major challenge will be aligning their current water resource plans with the Basin Plan and not to have to develop something totally new. However, this alignment will involve making some changes to the existing plans, and these changes will have to be worked up over time with their communities, which is another challenge.

A further challenge will be the establishment of an appropriate and consistent set of factors (often called ‘cap factors’) for converting entitlements into long-term average annual
yield, so that the various water entitlements across the basin can be converted into a ‘common currency’. This will be essential for determining progress towards ‘bridging the gap’ under the Basin Plan as entitlements are recovered for the environment. The basin water ministers have been very slow to agree on a new set of acceptable cap factors. However, at their May 2015 meeting, the Murray–Darling Basin Ministerial Council agreed that each basin state would work with the MDBA to settle its planning assumptions (including cap factors) by June 2016.

Ultimately, there will be additional challenges for both the states and the MDBA after 2019 when these water resources plans are implemented.

**Monitoring and evaluation programme**

The Basin Plan requires the MDBA to report on the effectiveness of the plan every year and on the impacts of the plan each five years (Australian Government, 2012). The plan sets a series of evaluation questions to guide the evaluation reports, in particular focusing on the extent to which the objectives, targets and outcomes of the plan have been achieved, how the plan has contributed to changes in the environmental, social and economic conditions of the Murray–Darling Basin, and how the Basin Plan can be improved.

It will be crucial to the acceptance of the Basin Plan and to its continuation that the social, economic and environmental benefits of the plan are assessed in a robust and acceptable way. The community will demand that the large investment of about A$14 billion of taxpayers’ money has been worthwhile. It is concerning, but probably not surprising, that there is still a large and vocal group in the basin that is critical of the Basin Plan, despite the fact that the commonwealth is contributing in the order of A$2.5 million/day to basin communities, which has to be possibly the largest funding support to rural communities in history.

Another important task for these evaluation reports is that they must also assess “to what extent has the program for monitoring and evaluating the effectiveness of the Basin Plan contributed to adaptive management and improving the available scientific knowledge of the Murray–Darling Basin” (Australian Government, 2012, p. 149). This is another first, and will be an essential input into the Basin Plan review.

The MDBA has recently published a monitoring, evaluation and reporting framework (MDBA, 2014g).

**Challenges**

Three major challenges are identified. The first will be to select the most appropriate social, economic and environmental indicators of change, and to integrate these in a way that is understandable by the community. A particularly difficult task will be to be able to separate changes in community well-being and economic output due to the Basin Plan from other important factors. For example, water availability and cost is obviously a major driver in irrigation productivity, however the economic worth of the goods produced is often more affected by overseas market demand and the rate of the Australian dollar. The MDBA has been rather slow in identifying what indicators and processes it will use to assess the social and economic changes in the basin, and how they will assess the part the Basin Plan has played in these changes. However, there are signs that a robust process is now being developed.\(^5\)

A useful start to the understandable and informative reporting of the benefits of the Basin Plan has occurred with the publication of the first (high level) report on the implementation
of the Basin Plan for 2013–14 (MDBA, 2015a). This report focuses on three key aspects of the Basin Plan: (1) better decisions at the right level, (2) productive and resilient industries and confident communities, and (3) healthy and resilient rivers, wetlands and floodplains. Obviously after only one year of implementation there has been insufficient time for major changes to occur. However, the report does summarize for each focus aspect what the Basin Plan is aiming to achieve, and broadly what steps have been put in place during 2013–14 to help achieve these aims.

The second major challenge will be to ensure the states play their part in undertaking the necessary monitoring and assessment of the ecological changes resulting from the enhanced environmental watering. Ecological monitoring is essential, but costly, and this will represent a major challenge for cash-strapped states.

The final major challenge will be for the MDBA to develop and implement a process for assessing the effectiveness of the Basin Plan contribution to adaptive management and improving the available scientific knowledge of the Murray–Darling Basin.

Aboriginal environmental outcomes

The Water Act (Australian Government, 2013) is almost silent of the role of Aboriginal communities in managing water resources in the Murray–Darling Basin (Australian Government, 2013), which is surprising given that these people ‘owned’ all the water and land before European settlement. Currently, Aboriginal people own slightly less than 1% of the land and water in the basin. This low level of ownership has meant Aboriginal people have not routinely been considered significant stakeholders in water management, and as a consequence have not been appropriately engaged in water planning and management.

However, the Basin Plan has partially addressed this deficiency by requiring that the regional water resource plan must have regard to the social, spiritual, and cultural values and uses of the Aboriginal people and also that “a water resource plan must have regard to the views of the Aboriginal people with respect to cultural flows” (Australian Government, 2012, ch. 10, pt 14).

In recognizing the importance of Aboriginal community involvement in water planning and management in the Murray–Darling Basin, the MDBA has helped establish and fund two independent Aboriginal advisory bodies: the Northern Basin Aboriginal Nations (NBAN) in the north and the Murray Lower Darling Indigenous Nations (MILDIN) in the south. These organizations are important for the implementation of the Basin Plan in promoting the views and perspectives of Aboriginal people on water research, policy and management, and fostering involvement of local traditional owners.

Aboriginal people have indicated their desire to have water for ‘cultural flows’. These are water entitlements that are owned by Aboriginal Nations and which may have environmental and commercial benefits.

Challenges

To ensure full and meaningful participation by Aboriginal people in the implementation of the Basin Plan, three major challenges have been identified (MDBA, 2015b):

• Empowering Aboriginal voices through building effective partnerships – a useful start has been made with the establishment of NBAN and MILDIN. It will be important that
there is ongoing support for these groups and that their advice is used to assist in the implementation of the Basin Plan. These and other Aboriginal groups also have an important role in explaining what water requirements are necessary to protect and enhance Aboriginal values and interests.

- **Building capacity of Aboriginal people to participate in water planning and management** – the involvement of Aboriginal communities in water planning and management is a very new field of endeavour for both water planners and Aboriginal people. Progress is being made in projects that employ Aboriginal staff locally and which promote professional development and respectful, mutually beneficial knowledge sharing. A major challenge exists with the Aboriginal community having the capacity to contribute adequately information on the ‘social, spiritual and cultural values and uses of the Aboriginal people’ that is required as part of the 36 regional water resource plans.

- **Adequately supporting research into cultural flows** – the MDBA is the major supporter of a National Cultural Flows Research Project, which should assist in addressing the considerable uncertainty about what constitutes ‘cultural flows’ or ‘cultural water’. The information that this project will generate should assist Aboriginal leaders to put their case better for cultural flows in the political sphere. It will be important that this project ultimately fulfils its objectives and that the results of this research are used where appropriate in the implementation of the Basin Plan.

**Establishing ongoing relationship with the community**

Genuine engagement with key stakeholders is essential in achieving any major reform, such as the Murray–Darling Basin Plan. However, effective engagement requires a long-term commitment, a genuine desire to engage, skilled and professional staff to run the process, and sufficient resources to sustain the process.

In developing the Basin Plan, the MDBA started the community engagement process very poorly, despite having a sensible stakeholder engagement strategy (MDBA, 2009). Hart (in press) identified two reasons why the initial stakeholder engagement was unsuccessful. First, the MDBA did not fully appreciate the existing resentment in the rural community with the number of contentious reforms that state jurisdictions had instituted over the decade before the basin planning process got underway. Second, the attempt to introduce an additional community consultation step by preparing a Guide to the Proposed Basin Plan in 2010 was a failure for three reasons: (1) the guide (MDBA, 2010) was too large and complicated to be an effective engagement document, (2) the time for community members to read and assimilate the material was far too short, and (3) there was no pre-exposure to the new ideas.

In early 2011 there was a change in leadership of the authority, which saw some major changes in direction, with a significantly improved engagement with basin communities and with the state agencies, and an extended timeline to 2019. The focus was on open and genuine engagement, making a greater effort to know the ‘players’, mostly through smaller round-table meeting with community leaders, and having a consistency of staff involved in these meetings. Without this changed process of genuine engagement it is doubtful that the Basin Plan would have been successful.

The MDBA have shown over the four-year period 2011–15 a genuine desire to engage with all key stakeholders. Importantly, the Basin Community Committee (BCC), the advisory
body that engages with communities across the basin on Basin Plan implementation, now appears to be working well.

**Challenges**
The challenge in establishing and maintaining ongoing relationships with stakeholders, including the community, is not simply one related to the MDBA. The challenge is a shared one with the states and other commonwealth agencies, particularly the Commonwealth Department of the Environment, because the Basin Plan implementation is interlinked with many agencies. Stakeholders often do not distinguish between agencies (state or federal) – they are all ‘government’ – and expect engagement as a whole on issues and as agencies, and not in a segmented way.

Specifically, a major challenge for the MDBA will be to maintain a long-term commitment to the engagement process, to ensure skilled and professional staff are allocated to run the process, and to direct sufficient resources to sustain the process.

Another challenge will be for the MDBA to measure and report to the community how its engagement process has assisted with the implementation of the Basin Plan. To this end, the MDBA have identified three indicators, which they will use to measuring the effectiveness of community engagement in the implementation of the Basin Plan, these being (1) the processes used to identify stakeholders from local communities and peak bodies to individuals, (2) how stakeholders are engaged, and (3) how engagement influenced Basin Plan implementation.

**Research programme**
The Water Act requires that the MDBA “support, encourage and conduct research and investigations about the Basin water resources” (Australian Government, 2013, p. 203), particularly about (1) using the basin water resources in an equitable, efficient and sustained manner, (2) improving the quality of the basin water resources, and (3) improving the condition of water-dependent ecosystems connected with the basin water resources. Further, one of the principles underpinning monitoring and evaluating the effectiveness of the Basin Plan is to use the “best available knowledge (including scientific, local and cultural knowledge) evidence and analysis […] to ensure credibility, transparency and usefulness of monitoring and evaluation findings” (Australian Government, 2012, p. 147).

The MDBA has established a high-level Advisory Committee on Social, Economic and Environmental Sciences (ACSEES) to assist with the requirement that the authority uses the best available knowledge. Additionally, the MDBA has established a number of research partnerships to assist with providing advice on research gaps and scoping of research projects, synthesizing existing scientific knowledge, undertaking commissioned research and analysis to meet specific needs, providing advice on the best available science and evidence base including knowledge gaps, and providing peer review to ensure best available science is being used and the evidence base is continually improved.

**Challenges**
A major challenge for the MDBA will be to ensure the research programme is closely linked with the monitoring and evaluation programme.
The establishment of enduring and productive partnerships with the research community within a constrained budget will be an additional challenge for the MDBA. Partnership approaches will be important for at least two reasons: (1) they will assist in undertaking research at appropriate spatial scales, given that much of the current research is undertaken at small scales and is not scalable to catchment, region or basin scales relevant to the Basin Plan; and (2) they will also assist in undertaking the type of multidisciplinary research that spans the social, cultural, economic and environmental aspects of the Basin Plan.

Also noted above will be the difficulty in distinguishing the social, economic and environmental changes due to the Basin Plan from other important factors. Given the major rebalancing in water use in the basin and the large amount of federal funds allocated to assist this rebalancing, the community (and politicians) will increasingly seek justification for this investment. Therefore, the triple bottom-line assessment of the Basin Plan and government investment must be a key focus for ongoing MDBA and commonwealth government research.

An additional challenge for the MDBA in seeking to undertake relevant research will be the importance of a developing and maintaining a sensible research strategy, working collaboratively with the research partnerships established, and establishing a pathway for including research results into the Basin Plan implementation process.

**Review of the Basin Plan**

The Basin Plan legislation requires the plan to be reviewed every 10 years, with the first review to occur in 2022. Although this is some time off, it will be important that the review process not be left until the last moment.

Two particular challenges are discussed here:

- The application of adaptive management to identify necessary policy and management changes to ensure the Basin Plan maintains its relevance in the future.
- The development of a process to ensure the Basin Plan can adapt to likely climate changes.

**Challenges**

**An adaptive management plan.** The Basin Plan is underpinned by an expectation that the application of adaptive management will result in the necessary policy and management changes to ensure the plan maintains its relevance in future, and particularly can adapt to climate change. The concept of adaptive management is beguilingly attractive. It is a systematic approach for continually improving resource management by learning from management outcomes – or more simply ‘learning by doing’. Conceptually, it involves implementing management actions, monitoring their effect on the resource management goals, assessing whether the particular resource condition is improving, and then making any necessary changes to the management in the light of this assessment.

However, as a recent literature review of the application of adaptive management to ecological systems (Westgate, Likens, & Lindenmayer, 2013) has found, there exist very few examples where adaptive management has been successfully undertaken and documented, and has resulted in demonstrable changes in either policy or management. Also Crase (2012)
has commented on the long-term nature of the Basin Plan and the fact that adaptive management will be crucial in keeping the plan relevant.

So given (1) the chequered history of adaptive management implementation and (2) the excessive time it normally takes to achieve any policy and/or management changes that might be suggested through adaptive management, it is legitimate to ask: is adaptive management on its own the best strategy for assessing future modifications to the Basin Plan under climate change?

The Basin Plan and state water resource plans recognize the inherent variability in the basin’s climate, and have developed over many years management processes for dealing with this variability in water availability, at least for consumptive users. For example, annual water allocations are based on the availability of water and change from year to year, and often within a year.

Thus, any adaptive management process must be able to take into account this variability and uncertainty. While the Water Act lists the steps involved in adaptive management, neither the act nor the Basin Plan provides a detailed process linking knowledge gained through adaptive management to future reviews of the Basin Plan.

Such a process could involve three major steps. First, a fully documented and publically available plan of how adaptive management will be used in the Basin Plan review process over the next decade should be developed. Such a plan is not yet available. Second, a comprehensive and well-funded monitoring and evaluation programme must be in place to collect the data and information needed to show whether the Basin Plan is working or not. This information will be crucial to any assessment of what modifications may be needed to the Basin Plan. A framework for this monitoring and evaluation programme has recently been published (MDBA, 2014g), and is discussed above. Importantly, the basin states must play their part in investing in this M&A programme at the local asset scale. Third, the process to engage all stakeholders who will be involved in the Basin Plan review process should be commenced as early as possible after the magnitude and type of changes occurring or expected to occur as a result of climate change have been identified.

**Strengthening the adaptive management process.** A challenge will be whether an adaptive management process *on its own* is sufficient to account for the looming impacts due to climate change. The concern is that adaptive management focuses too much on a somewhat retrospective look at management actions, i.e. make a management change, observe the consequences and then make further change if needed. And given the pace of environmental change, coupled with difficulties (and slowness) of making management and policy changes, it seems likely that significant delays will occur in making necessary future changes to the Basin Plan. Additionally, the adaptive management process can also be vulnerable to delaying tactics because of the inevitable uncertainties in what changes will be most effective.

So what additional processes might be adopted to strengthen the adaptive management approach? It is suggested that scenario planning, coupled with adaptive management, may represent a useful way to account better for possible future changes due to climate change and other factors. Scenario planning is a well-accepted process for identifying the possible futures the basin and its communities may face in the next 10–30 years (Choy et al., 2012; O’Connor, McFarlane, Fisher, MacRae, & Lefroy, 2005). Such a focus on possible (not probable) futures would allow some early thinking on the research (ecological,
social and economic) and community interactions that might need to be put in place early (i.e. in the next 5–15 years) to firm up or dismiss possible futures, rather than wait until changes become apparent.

Thus, a well-documented adaptive management process plan, incorporating a robust and well-funded monitoring and evaluation programme, will be absolutely essential to ensure the Murray–Darling Basin Plan retains its relevance in future. Further, the coupling of scenario planning to the adaptive management process will strengthen this process by identifying possible future basin conditions over the next 10–20 years under climate change.

While the above may be desirable, it will be important to ensure that the SDLs are in place, and their consequences experienced, before the next stage continues. And given that the state regional water resource plans will not all be in place until 2019, the 2026 date recommended by a recent review of the Water Act (Australian Government, 2014) for the revised (second) Basin Plan to be completed is sensible.

Adapting to climate change. There is now considerable evidence that suggested the southern basin (Murray, Murrumbidgee, Goulburn rivers) in particular will become hotter and drier, and with less frequent floods, over the next 20–30 years (CSIRO, 2008; Colloff et al., 2015; Grafton et al., 2013, 2014; Neave, McLeod, Raisin, & Swirepik, 2015). The recent Millennium drought illustrated just how dry the basin may become. During this drought, runoff in the southern Basin was 44% below the long-term average compared with a predicted fall of 33% under the Australian Commonwealth Scientific and Research Organization (CSIRO) ‘dry’ scenario by 2030 (CSIRO, 2008).

In addition to these rainfall and temperature effects, it has also been predicted that climate change will increase the potential for bushfires to occur in the catchment areas of the Murray–Darling Basin (Hughes, 2014), which will result in significantly less runoff for decades after any major bushfire has occurred (Brookhouse, Farquhar, & Roderick, 2013). This result will be particularly noticeable in the mountain ash-dominated forests of the Australian Alps, where rapid post-fire regrowth has been found to lead to long-term reduced runoff.

The changing climate will also result in major changes to the ecological assets and ecosystem services that the Basin Plan seeks to protect (Colloff et al., 2015; Pittock & Finlayson, 2013). For example, it has been suggested that these climate change impacts will result in a doubling of the period between floods, reduce flow volumes by 50–90% over current, and cause major changes to the basin’s ecology. Aquatic grasslands will become locally extinct, floodplain red gums will be in poorer condition and will transition to more terrestrial forests in the upper reaches of the floodplains, flood thresholds for water bird breeding will be met less frequently, as will high flow spawning cues for some fishes (Colloff et al., 2015).

There has been some criticism that the MDBA did not adequately consider climate change in developing the Basin Plan (Horne, 2014; Pittock & Finlayson, 2013), although Horne (2014) noted that the first-order task of the Basin Plan was to correct the balance between consumptive use and the environment on the basis of the current climate. He argued that adjustment for climate change could be undertaken when the Basin Plan is revised in 2022.

Neave et al. (2015) contend that in developing the Basin Plan, the MDBA built upon pre-existing approaches for managing river systems with extreme flow variability and also put in place additional measures within an adaptive management framework that could handle future climate change impacts. They argue that the suite of measures to respond to climate change fall into four broad categories: (1) those that refine existing water management
arrangements, (2) those that buffer the system from the additional stress of climate change, (3) those that enhance responses to climate change, and (4) those that facilitate adaptation to climate change at a range of timescales.

The main policy challenge over the next 5–15 years regarding the impacts of climate change on the Basin Plan will be focused on how reductions in water availability due to climate change should be shared between consumptive use and the environment. Given the possible changes to the basin’s ecology, the community and water resource managers will be faced with challenging questions regarding what Murray–Darling Basin they want and what it will be possible to achieve. Inevitably, this discussion will become polarized since irrigators, the environment, the community and the indigenous population will all be impacted upon.

Neave et al. (2015) have identified three particular challenges that will need to be addressed in the near future, including: (1) how state governments respond to reduced water availability in the development of new water resource plans, (2) whether environmental objectives remain feasible and appropriate under climate change, and (3) what the appropriate balance between social, economic and environmental outcomes will be as agricultural communities undergo broader changes in socio-economic circumstances due to climate change.

Obviously, there is still significant uncertainty as to exactly what these ecological changes will be, how rapidly they will occur, and what capacity we have to manage or adapt to them. However, it will be important that the challenges are identified as early as possible, perhaps through the scenario-planning exercise suggested above, and that any knowledge gaps are address through targeted research. Also, the earlier the inevitable discussions between the main players – communities, irrigators, environment and Aboriginal people – commence, the more likely it is that rational policies and management actions will be adopted in the next Basin Plan.

Conclusions

The Murray–Darling Basin Plan is the latest major water reform in Australia, capping off a long process of major water reforms. The Basin Plan represents an important advance in the integrated management of the basin's water resources.

This and a companion paper (Hart, 2015) focus on the current challenges in implementing the Basin Plan. There are many examples around the world where the implementation of major water reforms has been poorly done.

This paper discusses the main longer-term challenges, to 2019 and beyond, namely: developing and accrediting the regional water resource plans; further advancing the cooperative arrangements between the commonwealth and states to use effectively the large volumes of environmental water; continuing the ongoing relationship with the community; and establishing a robust monitoring and evaluation programme.

This paper has highlighted the major challenge for the states in developing their regional water resource plans before 2019. While these will build upon existing plans, the challenge will be to align these existing plans with the Basin Plan, a process that will take time to work up with their communities.

Another major challenge will be to use the large volume of environmental water efficiently and effectively in the inherently variable Murray–Darling river system. It was noted...
that while the commonwealth and states now have considerable experience in delivering environmental water to priority assets, there are still a number of constraints that challenge their effectiveness in this task. Constraints that must be addressed over the next decade include physical constraints, such as watering floodplains, and modifying rules relating to river operation and water storage.

The acceptance of the Basin Plan will be crucially dependent on the assessment of the social, economic and environmental benefits of the plan. The community will demand that the large investment of about A$14 billion of taxpayers’ money has been worthwhile. Thus, another major challenge will be the implementation of a monitoring, evaluation and reporting programme that assesses the social, economic and environmental benefits of the plan in a robust and acceptable way.

Finally, it was noted that the Basin Plan will need to be reviewed in 2022 and that there is a need to establish as a priority what form the review process will take. Two particular challenges were highlighted in this review process: (1) the application of adaptive management to identify necessary policy and management changes to ensure the plan maintains its relevance in the future, and (2) the development of a process to ensure the Basin Plan can adapt to likely climate changes.

Notes


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