International Journal of Water Resources Development (in press, 2015)

The Australian Murray-Darling Basin Plan: Challenges in its Implementation (Part 1)

Barry T Hart

Director, Water Science Pty Ltd, Echuca, Australia

Board Member, Murray Darling Basin Authority, Canberra, Australia

Summary

The latest in a set of major water reforms in the Australian Murray-Darling Basin occurred in November 2012 with completion of a new integrated water resources plan for the region (the Basin Plan). This occurred over a four-year period (2009-2012) and was not without controversy. However, perhaps the most challenging part of this reform is occurring now with the implementation of the Basin Plan between 2012 and 2024. This paper discusses the key tasks to be undertaken by June 2016 and the main challenges in their implementation. A companion paper discusses the challenges in implementing the other tasks that need to be settled by 2024.

Keywords: Murray-Darling Basin; Australia; water reform; sustainable diversion limits; water recovery; Government investment. Basin Plan,

Author Bio

Professor Barry Hart is Director of environmental consulting company – Water Science Pty Ltd, established after he retired from Monash University. He was appointed an Emeritus Professor by Monash University. Previously he was Director of the Water Studies Centre at Monash University and Deputy Director Research of the CRC for Freshwater Ecology.

Professor Hart has established an international reputation in the fields of ecological risk assessment, environmental flow decision-making (particularly using Bayesian Network models), water quality and catchment management and environmental chemistry (heavy metal and nutrient biogeochemistry). He has published over 175 refereed papers and 12 books, and is on the editorial board of 5 international journals.

He has received several awards, including the Limnology Medal (1982) from the Australian Society for Limnology, the Environmental Chemistry Medal (1996) and Applied Chemistry Medal (1998) from the Royal Australian Chemical Institute, and in 2003 a Centenary Medal for services to water quality management and environmental protection. He was also made a Member of the Order of Australia (AM) in the 2012 Queens Birthday awards.

He is well known for his sustained efforts in developing knowledge-based decision making processes in natural resource management in Australia and south-east Asia (particularly with the Mekong River Commission). Currently, he is involved in projects in China and PNG.

Professor Hart is currently a member of the Murray-Darling Basin Authority Board, and the External Stakeholder Advisory Panel (ESAP) for the Hidden Valley gold mine in PNG.

Introduction

The Murray-Darling Basin covers one-seventh of the land area of Australia, and is one of the most productive agricultural regions in Australia. However, the increasing regulation of the Murray–Darling River system, and over-allocation of water for consumptive uses, over the past 100 years, 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, which became law in November 2012 (Aust Govt, 2012). The Basin Plan represents an important advance in the integrated management of the Basin's water resources, and was the culmination of over 4 years of intensive work, capping off a long process of major water reforms in Australia that is summarised below.

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, it is expected that 2,750 GL/y will be recovered for the environment from the long-term average consumptive use of 13,623 GL/y (leaving a sustainable long-term consumptive allocation of 10,873 GL/y). This equates to a recovery of around 21% over the Basin. 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 (Fig.1).

The Basin Plan also represents the first time there has been a limit set on groundwater extraction across the Basin. The total of groundwater SDLs set by the Basin Plan is 3,334 GL/y.

This latest stage of water reform in the Australian Murray-Daring Basin was stimulated by a major drought (Millennium drought – Van Dijk et al., 2013) that occurred between 2000-2010, and a growing realisation that the Basin's ecology was being significantly degraded due to a lack of water for the environment (MDBA, 2010).

Australia shares a common problem with many countries around the developed and developing world who are experiencing major water scarcity problems (NWC, 2014), problems that undoubtedly will increase with the impacts of climate change (Jiang & Grafton, 2012; Grafton et al., 2013, 2014; Qureshi et al., 2013; Colloff et al., 2015). The UN (UNESCO, 2012; Cosgrove, 2012) and OECD (OECD, 2011) have been among many calling for urgent action to alleviate the issues.

This has lead to increased focus worldwide on the development of more sustainable and integrated water policies (Pegram et al., 2013). Examples include: Australia (Connell & Grafton, 2011; Hart, 2015), USA (Gleick et al., 2011), Canada (Bakker, 2007; Wilson, 2013), Europe (EU, 2012; Nielsen et al., 2013), India (Yang et al., 2014) and Chile (Valdes-Peneda et al., 2014). In many of these cases, adaptation to climate change is an important driver (Valdes-Pineda et al., 2014; Yang et al., 2014; Colloff et al., 2015).

However, despite these important and innovative moves in many countries to develop new water policies, there has been less emphasis on the challenging task of implementing these policies. Daniell et al. (2014) and Daniell & Barreteau (2014) identified a number of impediments to the uptake on new and innovative water policy.

In particular, they identified complex politics and powerful coalitions across multi-level governance systems and scales of interest as being important barriers to the implementation of new water policies. Additionally, Daniell et al. (2014) proposed two factors that could help facilitate the implementation of new policies: (i) the establishment of 'champions' for the new policies, and (ii) the creation of favourable conditions (e.g. incentives, funding) by higher levels of government.

Interestingly, both these factors have been addressed regarding the implementation of the Basin Plan. First, the Murray-Darling Basin Authority (MDBA) was established as the independent authority to lead (champion) the development and implementation of the Basin Plan. Second, the Australian Government has committed around $A14 billion for programs in support of water reform in the Murray-Darling Basin. Subsequently, in 2012, the Commonwealth Government announced that an additional $A1.775 billion would be allocated over the period 2012-2024 to obtain water for the environment through the SDL Adjustment mechanism, the Constraints Management Strategy and if needed additional purchase of water entitlements (Aust Govt, 2013, Part 2AA – Water for the Environment Special Account). This Commonwealth Government funding is for (i) investment in upgrading rural water infrastructure to improve water use efficiency on and off farm, with a share of water savings helping to 'bridge the gap' to the sustainable diversion limits under the Basin Plan, and (ii) to purchase of water entitlements for environmental use. The main features of the Basin Plan are summarised by Hart (2015a). This paper discusses the challenges in implementing the tasks that must be completed by June 2016, namely a one-off sustainable diversion limits (SDL) Adjustment Process for the southern Basin, a Constraints Management Strategy and a review of the SDLs set for the northern Basin.

A companion paper (Hart, 2015b) covers the challenges in implementing the other tasks that must be completed by 2024.

The Murray-Darling Basin

The Murray-Darling Basin (catchment) has an area of around 1 million km^2 (or one seventh the area of Australia) and is located in south-eastern Australia (Fig. 1). The system is divided by climate into northern rivers (Darling system) and southern rivers (Murray system). The Darling system is more influenced by tropical weather patterns with most rainfall occurring in the summer (Dec-Mar), while the Murray system is more winter-spring (June-Sept) rainfall dominated. The essential physical, ecological, socio-economic and political features of the Basin are described in MDBA (2010, 2012).

Although the Murray-Darling Basin covers a large area, runoff is very low compared with other major river systems around the world (Gordon et al., 2004). Inflows to the rivers of the Basin have ranged from 118,000 GL in 1956, a wet year, to less than 7,000 GL in 2006, an extremely dry year (MDBA, 2010). Prior to significant human changes in the Basin, on average about 32,000 GL/y (or 6% of average annual rainfall) occurred as run-off and flow into the Basin's rivers and streams.

There are over 2 million people living within the Murray-Darling Basin. Outside the Basin a further 1.3 million people are dependent on its water resources, most living in the southern city of Adelaide. The Murray–Darling Basin has also been home to Aboriginal people for at least 50,000 years, sustaining their cultural, social, economic and spiritual life.

The Murray-Darling Basin is one of the most productive agricultural regions in Australia, representing 20% of Australia's total agricultural land area, but contributing almost 40% of the annual gross value of agricultural production in Australia (MDBA, 2012). Irrigated agriculture is the major user of the Basin's water resources (currently around 40%) and contributes around 37% of the Basin's agricultural output. Key agricultural products in the Basin include fruit and nuts, vegetables, table and wine grapes, dairy, rice, cotton, grain, sheep and beef cattle (MDBA, 2012). In 2012-2013, irrigation in the Murray-Darling Basin accounted for around 50% of Australia's irrigated agricultural production, and was worth around $A7.2 billion (MDBA, 2015a).

The Basin has a large area of floodplain forests and wetlands, with 16 of the wetlands being Ramsar listed. It also supports a great diversity of nationally and internationally significant plants, animals and ecosystems, many of which are now threatened, vulnerable or degraded. The degradation of floodplain River Red Gum forests, native fish populations, water bird populations and the Coorong coastal lakes at the end of the system, are now well documented (MDBA, 2010, 2011b; Colloff et al., 2015). Much of this degradation has been caused by the increasing regulation of the Murray–Darling River system, and over-allocation of water for consumptive uses, over the past 100 years.

The Murray-Darling Basin Plan

Background to the Basin Plan

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 (NWC, 2009; Bark et al., 2014).

Over the past 30 years there have been a number of important changes in the management of the Basin's water resources, these being:

(a) In 1995, the Basin governments (Commonwealth, Victoria, New South Wales, Queensland, South Australia and the Australian Capital Territory) through the Ministerial Council agreed to a cap (an upper limit - www.mdba.gov.au/what-we-do/managing-rivers/the-cap) on the surface water diversions in the Murray-Darling Basin in response to reports that confirmed diversions in the Basin had grown rapidly, could grow further and that this growth had caused decline in river health. The stated objectives of the Cap were: (i) to maintain and where possible improve existing flow regimes, and (ii) to achieve sustainable consumptive use by developing and managing Basin water resources to meet ecological, commercial and social needs. In fact, the real reason for the Cap was to place 'a line in the sand' to ensure conditions did not get worse for both the environment and the users.

(b) In 2004, the Council of Australian Governments (COAG) adopted the National Water Initiative (NWC, 2004), the aim of which was to phase out overuse of water, reform the water entitlement system, and develop an active water trade market. The National Water Commission (NWC) was established at this time to assist in implementing the NWI. Although the NWC was terminated in 2015, its major role – to audit the implementation of the Basin Plan – will be now undertaken by the Productivity Commission.

(c) In January 2007 the then Prime Minister (John Howard) outlined a $A10 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
.

(d) In August 2007, the Australian Parliament passed the Water Act (2007) (Aust Govt, 2013), with Basin governments agreeing that the Australian Government take a larger coordinating role in the integrated management of the Basin's water resources. The Millennium drought (2000-2010) provided the 'crisis' so necessary for achieving these water reforms (Connell & Grafton, 2011; Grafton et al., 2012). During the height of the Millennium drought (2007), the situation became so serious that several towns in the Murray-Darling Basin were close to running out of drinking water, and to ensure that critical human water needs were adequately protected the Water Act (2007) was modified in 2008.

These reforms were historic in that the Basin States ceded some of their powers to the Australian Government, a significant change since under the Australian Constitution, State governments have responsibility for managing their State's water resources. There have been a number of calls over the years for the Commonwealth to take over state responsibility for surface water and groundwater management, although this would probably require the Australian Constitution to be altered via a referendum (Kildea & Williams, 2010).

This Commonwealth Water Act (2007) 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 (2013) provides a very useful discussion of Australian water reform in a climate change context over the period between mid-2006 and end 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*. MDBA (2011a) 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, 2013a).

The key elements of the Basin Plan are provided by Hart (2015a) and the MDBA web site (www.mdba.gov.au).

Challenges in Implementing the Basin Plan

As noted previously, there have been many examples around the world of innovative water policies being developed that have been slow to implement (Daniell et al., 2014). There is now considerable evidence emerging that the implementation task is often significantly underestimated.

Daniell et al. (2014) identified complex politics and powerful interest groups across multi-level governance systems and scales of interest as being important potential barriers to the implementation of new and innovative water policies. These factors are all present in spades in the Murray-Darling system, including multiple state jurisdictions, federal agencies, irrigation lobby groups, local governments, environmental groups, indigenous groups, vocal individuals, and local media ready to criticise.

More specifically, Horne (2014) has identified seven key issues to watch in the implementation of the Basin Plan. These include: (i) the effectiveness of the SDLs, (ii) the robustness of the methods used to acquire water through supply and efficiency measures, (iii) the need for transparency in assessing compliance with groundwater SDLs, (iv) maintaining the momentum in implementing the Basin Plan, (v) ensuring that action to address climate change impact is taken and not deferred, (vi) ensuring that the public is getting value for the money through the implementation of the water acquisition programs, and (vii) that implementation issues outside the Basin Plan (e.g. existing joint Federal-State programs) are treated sensibly and not axed by state action without careful examination of the implications.

Initially, it was expected that the Basin Plan would be implemented in the 7-year period 2012-2019. 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.

Government Investment

Before considering in detail the challenges associated with implementing the specific tasks of the Basin Plan, we consider the very real challenges associated with the continuation of funding to underpin the implementation.

Successive Australian Governments have committed to a large investment in water reform in Australia, with much of the focus on the Murray-Darling Basin. This commenced with the Howard liberal government's commitment in 2007 of $A10 billion over a 10-year period to the water reform process (initially known as *A National Plan for Water Security*), with this financial commitment subsequently honoured and augmented by the Rudd-Gillard Labor governments, and currently the Abbott coalition government.

The Australian Government now has in place a number of substantial programs in support of water reform in the Murray-Darling Basin. The programs include the *Sustainable Rural Water Use and Infrastructure Program* supports infrastructure investment, and water saving through infrastructure improvements*, Restoring the Balance in the Murray-Darling Basin Program*, which underwrites water 'buybacks', and the $A1.775 billion *Water for the Environment Special Account* funding for enhanced environmental outcomes (efficiency measures and constraints management) aimed at an additional water recovery of 450 GL beyond the 2,750 GL (Aust Govt, 2012).

Much of this funding is for investment in upgrading rural water infrastructure to improve water use efficiency on and off-farm, with a share of water savings helping to 'bridge the gap' to the sustainable diversion limits under the Basin Plan. There has

also been substantial investment in the purchase of water entitlements for environmental use, the so-called 'buy-back program'.

Hart (2015a) has commented that without this large investment portfolio, it is certain that the reform process would have received considerably more challenge from interest groups, and probably would not have been ultimately successful.

In June 2014, the Australian Government released a new *Water Recovery Strategy for the Murray-Darling Basin* (Aust Govt, 2014), outlining the Government's approach to recovering water for the environment. This strategy seeks to prioritise water recovery through infrastructure investment over 'buy-back' of water entitlements, with the latter capped at 1,500GL (long-term average).

This focus on infrastructure investment in preference to water buy-back is not without critics. Crase and colleagues (Crase, 2012; Crase et al., 2012, 2013) have argued that buy-backs are a more cost-effective means of recovering consumptive water for the environment than subsidising irrigation infrastructure upgrades. They cite four reasons against (as they say) 'the continued use of public funds to prop up selected irrigation interests', namely that infrastructure subsidies: (a) are the most expensive way of securing water, (b) will be subject to diminishing returns since the last megalitre will cost more than the first, (c) are inequitable in the sense that public funds are going to one sector of society (irrigators), and (d) they do not save water at a basin scale. Also, Wittwer & Dixon (2013) argued that from the point of view of regional economic management, infrastructure upgrades are inferior to public spending on health, education and other services in the Basin.

Additionally, Wheeler and colleagues (Wheeler et al., 2012, 2013; Wheeler & Cheesman, 2013) have provided a quite positive analysis of the early stages of the buy-back program to 2012, just after the Millennium Drought finished. They found that debt and cash-flow issues were a major reason for irrigators selling water, although many used the opportunity to restructure their business and achieve other objectives. For example, Wheeler & Cheesman (2013) reported that 60% of those surveyed had sold some water and kept farming. It seems that farmer attitudes to the water market are becoming more sophisticated, and that buy-backs will become just another consideration in decisions on the water portfolio they need for their business.

Currently (end of February 2015), Commonwealth environmental water holdings are 1,733 GL long-term average annual yield and of this total volume recovered, 67% has been obtained from water purchases (1,162 GL long-term average) (www.environment.gov.au/water/basin-plan/progress-recovery).

A total of 571 GL long-term average will be obtained from Commonwealth infrastructure investment, with an additional 218 GL recovered by state governments and other investments. Thus, the total water volume recovered (or contracted to be recovered) is currently 1,951 GL or 71% of the target of 2,750 GL.

The Government investment to date (end of February 2015) has been $A2.288 billion on buy-backs and $A3.113 billion on infrastructure programs and projects (J Robinson, Department of the Environment, Pers. Comm., May 2015).

Challenges

The current Australian Government's priority in investing in infrastructure upgrades to obtain additional water for the environment has a number of challenges. First, the cost of the water recovered is considerably more than if obtained by 'buy-back' of entitlements. For example, water recovered through infrastructure projects costs $A4,000 to $A6,000 per ML compared with $1,989 per ML for the buyback of 1,162

GL. This more costly recovery has been justified as having other advantages, e.g. contractors spent money in local communities, and at least for group irrigation schemes these are being upgrade and will be considerably more efficient in the future. Second, the method(s) used to assess the volume of water recovered through infrastructure upgrades is not transparent. The Department of the Environment publishes on its web site the amounts paid for entitlements obtained by 'buy-back', but is silent on the method for calculating water recovery through infrastructure upgrades.

A second challenge will be for the Australian Government to maintain the funds committed to the *Sustainable Rural Water Use and Infrastructure Program* such that this is sufficient to recover the gap between the 1,500 GL from the buybacks and the total figure of 2,750 GL.

It will be particularly important that funding for the two Federal agencies responsible for implementing the Basin Plan (e.g. MDBA) and the water recovery program (Commonwealth Environmental Water Office) continues at current budget levels until at least 2019. This funding is secure in the budget forward estimates until June 2017, but it is unclear what happens after that time. The time for clarification on this funding is rather short with only two budget cycles between now and 2017.

The CEO of the National Irrigators Council in commenting of the Federal Governments Budget announced in May 2015 noted 'there is no funding beyond 2016/17 in the Budget to manage or deliver the environmental water the Government has already recovered. The last thing we want is to be involved in another 'historic reform' in a few years time because successive Governments have failed to deliver on what they promised (www.irrigators.org.au/press_releases/114d5d166ae34a582474fb0419c4efc6.pdf).

The above discussion has focused on the large Commonwealth investment and support in implementing the Basin Plan. The Commonwealth also provided funds to the states to assist them in implementing their components of the Basin Plan. However, each of the states will be challenged in finding the additional investment they will need to make in carrying out their part of the implementation process, in particular developing the regional water resource plans and implementing the environmental watering plans.

Long-term average sustainable diversion limits

The Basin Plan aims to achieve a healthy working basin through the establishment of new long-term average sustainable diversion limits (SDLs) that reflect an environmentally sustainable level of water use (or 'take'). These SDLs are limits on the volumes of water that can be taken for consumptive purposes (including domestic, urban, industrial and agricultural use), and are set at both a catchment and a Basin-wide scale. The SDLs are essentially a new cap on consumptive water take that need to be met as long-term averages, with annual compliance to be assessed by taking into consideration the particular circumstances of each water year.

Surface Water

The Basin Plan establishes a long-term surface water SDL of 10,873 GL/y, which to be achieved will require an additional 2,750 GL/y to be recovered for the environment, or around a 21% adjustment to the 2009 consumptive water allocations over the Basin. It should be noted that the SDL includes all water used for consumptive purposes, including diversions from rivers and interceptions, the latter

mostly being water held in farm dams or used by commercial tree plantations. Little has been done to date to quantify the volume associated with interceptions.

Not all catchments require water to be recovered for the environment. For example, the Paroo and Warrego catchments are largely unmodified (Fig. 1), with little water abstracted for consumptive uses.

The Water Act (2007) required the new SDLs to be determined on the basis of an assessment of the Environmentally Sustainable Level of Take (ESLT). This was a new concept that required the MDBA to develop a robust and scientifically defensible method for determining the water requirements for the Basin's water-dependent assets, but also to take into account the need to minimize the social and economic impacts of any reduction in take.

The ESLT process does not specify a detailed environmental flow regime that must be delivered. Rather, it is a method that estimates the minimum amount of water that will enable the achievement of an ESLT and Basin-wide environmental objectives. Ultimately, the environmental outcomes achieved through the Basin Plan will be dependent on the environmental flow decisions made at a regional and local scale, in response to future climatic conditions and ecological responses. This is covered by the Basin Watering Strategy (BWS), the details of which are covered below.

The method used to develop this ESLT is a key component of the basin planning process. The steps involved in the method were:

- Identify Basin-wide environmental objectives,
- Determine the environmental water requirements for the key assets,
- Select a number of ESLT options (scenarios) for assessment,
- Identify the environmental outcomes for each scenario,
- Assess these environmental outcomes against the social and economic impacts,
- Select the optimal ESLT (and hence SDL).

Full details on the method are provided in MDBA (2011b) and Swirepik et al. (2015).

Groundwater

The groundwater SDLs were established using existing numerical groundwater models or a sustainable yield methodology that allows a percentage of the recharge for productive purposes (CSIRO, 2010). The two methodologies assess the ESLT for the Basin groundwater systems, with a focus on ensuring that groundwater-dependent ecosystems are maintained.

SDL Adjustment mechanism

Prior to the Basin States agreeing with the Basin Plan two additional components, which could modify the final SDL, were introduced. These were: (i) a one-off adjustment of the SDLs in the southern Basin to be completed by June 2016, with project implemented in the period up to 2024, and (ii) a review of the SDLs established for the Northern Basin with possible changes by June 2016. These are discussed below.

This SDL Adjustment mechanism was introduced at the request of the Basin water ministers with the aim of adding flexibility to the Basin Plan by allowing for a one-off adjustment to the SDL as a result of two types of changes, these being:

- *Supply measures* – these are environmental works projects and changes to river operations and management rules that would enable the equivalent environmental outcomes to be achieved with less water recovery. Water savings identified through these types of projects would allow the 2,750 GL recovery target to be reduced, thereby reducing the social and economic impacts of water recovery on irrigation communities. An example is the installation of infrastructure such as regulators and levee banks on a floodplain that enables a wetland to be inundated using smaller quantities of water than would typically be needed in a general 'overbank' flooding event.

  There are two elements that are key to ensuring any supply measure SDL adjustment proposal will achieve equivalent environmental outcomes to those in the Basin Plan. These are:

  (a) The ecological elements method that allows the environmental outcomes for different flow regimes associated with a particular supply measure to be assessed. This method was developed by CSIRO and independently reviewed as a practical and scientifically fit-for-purpose method to assess supply measures (Overton et al., 2014; IRP, 2015).

  (b) Benchmark model that provides a representation of the environmental, social and economic outcomes achieved from a 2,750 GL reduction target against which proposals for an SDL adjustment will be measured. Regardless of any change in the SDL, this benchmark must be maintained or improved. The benchmark model scenario describes environmental outcomes, which could be achieved through the combination of (i) the recovery of 2,750 GL/y of water for the environment, and (ii) a Basin-wide environmental watering strategy. A successful 'supply measure' will allow the volume of water recovery to be reduced, whilst maintaining equivalent benchmark environmental outcomes.

  The Basin states are currently preparing business cases for a package of SDL Adjustment projects (www.mdba.gov.au/what-we-do/water-planning/sdl/proposals).

  These proposals will initially be assessed for feasibility and value for money through a cooperative process involving all Basin governments. The package of proposals must be agreed by the State water Ministers. As soon as practicable after receiving the package of proposals, the MDBA will provide advice to the Federal water Minister on the proposals and the resultant SDL adjustment. Subject to approval by the Federal Minister, adjustments to the SDLs will need to be supported by the Australian Parliament through an amendment to the Basin Plan.

  States will have until 2019 to incorporate any adjustments in their water resource plans, with all SDL adjustment projects to be completed by 2024. At this time, MDBA will review the projects to reconcile the anticipated outcomes with the achieved outcomes and make any final SDL adjustments accordingly.

- *Efficiency measures* – these are investment proposals that could increase the amount of water that could be recovered for the environment in ways that entail neutral or beneficial social and economic impacts (such as on-farm efficiency works). These projects allow more water to be recovered for the environment (that is, above 2,750 GL recovery target currently required to meet the SDL) without causing additional social and economic impacts on irrigation communities.

An example would be improving the efficiency of on-farm irrigation with the water savings transferred to environmental use.

In 2012, the Federal Government announced that an additional $A1.775 billion would be allocated over the period 2012-2024 to obtain water for the environment through the SDL Adjustment mechanism, the Constraints Management Strategy and if needed additional purchase of water entitlements (Aust Govt, 2012, Part 2AA – Water for the Environment Special Account). Of this, $A200 million has been allocated to implementing the Constraints Management Strategy.

Challenges

The timeline for the preparation of business cases for SDL Adjustment projects and assessment of these is tight (June 2016). There is certainly an incentive for the states to actively prosecute these proposals since if successful the SDL for their catchments could be increased and there is also funds available to implement the successful projects.

A second challenge is that the state water Ministers must agree on the package of proposals to be considered for SDL Adjustment. This will inevitably require difficult trade-offs between the states, particularly NSW, Victoria and South Australia. However, the lure of additional Federal funds (upwards of $A1.5 billion) should provide sufficient incentive for the Ministers to work through the issues.

Another challenge relates to the expectation by some states that the SDL Adjustment mechanism could provide several hundred GL of 'savings' (a figure of 650 GL is often mentioned). It is not yet apparent whether this expectation will be met by the projects being assessed. However, the Basin Plan specifies an upper and lower limit of net change of 5% to the existing SDL as a result of the SDL Adjustment mechanism. This equates to ca. 540GL (of the Basin-wide limit of 10,873GL).

A final challenge relates to the cost of implementing these projects. The Federal government has allocated around $A1.5 billion to assist states to implement their projects. However, the total cost of the projects is not yet known and there may be a shortfall in the total Federal and States funding available. If this occurs it will need to be resolved or the SDL changes modified.

Northern Basin review

In finalising the Basin Plan, the MDBA recognised there was less knowledge available for the northern basin, and provided a requirement in the Basin Plan for additional work to be undertaken to see if there is a case for changing the initial SDL. This requirement for additional knowledge particularly applied to the Condamine-Balonne and Barwon-Darling systems (MDBA, 2015b).

The MDBA is currently undertaking a review of the northern basin and this is scheduled for completion in June 2016 (MDBA, 2015b). A Northern Basin Advisory Committee (NBAC) has been established to advise on the review.

The expected outcomes of the review are: (i) improved information on the environmental outcomes and social and economic costs and benefits for different diversion limits, (ii) recommendations about possible improvements to Basin Plan settings in the northern Basin, (iii) advice for the Commonwealth Department of the Environment on how best to recover the remaining target for environmental water (MDBA, 2015b).

Challenges

A major challenge for the MDBA will be to provide a final report that has community support. It will need to effectively integrate the four areas of investigation, namely (i) the environmental science that will identify the watering requirement for the key environmental assets in the region (particularly the Lower Balonne floodplain, Narran Lakes and the Barwon-Darling system), (ii) the floodplain inundation modelling to map the extent of floodplain inundation under various flow scenarios, (iii) the hydrological modelling to test various water recovery scenarios for the northern basin, and (iv) the assessment of the social and economic impacts of various water recovery scenarios, including the impacts on irrigated agriculture, regions and communities, and the benefits to floodplain graziers.

Another challenge will be to effectively use the advice provided by NBAC in the setting of any new SDLs. This committee is made up of key community leaders who have provided the MDBA with sage advice, particularly regarding the investigations program, the likely community acceptance of changes to the SDL, and on water recovery projects.

Constraints Management Strategy

This requirement was introduced to the Basin Plan at the request of the Basin water Ministers. The Strategy was required to explore new ways to manage water delivery through the waterways to ensure their long-term health, while avoiding or mitigating the effects on people who live and farm on the floodplain close to these waterways. The task was to identify constraints that restrict the volume and timing of environmental water that can be delivered through the river system, that if addressed could deliver better environmental outcomes. Such constraints could include: (i) physical constraints on floodplains, such as bridges, levees or agricultural land that would be inundated by overbank flows, or (ii) river management constraints, such as river operations that have been optimized for irrigation water delivery and management rules such as carry over).

Addressing the various constraints to environmental water delivery will not result in any changes to the SDLs, but will increase the effectiveness of the environmental watering.

The MDBA released the Constraints Management Strategy in November 2013 (MDBA, 2013b). Projects to address constraints are to be decided by June 2016 and implemented in the period up to 2024. Details of progress to date are provided in MDBA (2014).

The Federal Government has allocated a total of $A200 million to implement the constraints management strategy (part of the $A1,775 billion Special Account – Aust Govt, 2012).

Challenges

A major challenge will be to negotiate an acceptable package of constraints mitigation projects that effectively address the identified impacts and provides a satisfactory outcome for landholders. There is currently support and opposition in the community depending upon whether individuals or groups (e.g. local government) see advantage or disadvantage in the proposal. Generally, landholders in the upper parts of the catchment see disadvantages and risks to their businesses from higher flows, while landholders in the lower parts, particularly floodplain graziers, see benefits.

The states are leading the development of projects with the MDBA providing technical support. The MDBA is also supporting the extensive consultation with community groups on the feasibility of possible constraints that might be addressed in particular catchments. In particular, local knowledge is being used to 'ground-truth' the results of floodplain inundation modelling and mapping, and to understand what the effects of these flows might be on properties. Working through these local comments and objections in the relatively short time available will be challenging.

A further challenge is that all of the possible projects addressing particular constraints will require state government approval and action. For example, reservoir operation rules, including carry-over, and the establishment of easements allowing inundation of floodplain land, will require state government agreement. There is always a possibility that a particular state government for whatever reason may decide not to agree to particular constraint reduction measure. Given that the River Murray, for instance, runs through three states, an integrated suite of proposals will need to be agreed between all jurisdictions involved, including the Commonwealth. This will be a challenging task.

The cost of implementing these CMS projects may also provide a challenge. The Federal government has allocated $A200 million to assist states to implement constraints projects. However, the total cost of the projects is not yet known and there may be shortfall in the total Federal and States funding available.

A final challenge will be the criteria and process for choosing constraints projects should be chosen as part of the SDL Adjustment process. This will need to be done before the June 2016 deadline, a very short time indeed.

Conclusions

The development of the Murray-Darling Basin Plan, which became law in November 2012, 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.

Given that implementation of major water reforms around the world has been generally poorly done, this paper focuses on the challenges in now implementing the Basin Plan.

In the short term, to July 2016, the main challenges for the Basin Plan will be to implement the SDL adjustment mechanism in the southern Basin, and to complete and implement the review of SDLs in the northern Basin. The SDL adjustment mechanism is largely in the hands of the state water Ministers who must agree on the package of proposals to be considered, a task that is sure to challenge them. For the northern Basin, the challenge will be to provide a final outcome regarding possible changes to the SDLs that is broadly acceptable to the community.

The longer-term challenges are covered in a companion paper (Hart, 2015b).

But perhaps the greatest challenge will be to ensure the Commonwealth funding for buy-backs and infrastructure modernisation is maintained over the next 5-10 years so that the additional environmental water required is obtained by the Commonwealth. Pressure to reduce budgets is always present, and it will require continued bi-partisan political commitment to this reform, support from the states, and pressure from the community to ensure the funding is not reduced. Reduction in

Commonwealth funding represents the biggest risk to the full implementation of the Basin Plan.

Acknowledgements

This paper has relied heavily on the many reports prepared by MDBA staff. Their contributions to the Basin Plan development and now its implementation are acknowledged. I wish to thank James Horne, the many MDBA staff members and colleagues from the Commonwealth Environmental Water Office for their comments on earlier drafts of the paper.

References

Aust Govt (2012). *Water Act 2007 – Basin Plan 2012*, *Extract for the Federal Register of Legislative Instruments* (28 November 2012), Australian Government, Office of Parliamentary Counsel, Canberra, 245pp.

Aust Govt (2013). *Water Act 2007 (with amendments)*, Australian Government, Office of Parliamentary Counsel, Canberra, 571pp.

Aust Govt (2014). *Water Recovery Strategy for the Murray-Darling Basin*, Commonwealth of Australia, Canberra, 68pp.

Bakker, K. (Ed.) (2007). *Eau Canada: The Future of Canada's Water*, Univ British Columbia Press, Vancouver.

Bark, R., Kirby, M., Connor, J.D. & Crossman, N.D. (2014). Water allocation reform to meet environmental uses while sustaining irrigation: a case study of the Murray–Darling Basin, Australia. *Water Policy 16*, 739-754.

Colloff, M.J., Lavorel, S., Wise, R.M., Dunlop, M., Overton, I.C. and Williams, K.J. (2015). Adaptation services of floodplains and wetlands under transformational climate change. *Journal of Applied Ecology* (in review).

Connell, D. & Grafton, R.Q. (Eds) (2011). *Basin Futures: Water reform in the Murray-Darling basin*, ANU Press, Canberra.

Cosgrove, C. (2012). *Main Messages*, in United Nations World Water Development Report 4; Vol 1 - Managing Water Under Uncertainty and Risk, UNESCO, Paris, 1-16.

Crase, L. (2012). The Murray-Darling Basin Plan – An Adaptive Response to Ongoing Challenges? *Economic Papers* 31, 318-326.

Crase, L., O'Keefe, S. and Kinoshota, Y. (2012). Enhancing Agri-Environmental Outcomes: Market-Based Approaches to Water in Australia's Murray-Darling Basin, *Water Resources Research* 48, DOI: 10.1029/2012WR012140.

Crase, L., O'Keefe, S. and Pawsey, N. (2013). A Note on Contradictions in Australian Water Policy, *Economic Papers* 32, 353-359.

CSIRO (2010). *The Groundwater SDL Methodology for the Murray-Darling Basin Plan*, Water for a Healthy Country National Research Flagship, CSIRO, Canberra.

Daniell, K.A. & Barrateau, O. (2014). Water governance across competing scales: Coupling land and water management. *Journal of Hydrology, 519*, 2367-2380.

Daniell, K.A., Coomes, P.J. & White, L. (2014). Politics of innovation in multi-level water governance systems. *Journal of Hydrology, 519*, 2415-2435.

EU (2012) *Report on the Implementation of the Water Framework Directive (2000/60/EC): River Basin Management Plans*, European Union, Brussels, 14pp.

Gleick, P.H., Allen, L., Christian-Smith, J., Cohen, M.J., Cooley, H., Heberger, M., Morrison, J., Palaniappan, M. & Schulte, P. (2011). *The World's Water: Volume 7*, Island Press, Washington.

Gordon, N.D., McMahon, T.A., Finlayson, B.L., Gippel, C.J. & Nathan, R.J. (2004). *Stream Hydrology - An Introduction for Ecologists, 2nd Edition*, John Wiley & Sons Ltd., West Sussex, England, 448pp.

Grafton, R.Q., Libecap, G.D., Edwards, E.C., O'Brien, R.J. & Landry, C. (2012). Comparative assessment of water markets: insights from the Murray-Darling Basin of Australia and the Western USA. *Water Policy 14,* 175-193.

Grafton, R.Q., Pittock, J., Davis, R., Williams, J., Guobin Fu, G., Warburton, M., Udall, B., McKenzie, R., Yu, X., Che, N., Connell, D., Jiang, Q., Kompas, T., Lynch, A., Norris, R., Possingham, H. & Quiggin, J. (2013) Global insights into water resources, climate change and governance. *Nature Climate Change, 3*, 315-321.

Grafton, R.Q., Pittock, J., Williams, J., Jiang, Q., Possingham, H. & Quiggin, J. (2014) Water planning and hydro-climatic change in the Murray-Darling Basin, Australia. *Ambio, 43*, 1082-1092.

Hart, B.T. (2015a). The Murray-Darling Basin Plan: 1. Factors Leading to its Successful Development. *Ecohydrology & Hydrobiology* (in press).

Hart, B.T. (2015b). The Australian Murray-Darling Basin Plan: Challenges in its implementation (Part 2). *International Journal of Water Resources Development* (in press).

Horne, J. (2013). Australian water policy in a climate change context: Some reflections. *International Journal of Water Resources Development, 29*, 137-151.

Horne, J. (2014). The 2012 Murray-Darling Basin Plan – issues to watch. *International Journal of Water Resources Development, 30*, 152-163.

IRP (2015). *SDL Adjustment Ecological Elements Method Development Report: Review of the Final Report*, Report of the Independent Review Panel to the Murray-Darling Basin Authority, Canberra, 12pp.

Jiang, Q. & Grafton, R.Q. (2012) Economic effects of climate change in the Murray-Darling Basin, Australia. *Agricultural Systems, 110,* 10-16.

Kildea, P. and Williams, G. (2010). The Constitution and the management of water in Australia's rivers. *Sydney Law Review, 32*, 595-616.

MDBA (2010). *Guide to the Proposed Basin Plan. Vol 1 Overview.* - Murray-Darling Basin Authority, Canberra.

MDBA (2011a). *The Living Murray Story*, Murray-Darling Basin Authority, Publication Number 157/11, Canberra, 95pp.

MDBA (2011b). *The proposed 'environmentally sustainable level of take' for surface water of the Murray-Darling Basin: Methods and Outcomes*, Murray-Darling Basin Authority, November 2011, Canberra, 218pp.

MDBA (2012). *The socio-economic implications of the proposed Basin Plan*, Murray-Darling Basin Authority, May 2012, Canberra, 35pp.

MDBA (2013a). *Handbook for Practitioners: water resource plan requirements*,

Murray-Darling Basin Authority, October 2103, Canberra, 108pp.

MDBA (2013b). Constraints Management Strategy 2013-2024, Publication No. 28/13, Murray-Darling Basin Authority, Canberra.

MDBA (2014). *Constraints Management Strategy Annual Progress Report 2013–14*, Murray-Darling Basin Authority, Canberra, 74pp.

MDBA (2015a). *Towards a Healthy, Working Murray-Darling Basin: Basin Plan Annual Report 2013-14*, Publication No. 46/14, Murray-Darling Basin Authority, Canberra, 34pp.

MDBA (2015b). *The Northern Basin Review*, Murray-Darling Basin Authority, Canberra, 8pp.

Nielsen, H.O., Frederiksen, P., Saarikoski, H., Rytkönen, A.-M. & Pedersen, A.B. (2013). How different institutional arrangements promote integrated river basin management. Evidence from the Baltic Sea Region, *Land Use Policy, 30*, 437-445.

NWC (2004). *Intergovernmental Agreement on a National Water Initiative*, p. 39, National Water Commission, Canberra.

NWC (2009). *Australian Water Reform 2009: Second Biennial Assessment of Progress in the Implementation of the National Water Initiative*, National Water Commission, Canberra, 306pp.

NWC (2014). *National Water Initiative – Ten-year anniversary*, National Water Commission, Canberra.

OECD (2011). *Water Governance in OECD Countries: A Multi-Level Approach*, Organisation for Economic Co-operation and Development Paris, 245pp.

Overton, I.C., Pollino, C.A., Roberts, J., Reid, J.R.W., Bond, N.R., McGinness, H., Gawne, B., Stratford, D.S., Merrin, L.E., Barma, D., Cuddy, S.M., Nielsen, D.L., Smith, T., Henderson, B.L., Baldwin, D., S., Chiu, G.S. & Doody, T.M. (2014). *Development of the Murray-Darling Basin Plan SDL Adjustment Ecological Elements Method*, Report by CSIRO for the Murray Darling Basin Authority, Canberra, 190pp.

Pegram, G., Li, Y., Le Quesne, T., Speed, J., Li, J. & Shen, F. (2013). *River Basin Planning: Principles, Procedures and Approaches for Strategic Planning*, UNESCO, Paris, 184pp.

Qureshi, M.E., Hanjra, M.A. & Ward, J. (2013). Impact of Water Scarcity in Australia on Global Food Security in an Era of Climate Change. *Food Policy, 38*, 136-145.

Swirepik, J.L., Burns, I.C., Dyer, F.J., Neave, I.A., O'Brien, M.G., Pryde, G.M. & Thompson, R.M. (2015). Science informed policy: Establishing environmental water needs for Australia's largest and most developed river basin. *River Research and Applications* (in review).

UNESCO (2012). *United Nations World Water Development Report 4: Vol 1 - Managing Water Under Uncertainty and Risk*, United Nations Educational, Scientific and Cultural Organization, Paris, 909 pp.

Valdés-Pineda, R., Pizarro, R., García-Chevesich, P., Valdés, J.B., Olivares, C., Vera, M., Balocchi, F., Pérez, P., Carlos Vallejos, C., Fuentes, R., Abarza, A. & Helwig, B. (2014). Water governance in Chile: Availability, management and climate change. *Journal of Hydrology, 519*, 2538-2567.

van Dijk, A.I.J.M., Beck, H.E., Crosbie, R.S., Jeu, R.A.M.d., Liu, Y.Y., Podger, G.M.,

Timbal, B. & Viney, N.R. (2013). The Millennium Drought in southeast Australia (2001–2009): Natural and human causes and implications for water resources, ecosystems, economy, and society. *Water Resources Research, 49,* 1040-1057.

Wheeler, S. & Cheesman, J. (2013). Key findings from a Survey of Sellers to the Restoring the Balance program, *Economic Papers* 32, 340-352.

Wheeler, S., Zuo, A., Bjornlund, H. & Lane-Miller, C. (2012). Selling the farm silver? Understanding water sales to the Australian government. *Journal of Environmental and Resource Economics, 53*, 133-154.

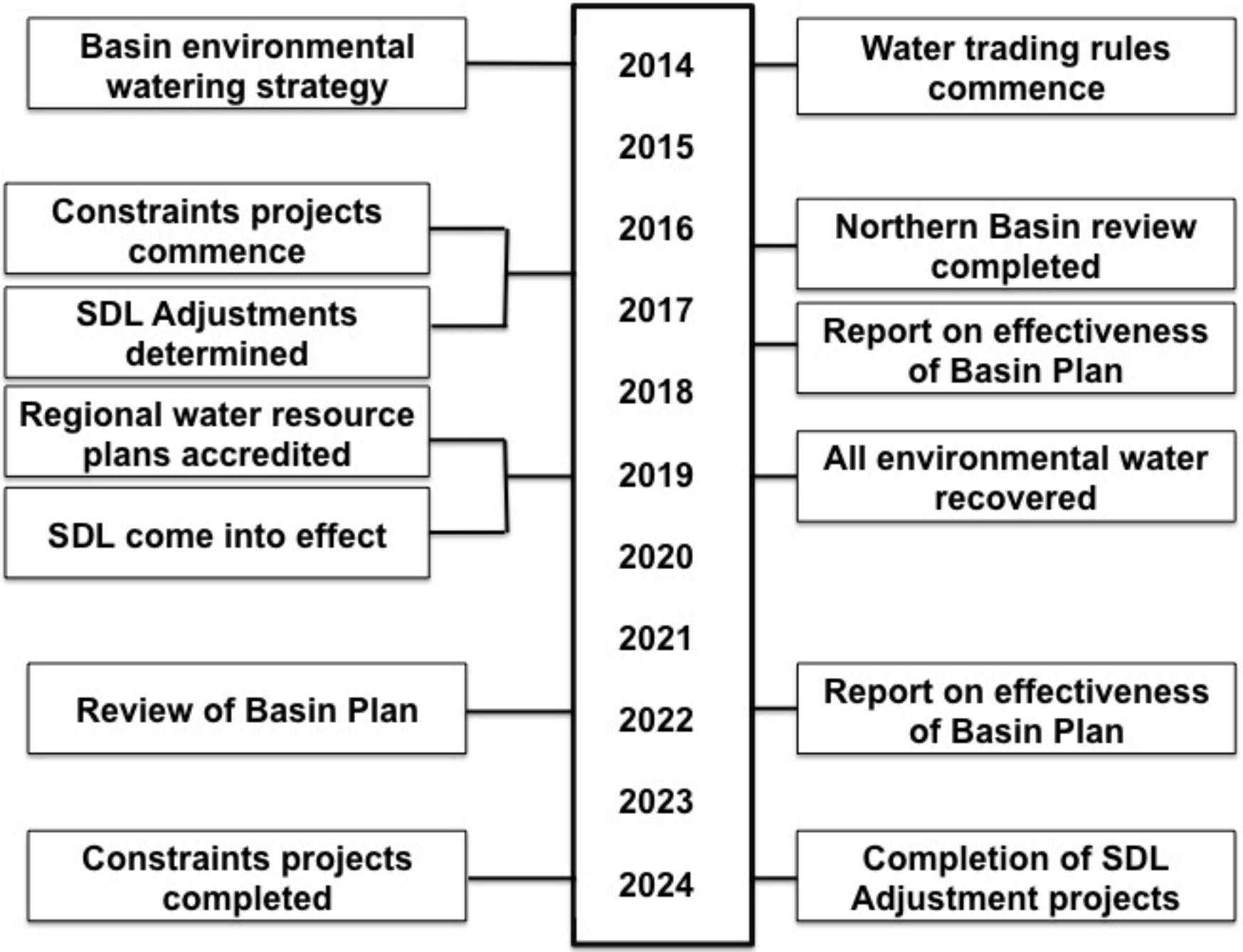
Wilson, P. (2013). *The Blue Paper: Water Co-governance in Canada*, Forum for Leadership on Water (FLOW), 39pp (http://www.flowcanada.org/document/374).

Wittwer, G. & Dixon, J. (2013). Effective use of public funding in the Murray-Darling Basin: a comparison of buybacks and infrastructure upgrades, *Australian Journal of Agricultural and Resource Economics* 57, 399-421.

Yang, Y.-C.E., Brown, C., Yu, W., Wescoat, J. & Ringler, C. (2014). Water governance and adaptation to climate change in the Indus River Basin. *Journal of Hydrology, 519*, 2527-2537.

Figures


Queensland
Brisbane
South
Australia
New South
Wales
Darling River
Sydney
Adelaide
Canberra
Murray River
Victoria
Melbourne


Basin environmental watering strategy
Constraints projects commence
SDL Adjustments determined
Regional water resource plans accredited
SDL come into effect
Review of Basin Plan
Constraints projects completed
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Water trading rules commence
Northern Basin review completed
Report on effectiveness of Basin Plan
All environmental water recovered
Report on effectiveness of Basin Plan
Completion of SDL Adjustment projects