THE MURRAY-DARLING BASIN PLAN FAILS TO DEAL ADEQUATELY WITH CLIMATE CHANGE

Our April issue featured a technical paper titled 'Managing Water in the Murray-Darling Basin Under A Variable And Changing Climate'. The paper caused a bit of a stir and created dispute among Australian scientists. In this opinion piece Jamie Pittock, John Williams and R Quentin Grafton from the Australian National University state their case.

Managing the risks and resilience of the Murray-Darling Basin River systems into the future requires that the Basin Plan incorporate measures to adapt to the projected impacts of climate change on both trend and variability. There is sufficient quantitative knowledge available that indicates there are significant direct and indirect risks from climate change on water availability. Yet the current Basin Plan and associated programs do not properly address climate change and there are at least seven actions required to manage climate change and water inflow risks into the future.

It is our view that the failure to use current knowledge on projected impacts of climate change in the computation for the Basin Plan's sustainable diversion limits, or provision for systematic adjustment into the future, significantly increases the risks to the ecological heath of the river systems. It also increases the uncertainty to communities, who now have no clear policy setting or process to manage the anticipated changes in water availability into the future. We conclude that action is required to revise the Basin Plan (and the *Water for the Future* package) earlier than is scheduled for 2022.

CLIMATE CHANGE IMPACTS AND STREAM FLOW RISKS IN THE BASIN

Reduced water availability in the Basin due to climate change has been projected from the 1980s (Pittock, 1980; Palmer *et al.*, 2008). The mid-latitude location makes the Basin particularly sensitive to climate-induced hydrological change (Palmer *et al.*, 2008; Gallant *et al.*, 2012; Grafton *et al.*, 2012). Last decade, CSIRO projected scenarios for surface water availability in the Basin by 2030. The scenarios of 'extreme wet' – 7% more water, 'median' – 12% less, and 'extreme dry' – 37% less, exhibit great uncertainty (CSIRO, 2008). The higher or lower inflows increase down the river to the sea so that, for example, an extreme dry scenario could result in as much as a 69% fall in outflows.

In this context it is imperative that relevant governments enact robust climate change adaptation measures to manage increased temperatures, changes in water availability and more frequent extreme events, among other impacts. The Federal Government has adopted a regulatory Basin Plan to manage water diversion limits, supported by other programs, notably the *Water for the Future* package that seeks to facilitate the reallocation and better management of water among consumptive and environmental users. Of fundamental importance is the failure of the current Basin Plan to incorporate projected climate change impacts in the assessment of the 'sustainable diversion limits' (SDL; SSCRRAT, 2013), which are critical mechanisms to give some level of confidence to water users and managers of the river health.

SEVEN MAIN PROBLEMS FOR CLIMATE CHANGE ADAPTATION

While Neave *et al.* (2015) suggest ways in which the current Basin Plan may be adjusted to manage climate change from 2022, all of the measures outlined fail to deal with the primary task, which is to have means to set and adjust the SDLs in line with the anticipated impacts of climate change. In their conclusion, Neave *et al.* (2015) admit this when they state: "Policy challenges remain, not the least of which is how reductions in water availability due to climate change could be shared between consumptive use and the environment".

We argue that no allowance has been made in the SDLs for long-term climate change to adequately partition water use adjustment for consumptive users and the environmental health needs of the river systems.

We contend that there are seven main problems for climate change adaptation that are predictable, capable of being addressed by Australian governments and to which the Basin Plan does not adequately respond. Importantly, these issues are raised in the peer-reviewed academic literature and in parliamentary inquiry evidence, but are not cited by Neave *et al*. (2015). We highlight seven failings of the 2012 Basin Plan and complementary measures.

1. Allocated insufficient water to reduce historic impacts

Good, current ecological health of an ecosystem is likely to increase its resilience to future climatic variability and change. Consumptive use of water diverted from any ecosystem is likely to have some degree of environmental impact, and while science should inform decisions with data on thresholds and options, society must make value judgements as to the level of environmental degradation that is acceptable. Neave *et al*. raise the question of "whether environmental objectives remain feasible and appropriate under climate change" (2015:102), but the Basin Plan process does not address this question (SSCRRAT, 2013), as admitted by the Murray-Darling Basin Authority (Borschmann and Phillips, 2015).

In the case of the Basin, the thresholds of acceptable change under the current climate have been established in two main ways. Under the Ramsar Convention on Wetlands, Australia committed in international law to maintain the "ecological character" of designated sites unless the Federal Government declares that it will not do so in "the urgent national interest" (which it has not declared). As many of the 16 Ramsar sites in the Basin were designated in the 1970s and 1980s, Australia is committed to maintaining the ecological condition that existed at that time (Pittock *et al*., 2010). Further, the *Water Act* requires that the 'environmentally sustainable levels of (water) take' in the Basin Plan do not compromise 'key ecosystem functions' or 'key environmental assets,' including water-dependent ecosystems, ecosystem services and sites with ecological significance (Commonwealth of Australia, 2008; MDBA, 2010a). These are onerous environmental standards given the propensity of the River Murray system to degrade from 'the bottom up' with insufficient flows.

Ostensibly, the Basin Plan commits to a surface water reallocation of 2,750 GL/yr on average to environmental flows that will help restore many wetlands in the Basin, and there is a less secure political commitment relying on engineering works to effectively reallocate a further 450 GL/yr on average (SSCRRAT, 2013). This amounts to a reallocation of water from consumptive use to the environment of up to 29% (Pittock, 2013). While this is substantial, there are a number of peer-reviewed (e.g. Grafton *et al*., 2014) and public assessments (e.g. Lamontagne *et al*., 2012; SSCRRAT, 2013) that suggest that this volume of water is insufficient to achieve the Federal Government's environmental targets for the Basin.

The issue is that wetlands further down river require larger river flows to water, especially those flood plain wetlands of the Riverlands in South Australia, and the Coorong and Lower Lakes where flows are needed to flush salt out to sea (Lamontagne *et al*., 2012; CSIRO, 2011). The initial CSIRO modelling for the Guide to the Basin Plan suggested that a reallocation of 7,600 Gl/yr on average would be required to achieve the desired ecological outcomes (MDBA, 2010b). By contrast, reallocation of 3,200 GL/yr on average to environmental flows only achieves 66% of the 112 targets set by the Authority to deliver a healthy working river (WGCS, 2012b; SSCRRAT, 2013). The South Australian Goyder Institute review states that, "While the Draft Basin Plan would bring some benefits to the South Australian environmental assets of the River Murray, few of the EWRs [environmental water requirements] required to maintain the ecological character of the region are met (Lamontagne *et al*., 2012:27)".

It is notable that an objective of the Basin Plan is to use higher river flows to increase the numbers of years in which the Murray Mouth is open, so as to maintain estuarine and migratory biota, as well as enable egress of salt to the sea. The Authority's *Guide to the Basin Plan* argues that: "In the long term the additional water for the environment should see the Murray Mouth open between 90% and 92% of the time [for a 3,000 GL/y reduction on current diversion limits and a 4,000 GL/y reduction, respectively], compared to 64% of the time as modelled under the current arrangements" (MDBA, 2010a:xxvi). Yet, after wetter years since 2010 and reallocation of 1957.4 GL (as at 31 May 2015) in long-term average annual yield (71.2% of the planned 2,750 GL reallocation; DoE, 2015), in early 2015 dredges were being used to keep the Murray Mouth open, which shows the failure of the interventions authorised in the Plan to date (Winter and Curtain, 2015). A number of wetlands that the Federal Government has committed to conserve, including the Riverlands and the Coorong and Lower Lakes, are, therefore, highly likely to be further degraded under the 2030 median and extreme dry climate change scenarios for the Basin. Further reallocation of water to sustain the ecological health of the river system is required.

2. Excessive consumptive water use in dry years

The adopted Basin Plan does not change the rules that the State Governments use to allocate most available water to consumptive users in dry years. In the past, the argument has been that Australian biota is used to drought so can survive the odd dry year. The risk with climate change is that more severe droughts may increase the period between watering of wetlands beyond the thresholds that such species may withstand (CSIRO, 2008), as already evident from the death of large areas of floodplain forests due to excessive water diversions and drought (Pittock *et al*., 2010).

In 14 of the 18 Basin regions current water-sharing arrangements allocate water to agriculture over the environment (Pittock, 2013). For example, in the Murrumbidgee River catchment the water-sharing rules resulted in negligible outflows into the River Murray between 1994 and 2010, while irrigation diversions remained above 1,500 GL/yr (Grafton *et al*., 2014). The Authority proposed in 2010: "A principle of equitable sharing of any reduction in water availability between consumptive and environment uses" to manage climatic variability (MDBA, 2010a:109). Unfortunately, due to the complexity of implementing this change in the different contexts of each tributary catchment (for instance, changing the reliability of each different class of water entitlement), this reform was abandoned. The water entitlements acquired by the Commonwealth Environmental Water Holder have the same legal character as consumptive water and are potentially available to manage dry years, but at best this will amount to only a fifth of all the environmental water (Pittock, 2013). The Basin Plan needs to be revised to ensure a more equitable allocation of water to sustain environmental health in dry years.

3. Increased groundwater extraction

The plan does systematically regulate groundwater and surface water extractions across the Basin for the first time. While this is sound practice, the baseline diversion limit (BDL) of groundwater was increased from 1,786 GL/yr in the 2010 Guide to 2,386 GL/y in the 2012 Basin Plan, and then the Basin-wide groundwater SDL was increased from 2,095 GL/yr to 4340 GL/yr (MDBA, 2012b) and subsequently reduced to 3,334 GL/yr (SSCRRAT, 2013). Overall, this is an increase of 1,548 GL/yr, a fivefold rise in permissible groundwater extraction from the Basin. The same models and methodology were used in the development of groundwater SDLs in both the

Guide to the Basin Plan and the *Basin Plan* and this large increase in permitted consumption is the result of changes in the assumptions underlying the models, and "consultations with the states and water users" (MDBA, 2012b; WGCS, 2012a). These assumptions and methodology are open to serious question (WGCS, 2012a; SSCRRAT, 2013) even for our historical climate and, most importantly in this discussion, make no provision for climate change. Further, Barron *et al.* (2011) show that most of the priority aquifers in Australia might expect water shortages under a dry scenario of climate change.

Comprehensive analysis and modelling by CSIRO (2008) suggested that groundwater extraction should be capped in some systems, reduced in others and the cases for increases were modest. Further, there is little evidence (MDBA, 2012b) of rigorous assessment of these proposed increased levels of groundwater take on discharge and base flow of rivers, and which CSIRO (2008) showed could be significant in the long term. Conversely, provisions of flooding for adequate groundwater recharge have largely been neglected, such that the Plan may not adequately protect the integrity of the groundwater system itself or the groundwater-dependent ecosystems (SSCRRAT, 2013; WGCS, 2012a). A precautionary approach is required and the groundwater SDL increase in the Basin Plan should be withdrawn.

4. Established unnecessary path dependency

A great number of the initiatives undertaken in the name of Basin management reform have established unnecessary path dependency with water allocations and infrastructure. As discussed, the reallocation of water to the environment falls short of the volumes needed to maintain a number of key wetlands in the target condition under the current climate, and the issuing of new groundwater entitlements creates conditions under which further water reallocation will be more expensive and politically harder to achieve to manage future climatic shifts.

Over five billion dollars (AUD) is allocated, of which about three billion has already been spent in the Federal Government's *Sustainable Rural Water Use and Infrastructure Program*, with the bulk of these funds being spent on 'improving' the efficiency of water delivery infrastructure (Grafton, 2015). This infrastructure investment has been extensively criticised on a number of grounds. For water recovery it is up to four times more expensive than purchasing water entitlements, it is a subsidy for one sector of the farming community over others, and it 'gold plates' infrastructure in places that may not be viable for irrigation under future climates (Productivity Commission, 2010; Adamson and Loch, 2014). Such subsidies can also, in some circumstances, result in reduced net downstream stream flows (Adamson and Loch, 2014; Qureshi *et al.*, 2010).

'Environmental works and measures' infrastructure is being constructed "to multiply the environmental benefits achievable from the water available […] to enable controlled landscape-scale flooding using environmental water – often in much smaller volumes than would be required without these works" (MDBA, 2011a: 56) to reduce the volume of water that needs to be reallocated to the environment (SSCRRAT, 2013). However, these works have been criticised for benefiting only small areas of wetlands, having negative environmental impacts and high opportunity costs. More importantly, this irrigation and 'environmental' water efficiency infrastructure is being constructed without any climate change impact assessment, so may become redundant and need to be decommissioned under a future climate (Pittock *et al.*, 2012). In these contexts the Basin Plan and associated path dependency programs are undertaking 'overly narrow' adaptation and 'maladaptation' (Nelson, 2010; Barnett and O'Neill, 2010). Instead, monies allocated to irrigation and floodplain environmental works and measures programs should be redirected towards the many alternative ways of generating environmental and socio-economic benefits.

5. Focused on a median climate change scenario

In assessing potential climate change impacts on water availability, CSIRO did not assign probabilities to the range of projections, noting that they are each possible (CSIRO, 2008). In 2010, the Authority commented that: "While there is uncertainty associated with different predictions of the magnitude of climate change effects by 2030, there is general agreement that surface water availability across the entire Basin is more likely to decline, with Basin-wide change of 10% less water predicted" (MDBA, 2010a: 33). This misinterpretation equates 'median' scenario as 'predicted' for planning purposes. Risk management practice requires consideration of affordable measures that can reduce the risks arising from less probable, but more damaging, outcomes (Pittock and Finlayson, 2011b). This interpretation also shows that the Authority considers that the climate is likely to change in a gradual, linear manner rather than considering the risk of a greater rate of change over time, as seen with the reduction of inflows into Perth's reservoirs (Petrone *et al.*, 2010).

Instead, there is a need for adaptation measures to be based on 'no regrets' and robust adaptation measures that may offer benefits under a range of climatic outcomes. Analytical tools exist to select such measures in the Basin (Lukasiewicz *et al.*, 2013) and should be applied.

6. No water allocated to reduce the future impacts of climate change

In 2010 the Authority proposed an additional reallocation of three per cent of consumptive water to offset climate change impacts in the life of the Plan based on a (mis)interpretation of CSIRO's 'median' projection (Pittock and Finlayson, 2011b). The Authority abandoned efforts to reallocate water for climate change adaptation in 2011 (MDBA, 2011b), stating that it has: "formed the view that there is considerable uncertainty regarding the potential effects of climate change, and that more knowledge is needed to make robust water planning and policy decisions that include some quantified allowance for climate change. Until there was greater certainty MDBA considered that the historical climate record remains the most useful climate benchmark for planning purposes" (MDBA, 2012a: 123).

Given the Authority's position, we question under what circumstances it would ever be prepared to make a pre-emptive reallocation to reduce the likely impacts of climate change. Given the uncertainty, it would be wise to cease issuing new water entitlements, such as for groundwater, to retain greatest flexibility to reallocate water to manage climate change in the future. Retaining the option of acquiring further water is needed, but is precluded by a bill to cap the purchase of water entitlements for environmental flows to 1,500 GL (Hunt *et al.*, 2015). Reallocation of water to account for climate change will get harder, not easier, as funds from the Australian Government's multi-billion dollar *Water for the Future* package are exhausted and if water availability declines (Grafton, 2015). Further, adjustment of the SDLs is now legally complex and administratively difficult (Young, 2011).

Immediate consideration should be given to applying new mechanisms, such as those canvased by Young (2011) and others, to adjust the allocation of water between consumptive use and the flows necessary for healthy river ecosystems to account for change climate. This issue will continue to cause uncertainty in Basin communities if left unaddressed.

7. Overlooked ecosystem-based adaptations

The 2008 reforms of Basin management in the *Water Act*, as represented by the Plan, involved a narrowing of the broader natural resources management agenda to a focus on water quality and quantity (Connell and Grafton, 2011). As a result, a number of critical and complementary, non-volumetric measures to aid climate change adaptation are not adequately included in current Basin management programs. Major investments should be made in these measures, including: restoring riparian vegetation and instream habitat; modifying or removing water infrastructure to restore connectivity for aquatic wildlife; construction of thermal pollution control devices on dams to enable control over the temperature of discharged water to sustain aquatic wildlife; focusing restoration efforts on climatic refugia; and protection of the remaining free-flowing rivers (Pittock and Finlayson, 2011a; Lukasiewicz *et al.*, 2013).

CONCLUSION

The problems with Basin water management for climate change begin with the insufficient allocation of water to restore and maintain freshwater ecosystems under the current climate. This poses large risks for both water extractors and the environment. These challenges are exacerbated in two key ways. First, the 2012 Basin Plan includes no measures to address projected climate change, even though the modelling to do so was available. Second, the *Water for the Future* package has committed billions of dollars for infrastructure subsidies and is establishing path dependencies with water allocations and infrastructure that will need to be undone at great cost with moderate climate change.

The history of attempts to better manage water resources in the Murray-Darling Basin since the time of Australian federation is one of human-induced environmental crises catalysing reforms that are weakened by political compromises (Connell, 2007). The current Basin Plan does not contain sufficiently robust measures to adapt to projected climate change. The only meaningful climate change measure adopted in the 2012 Basin Plan is a requirement to revise the plan every 10 years to incorporate new knowledge. This is simply not good enough in the world's driest inhabited continent and a country subject to extreme weather-related risks. In response, we call for the immediate adoption of seven additional measures, rather than waiting until 2022.

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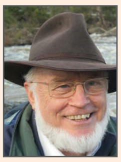

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