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The economic and social effects of the Murray–Darling Basin Plan: recent research and next steps

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Abstract

The Murray–Darling Basin Authority (MDBA) is responsible for identifying new environmentally sustainable diversion limits (SDLs) for consumptive water in the Basin. In October 2010, the Authority released the Guide to the proposed Basin Plan containing three SDL scenarios. These scenarios involved reducing long-run average consumptive diversions by 22, 26 and 29 per cent. ABARES has estimated that reducing irrigation diversions by 26 per cent could reduce the gross value of irrigated agricultural production (GVIAP) in the Basin by around 15 per cent, and gross regional product (GRP) by around 1.3 per cent. When mitigating policies are taken into account, however, the decline in GVIAP falls to around 10 per cent, and the decline in GRP falls to around 0.7 per cent.

While the overall effect on economic activity in the Basin is likely to be relatively modest, the effect could be significant for some towns highly dependent on irrigation expenditure. In particular, some towns surrounded by irrigated broadacre activities such as rice could be significantly affected by reductions in irrigation water availability.

It will be important to investigate options for reducing the costs of satisfying environmental needs. Under the Water for the Future (WftF) program, water purchases to date have been restricted to water entitlements, and investments in water infrastructure have been restricted to irrigation infrastructure. It may be worthwhile broadening the scope of the WftF program to allow the purchase of water products other than entitlements and investments in infrastructure other than irrigation infrastructure.

Key words: Economic effects, Murray–Darling Basin Plan, water, costs, benefits, irrigation, infrastructure

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1 Introduction

The over-allocation of water to consumptive use (and particularly to irrigated agriculture) has damaged a number of important water-dependent environmental assets in the Murray–Darling Basin (MDBA 2010a). Under the *Water Act 2007* the MDBA is responsible for developing a plan to manage water resources in the Basin. The centrepiece of this plan is the establishment of environmentally sustainable diversion limits (SDLs) on surface and ground water use within the Basin. The purpose of the SDLs is to achieve a more sustainable balance between consumptive water uses and the environment.

In October 2010 the MDBA released the *Guide to the proposed Basin Plan* (the Guide), effectively the first of two draft plans. This guide outlined three SDL scenarios, involving reductions in long-run average consumptive diversions of between 22 and 29 per cent (or 3000 to 4000 GL). However, any new limits imposed on diversions are not being introduced in isolation. The Australian Government is currently implementing policies aimed at mitigating the effects of lower irrigation diversions on irrigated agriculture and regional communities. These include the Water for the Future (WftF), program which involves purchasing water entitlements from irrigators and investing in water saving infrastructure. There is also the additional commitment to address any remaining gap between the volume of water secured through the WftF program and the volume required to meet the SDLs through additional entitlement purchases (ALP 2010).

Since the release of the Guide there has been significant debate about 'balancing' the environmental, economic and social effects of the Basin Plan (Burke 2010a; Burke 2010b). As a starting point, the benefits of the plan should outweigh its costs. Maximising the net benefits of the plan requires the further condition that water is shifted from consumptive to environmental use only while the benefits from acquiring an additional megalitre of water (the marginal benefit) exceed the costs of supplying this water (the marginal cost).

Undertaking a quantitative analysis of this type is problematic. Information is needed on the costs and benefits of water use. In the context of increasing environmental flows, information is required on environmental responses to different environmental flow regimes and the value individuals derive from services provided by environmental assets. Much of this information does not exist.

Valuing environmental benefits is complicated by the fact that markets do not exist for many of these benefits. This means that estimates of benefits must be derived from ‘indirect’ market data, such as the cost of travel to environmental sites, or ‘stated preference’ information where stakeholders are asked questions about their preferences to determine their values. Although the methods for measuring these non-market values are improving, there are still real difficulties with their use (Hanley and Barbier 2009).

In contrast, many of the costs of increasing environmental flows are relatively easily identifiable and valued in a market. The main costs include the opportunity cost of diverting water from productive activities such as irrigated agriculture and the costs of building and installing infrastructure. The cost of administering programs such as the WftF program and the associated cost of raising revenue to fund the program should also be included. There are also social costs, which are less amenable to valuation. For instance, it is likely to be difficult to estimate the value of stress experienced by individuals and families in the event that reduced irrigated agriculture leads to unemployment or the need to change vocation or to relocate. There could also be a range of other costs associated with declining populations in towns affected by reductions in irrigated activity.

The distribution of the costs and benefits of the Basin Plan is also an issue. While the benefits generally accrue to the community as a whole, the costs are likely to be concentrated in those areas where the reduction in water use in agriculture is greatest (and where the subsequent flow-on effects are greatest). The government commitment to purchase water from the market to bridge any gap between the SDLs and water recovered through the WftF program will compensate for the majority of the costs borne by irrigators (there may be indirect costs for irrigators remaining in systems where large volumes are purchased by the government). Although the flow-on effects associated with reduced activity in regional economies and towns are mitigated to an extent by water recovered through the WftF program, some towns and regions are still expected to experience significant effects.

While there has been little work attempting to place a dollar value on the benefits of the increased environmental water associated with the SDLs outlined in the guide, there has been considerable analysis of the effect on irrigated agriculture and regional economies. Understanding the likely change in the pattern of irrigated production is essential for understanding the types of effects for towns and communities that flow from that and developing response strategies. The next section of this paper outlines the analyses undertaken by ABARES of the effect of the SDLs (outlined in the Guide) on irrigated agriculture. This is followed by a brief description of the relative vulnerability of communities in the Basin to reductions in water availability. In the final section, some possible options for increasing the value received from the $8 billion currently allocated to acquiring water for the environment in the Basin are explored.

2 Economic analysis

In October 2010, ABARE–BRS (now ABARES) released two reports analysing the economic effects of the major water policies affecting irrigation in the MDB. The first estimated the economic effects of the SDLs contained in the *Guide to the proposed Basin Plan* in isolation from other water policies (ABARE–BRS 2010a), while the second estimated net economic effects taking into account other policies aimed at mitigating the effects of the SDLs contained in the guide (ABARE–BRS 2010b). ABARE–BRS also released a third report that looked at the vulnerability of Basin communities to reduced access to irrigation water (ABARES–BRS 2010c).

The second analysis specifically considered:

- the Basin plan 3500GL SDL option
- the $3.1 billion WftF entitlement purchase program
- the $4.4 billion WftF investment programs targeted at upgrading irrigation infrastructure in the MDB
- the government’s commitment to address any remaining gap between the volumes of water secured through the WftF program and the volume required to meet the SDLs through additional entitlement purchases.

Modelling

The two economic reports used the ABARES Water Trade Model (a model of irrigated agriculture in the MDB) to estimate direct effects on irrigated agricultural production by region and commodity, including changes in water use and the annual gross value of irrigated agricultural production (GVIAP). These studies also used a general equilibrium model of the Australian economy (AusRegion) to estimate flow-on effects to regional economies both within and outside the Basin, including changes in GRP and employment.

More detail on the economic models used to generate these estimates is provided in ABARE–BRS (2010a and 2010b).

Scenarios

The ABARE–BRS (2010b) study considered two policy scenarios; an SDLs only scenario (Scenario 1) and an SDLs with other government actions scenario (Scenario 2) (see table 1). Each policy scenario includes assumptions on changes in net irrigation water availability (reductions due to SDLs or water purchases and increases due to infrastructure investments) and government expenditure (due to entitlement purchases and investments in irrigation infrastructure). A detailed description of the scenarios is contained in ABARE–BRS (2010b).

Data and assumptions

ABARES used a range of available data sources, including ABS agricultural census data, to construct a baseline scenario representative of long-run average irrigation water use, land use, and GVIAP in the Basin (table 2). The MDBA, in turn, supplied the SDL scenarios, while the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) supplied assumptions on the WftF program, including projected regional expenditures, volumes of water recovered and the distribution of these expenditures and water recovery over time, for both the water entitlement purchase and infrastructure investment programs. More detail on these data sources and assumptions are provided in ABARE–BRS (2010a and 2010b).

Results

The results generated by the models are estimates of the long-term effects of scenarios 1 and 2 on irrigated agriculture and economic activity at a regional, Basin and national level.

Basin-level effects on irrigated agriculture

Table 3 contains basin-wide results for scenarios 1 and 2. The estimates indicate that GVIAP and the gross value of agricultural production (GVAP) in the Basin could decline by around 15 per cent and 5 per cent, respectively, if the SDLs are implemented in the absence of mitigating policies (Scenario 1). It is estimated that GVIAP and GVAP will fall by around 10 per cent and 4 per cent, respectively, in the presence of mitigating policies (Scenario 2).

Figure 1 depicts the Basin-wide effects of the two scenarios on GVIAP over the time frame of the WftF program, factoring in the assumed timing of SDL adoption by the states and the assumed timing of entitlement purchase and infrastructure investment programs. Under Scenario 2, government water purchases bring forward reductions in irrigated agricultural production that would have otherwise occurred at the time the SDLs are implemented.

The Water Trade Model (WTM) estimates indicate that reductions in GVIAP (both in percentage change and absolute terms) will be greater for irrigated broadacre activities than for horticulture (both annual and perennial), and that these reductions are greater under Scenario 1 (the SDLs only scenario) than under Scenario 2 (table 4).

Under Scenario 1, the largest absolute annual reductions in GVIAP are expected to occur in irrigated cotton (–$297 million), rice (–$176 million), dairy (–$93 million), hay (–$84 million) and cereals (–$83 million). When the mitigating policies considered in this study are incorporated, the effect on GVIAP is reduced to –$216 million for cotton, –$119 million for rice, –$53 million for dairy, –$54 million for hay and –$58 million for cereals.

The reductions in GVIAP for irrigated cotton and rice account for more than half of the total reduction in GVIAP under both scenarios. The relatively small effects on horticulture are consistent with water being traded away from lower value activities to higher value activities, or horticulture irrigators not selling water under the buyback program.

Economic impact analyses of the Basin Plan scenarios have also been undertaken by the Risk and Sustainability Management Group (RSMG) at the University of Queensland and the Centre for Water Economics, Environment and Policy (CWEEP) at the Australian National University (table 5). At an aggregate level, the results of these analyses are very similar to those of ABARES, with around a 14 per cent reduction in Basin GVIAP under the 3500GL SDL scenario.

Regional-level effects on irrigated agriculture

The regions that incur the most significant declines in irrigated activity under scenarios 1 and 2 are spread across the northern and southern Basin (table 6). These regions also tend to be those that are most heavily involved in producing cotton and rice, as well as pasture-dependent commodities such as dairy products.

The Murrumbidgee and Murray regions in southern New South Wales almost exclusively account for rice production in the MDB. Under the SDLs only scenario (Scenario 1), these regions account for nearly one-third of the $939 million reduction in GVIAP estimated for the Basin. The major cotton growing regions in the northern Basin (Gwydir, Condamine and Namoi) in turn account for more than 20 per cent of the total reduction in GVIAP under Scenario 1, as do the northern Victorian regions specialising in dairy and hay production (Goulburn–Broken, Murray (Vic) and Loddon). The concentration of effects is further illustrated by examining the changes in GVIAP by region by economic activity (table 7). The top 10 effects (by region by activity) account for 55 per cent of the total reduction. The next 10 effects account for a further 16 per cent. The biggest single impact is on rice in the Murrumbidgee, followed by cotton in the Condamine, Gwydir, Namoi and Barwon–Darling regions.

When government actions are taken into account (Scenario 2), regional effects are smaller with the reduction in GVIAP falling to $630 million (see table 7). The distribution of reductions in irrigated activity across regions is similar under both scenarios.

Effect on gross regional product

Table 8 contains GRP and GDP estimates for scenarios 1 and 2 in 2018–19. It is estimated that GRP in the MDB could decline by around 1.3 per cent under Scenario 1, with the Riverina and North East Victoria regions being most affected (map 1) (note that regions used in AusRegion are aggregations of regions used in the WTM).

The WftF program and additional purchases aimed at 'bridging the gap' will help mitigate the flow-on effects of reduced irrigated agriculture on regional economies. In addition to partially offsetting the effect of the SDLs on irrigated agriculture, investment in infrastructure will also provide a significant—but relatively short-lived—stimulus to regional economies. In contrast, additional income from water entitlement purchases is assumed to have a modest but sustained effect on regional economies. It is estimated that the WftF program and additional water purchases will reduce the effect of the Basin plan on GRP by nearly half, from –1.3 per cent to –0.7 per cent.

These relatively small percentage change estimates are to be expected given the size of the MDB economy (GRP of $59 billion in 2000–01) relative to the estimated reduction in agricultural activity (around $600 million). It should be noted that while the effect on basin-wide economic activity is expected to be relatively modest in the long run, the effect on individual regions and towns highly dependent on irrigation activity could be significant.

Effect on employment

It is estimated that employment in the Basin will decline slightly (–0.1 per cent, equivalent to around 900 jobs) under Scenario 1 and remain virtually unchanged under Scenario 2. In the long run, investments in water infrastructure are expected to partially offset the reduction in irrigation water that would occur under the SDLs, while payments for water entitlements should lead to a small increase in household expenditure. This should, in turn, reduce the effect on regional economic activity and employment.

The changes in employment are much smaller than changes in GRP. The employment estimates generated by AusRegion are long-term estimates, and assume that labour is relatively free to move between industries and regions. While this is likely to be a fair assumption in the long run, especially when the economy is performing strongly as it is now, changes in access to irrigation water are likely to lead to more immediate and significant effects on employment, especially in towns and communities highly dependent on irrigation.

Additional analysis undertaken by ABARES following the release of the reports for the MDBA (ABARE–BRS 2010a) and DSEWPaC (ABARE–BRS 2010b) suggests that the short-run effects on employment in the Basin could be several times higher than the long-run effects, with an estimated short-run decline in employment following the introduction of the SDLs of around –0.55 per cent (or around 5000 jobs) under Scenario 1 in 2014–15. This estimate assumes the full reduction in water use up to 2014–15 is sourced at one point in time, and that the mobility of labour and capital between sectors is restricted so as to better capture short-run effects.

This estimate of the short-run impact is likely to overestimate what may actually occur. To begin with, water purchases will occur over time, with a significant proportion of purchases expected to occur before the introduction of the SDLs (figure 1). This will allow some labour released from irrigation and related processing sectors to be more easily absorbed into other sectors than would be the case if the reduction in irrigation water availability occurred at one point in time. Moreover, the effect of the SDLs on irrigation water availability is expected to be partially offset by water savings from investments in irrigation infrastructure.

Local effects

While the effects on economic activity at a Basin and broad regional level are estimated to be relatively modest, the effects on smaller local areas may be more significant. Each of the Basin regions contain a mix of small and medium-sized towns, as well as larger regional centres. Larger regional centres tend to have a broad economic base, which will act to cushion the impact of a decline in irrigated activity. The effects of the SDLs are likely to be more substantial in smaller regional towns heavily dependent on irrigation than in larger regional centres.

Table 9 identifies seven sustainable yield regions where Scenario 2 is estimated to lead to a reduction in the value of irrigated activity of more than $40 million a year. The Murrumbidgee, Condamine, Barwon–Darling, Murray (NSW), Namoi, Murray (Vic), Gwydir and Goulburn–Broken regions are expected to experience the greatest falls in GVIAP.

A reduction in irrigated activity is likely to be reflected in a shift away from irrigated agriculture to dryland agriculture. Since irrigated agriculture is more input-intensive than dryland agriculture, a shift toward dryland agriculture is likely to be reflected in lower farm input expenditure within a region.

WTM estimates suggest that irrigated annual cropping and activities involving irrigated pastures are likely to decline more significantly than horticulture production, as a result of reduced diversions. Some towns that are highly reliant on irrigated agriculture could be significantly affected by changes in water availability, especially if the main irrigated activities in the local area are rice, cotton or dairy. As discussed earlier and illustrated in tables 6 and 7, the effects on irrigated agriculture are estimated to be relatively concentrated. A more detailed discussion and analysis is contained in ABARE–BRS (2010a).

The impact of reductions in irrigated agricultural activity on specific towns will depend on a variety of factors, many of which are difficult to predict. For example, it is difficult to predict when critical thresholds for some businesses are likely to be reached, particularly in the case of downstream processing facilities (such as rice, dairy and cotton). In practice, the future of individual Basin communities will depend on a range of variables, many of them external to the Basin plan and the WtfF program, such as changes in commodity prices, the effects of other government policies, demographic changes and prevailing local climate conditions.

Qualifications

As with all modelling estimates, the economic results reported in ABARE–BRS (2010a and 2010b) need to be treated with a degree of caution. While model estimates provide a guide to the potential magnitude of effects in different regions and industries, actual effects will depend on a number of uncertainties that are not incorporated in the modelling. For instance, it is uncertain how much water will actually be saved by investments in more efficient infrastructure. There is also uncertainty about future commodity prices, future climate, the effect of government policies other than those considered in this study and the way in which states implement the Basin plan.

The model results are also based on changes in long-run average diversions, and do not take into account the potential for a change in the variability of diversions to affect the pattern of irrigated activities. Changes in variability can have implications for short and long-run farming decisions, including crop planting decisions, capital investment decisions and decisions about different farming activities, particularly between perennial and annual crops. The effect of the proposed SDLs on variability is not known at this time. For example, there is uncertainty as to how the SDLs will be implemented on a year-to-year basis, which could affect water availability under different conditions, particularly during very dry years.

Although the long-run effect of the Basin Plan on employment is expected to be small relative to total MDB employment, the estimated employment changes remain subject to some uncertainty given their relatively small size and the simplifying assumptions of the model. The broader regional effects estimated by the AusRegion model depend on a range of assumptions, including about the extent to which displaced agricultural labour in a given region will find employment in other industries within the region or will migrate to other regions inside or outside the MDB. There are also uncertainties about the timing of effects, as the purchase of water is expected to occur over a relatively long time frame. In addition, it is difficult to predict when critical thresholds for some businesses are likely to be reached, particularly in the case of downstream processing facilities (such as rice, dairy and cotton).

3 Community vulnerability analysis

In October 2010, a report prepared by ABARE–BRS for the MDBA was released looking at the vulnerability of Basin communities to reduced access to irrigation water more generally (ABARE–BRS 2010c). This research was undertaken in collaboration with the University of New England's Institute for Rural Futures.

The aim of this study was to increase understanding of the socioeconomic circumstances of communities located in the MDB, and to provide a readily accessible measure with which to compare the relative vulnerability of communities to a reduction in access to irrigation water. It should be noted that the analysis did not attempt to differentiate between regions based on specific SDL scenarios or the nature of the response of irrigators to reduced water availability. However, for a given reduction in water availability, it can be expected that many of the non-market costs of adjustment will be higher for communities that are relatively more vulnerable.

Method

The study involved mapping the vulnerability of communities in the Basin using social indicators populated with ABS census data (ABS 2007) and water use data (ABS 2008). This is a well-known method for tracking changes in socioeconomic circumstances of resource-dependent communities.

The research defined community vulnerability as the degree to which a community is susceptible to pressures and disturbances (for example, climate change), with vulnerability being a function of sensitivity and adaptive capacity. Sensitivity is defined as a measure of a community's reliance on irrigation water and dependence on associated agricultural and processing employment. Adaptive capacity is defined as the inherent capacity of a community to manage or cope with change, taking into account measures such as income, education levels, age structure, mobility, housing and economic diversity.

Results

The results of the analysis show that community vulnerability to changes in water availability varies widely across the Basin (map 2). In particular, there are two large areas where community vulnerability is identified as being high to very high. One is located in the north-east of the Basin (covering parts of the Border Rivers, Barwon–Darling, Gwydir and Namoi regions), while the other is concentrated along the Murray River above the confluence of the Murray and Darling rivers and along the Murrumbidgee River. The vulnerability study identifies communities located in these areas as having a combination of higher sensitivity to changes in water availability (that is, very high dependence on water for agriculture and high agri-industry employment) and limited capacity to adapt (that is, lower levels of human capital, social capital and economic diversity) compared with other areas in the Basin. These areas roughly coincide with those identified in the ABARE–BRS economic analysis as regions where there may be significant reductions in irrigated activity following the implementation of SDLs.

Qualifications

The method used in the analysis has several limitations. The first limitation is that community vulnerability is complex, and it is unlikely that a single measure will capture the full experience of communities undergoing rapid change. Second, the use of ABS census data reveals only part of the story. Further validation and scrutiny of the indicators is recommended to establish whether they represent people's experiences at a community level, and to increase understanding of the community vulnerability index. As a result, map 2 should be viewed with care; it is intended to assist with understanding patterns of vulnerability in the Basin and is thus illustrative rather than definitive.

4 Maximising the benefits and minimising the costs of environmental water

The Australian Government has allocated around $8 billion to recovering water for the environment in the MDB under the WftF program. To date, this program has focused on purchasing permanent water entitlements and investing in irrigation infrastructure to reduce water losses. Given the size of this budget, it may be worthwhile investigating whether there are other options that can satisfy environmental needs at a lower cost. The remainder of this paper examines the potential for broadening the range of water markets the Commonwealth Environmental Water Holder (CEWH) can participate in and the type of water infrastructure that can be invested in to reduce the cost of satisfying environmental needs.

Regardless of whether the benefits and costs of reallocating water from consumptive to environmental use can be fully quantified, it is useful to focus on identifying the main costs of satisfying an environmental goal. There will usually be more that one option for achieving an environmental goal, so this approach will allow a comparison of costs.

At a very basic level, some environmental assets will require access to relatively stable water supplies, whereas others require only intermittent access to water, as is the case for floodplain wetlands. Within the context of the WftF program, high-security water entitlements are likely to be able to cost-effectively satisfy the needs of environmental assets that require stable access to water. There may, however, be cheaper options for satisfying intermittent environmental demands than purchasing entitlements or investing in irrigation infrastructure.

There are basically two options for reconnecting rivers with wetlands. The first is to create or enhance an environmental flood by releasing water from a dam to top up a natural high-flow event. The second is to mimic a flood using engineering works, which may or may not be linked to a high flow event.

Creating or enhancing an environmental flood by releasing water from a dam to top up a natural high-flow event may require access to significant volumes of water, whereas investing in environmental works and measures such as regulators and pumps installed along river systems may be able to mimic a flood using much less water. Engineering solutions work by either artificially raising river levels so that water flows over the riverbank or by diverting water to a desired location by pumping it over the riverbank or by diverting it through a structure such as gate in the side of the river.

Topping up high-flow events

The options for acquiring water to top up high-flow events under the WftF program have to date been restricted to investing in irrigation infrastructure or purchasing water entitlements. The Productivity Commission (2010) suggests that investing in irrigation infrastructure is generally not cost-effective, and that purchasing water from irrigators is likely to be a less costly option. There is some evidence to support this claim, with water savings generated by investments in the Northern Victoria Irrigation Renewal Project costing around $4400 per megalitre (NVIRP 2010) compared with around $2000 per megalitre for purchasing high-security water entitlements (GHD Hassall 2010).

Even if the acquisition of water to top up high-flow events was confined to water purchases, it still may be possible to reduce the cost of these acquisitions by broadening the range of water markets the CEWH can participate in to include water allocation and water options markets.

Satisfying the peak intermittent watering needs of wetlands using only entitlements may require the CEWH to purchase large volumes of water entitlements. While it may be possible to reduce the volume of entitlements needed by allowing the allocations attached to these entitlements to be carried over for future use, this could lead to other problems if water storage rights are poorly defined, which is currently the case for most dam systems in the Basin (Hughes and Goesch 2009). For instance, if the CEWH carried over large volumes of water in systems where storage rights are poorly defined, this could lead to dams spilling earlier than would otherwise have been the case, adversely affecting the yield of other water users' entitlements (Hughes and Goesch 2009).

The effect of purchasing large volumes of entitlements on irrigated agriculture will depend on whether the CEWH can sell excess allocations attached to these entitlements to irrigators in dry years (the opportunity cost to irrigated agriculture in wet years is likely to be low, as this water would typically have been used for relatively low value irrigated activities). If the CEWH is allowed to sell these allocations, the opportunity cost of these purchases will be significantly reduced.

It should be noted that while the *Water Act 2007* allows the CEWH to trade and carry over allocations, this power appears to be limited (PC 2010). The CEWH has interpreted the Water Act to permit the sale of annual water allocations and permanent water entitlements if the allocations are not required to meet environmental objectives in the current year and if the water cannot be carried over to the next year (DEWHA 2010). Annual allocations and permanent water entitlements may also be sold if the proceeds are used to acquire other water that will improve the capacity to protect and restore the environment (DSEWPaC 2010). The Productivity Commission (2010) note that it is difficult to predict how these powers will be exercised by the CEWH and that there may be instances where these caveats on trade lead to inefficient outcomes at a system-wide level. For instance, there may be periods when, rather than carrying over unneeded water or selling it to acquire water at other locations, it may be more efficient to sell water and retain the funds for acquisitions in future seasons (PC 2010).

If the SDL options contained in the Guide to the Proposed Basin Plan are a reasonable indication of potential reductions in irrigation diversions, the government may need to purchase a substantial volume of water entitlements, both under the WftF program and through additional purchases needed to close the gap between the SDLs and water recovered via buybacks and infrastructure investments under the WftF program. The removal of the allocations attached to these entitlements from the market could have significant implications for irrigators and the temporary water market. The allocation market allowed water to move between uses which significantly reduced the impact of the recent drought on irrigation in the southern Basin. Many irrigators with permanent plantings were able to avoid or reduce the extent of plant losses (and the associated costs) due to low allocations by accessing the allocation market (see box 1).

Box 1: Allocation trade during drought

A study by Mallawaarachchi and Foster (2009) found that there has been nearly a 50 per cent increase in the volume of allocations traded since 2004–05, and that in 2007–08 1298GL of temporary water was traded in the southern MDB, representing around 87 per cent of total water diverted from the Murray system that year. Mallawaarachchi and Foster (2009) also provide some examples of how access to the temporary water market allowed farmers to mitigate the impact of the drought. For instance, an interview with a horticulture farmer located in the Riverland revealed how he would have had to let some vines and almond trees die if he had to rely solely on his 32 per cent allocation in 2007–08. However, he was able to keep his younger plantings alive and maintain production on mature stands by purchasing 260 ML of water on the temporary market at a cost of $250 000.

Mallawaarachchi and Foster (2009) found that South Australian irrigators benefitted from trading in water from upstream states by around $31m in 2007–08, whereas upstream irrigators benefited by around $4 million.

The Productivity Commission (2010) has also identified a number of advantages in using seasonal allocations to target environmental watering demands over water entitlements. To begin with, allocation trades can be executed more quickly than entitlement trades, providing the CEWH with more flexibility to engage in adaptive management. The certainty of obtaining purchased water makes allocations suitable for targeting immediate environmental needs, whereas their temporary nature allows better targeting of highly variable and sporadic environmental demands.

On the downside, there is potential for the CEWH's entry into the allocation market to be disruptive. For instance, large volumes of water will be needed in some years, which could be difficult to source at short notice. In addition, the entry of a large buyer into the allocation market, often early in the season when irrigators are uncertain as to what their final allocations will be, could lead to a significant increase in allocation prices. Given that the CEWH would be a large player in the market, and could potentially influence market prices, there are a range of governance issues that would need to be addressed. The Productivity Commission (2010) recommends that seasonal allocations be included in a wider portfolio of water products.

Another alternative for acquiring environmental water is through the use of water options contracts. An options contract is a derivative product that attaches to an underlying security, such as a water entitlement. Under this method, the CEWH would purchase water options from irrigators, with the contract stating the conditions (trigger) under which the CEWH would gain access to water. This trigger could be set in terms of an allocation rate. ABARE modelling has shown that there could be significant savings (excluding transactions costs) when using options that are triggered at high allocation rates in the presence of countercyclical demands (Heaney and Hafi 2005). The use of water options would reduce the need for the CEWH to enter the allocation market to source large volumes of temporary water at short notice, and any potential disruption to this market. The Productivity Commission (2010) suggests that options contracts can provide significant flexibility in targeting environmental outcomes, in terms of duration and frequency of exercise of the options.

One of the downsides of water options is that there is currently no active market, and that there are likely to be significant transaction costs in establishing one given the complexity of these markets (PC 2010). For example, there will be costs in establishing institutional support for the contracts, in specifying the option and in determining the appropriate option price.

Given that there are advantages and disadvantages in sourcing water using entitlements, allocations and options, it may be useful to acquire a portfolio of water products. According to Scoccimarro and Collins (2006), such a portfolio may be the most effective approach to balance effectiveness, cost and workability in meeting environmental demands.

Engineering solutions

Creating or enhancing a flood by releasing water from a dam to top up a natural high-flow event may require access to significant volumes of water, whereas engineering solutions may be able to achieve similar environmental outcomes using much less water. The suitability of engineering solutions to achieve environmental outcomes will depend on the type of environmental need, the geomorphology of the river system and their cost relative to other options.

The water 'savings' from investing in engineering solutions could be significant. For instance, in a report released by the Victorian Department of Sustainability and Environment (2009) it is estimated that the volume of water needed to flood 30 per cent of Lindsay Island floodplain ecosystem on the River Murray could fall from 1000 GL per flood event to 92 GL per flood event using engineering solutions. The cost of building this infrastructure is estimated to be $43 million (DSE 2009). For comparison, if it cost $4000 to save a megalitre of water through investments in irrigation infrastructure (similar to costs of some projects), it would cost $4 billion to acquire 1000 GL. If it cost $1000 per megalitre to purchase a low security water entitlement, the cost of acquiring 1000 gigalitres would be $1 billion. Even if these purchases were confined to allocations in wet years when allocation prices could be down around, say, $50 per megalitre, it could cost around $50 million for each flood event. It should be noted that engineering solutions will not always be the most cost-effective option for satisfying intermittent environmental needs.

There may also be additional costs in using water purchased from irrigators or acquired from investments in irrigation infrastructure if topping up high-flow events leads to flood damage to farmland and urban areas. According to the MDBA (2010b), river operators are legally prevented from undertaking actions that increase flooding impacts on third parties, because of potential legal liability. As a result, the risk of artificial floods causing damage to third parties is an important consideration in assessing the method by which environmental sites will be watered.

Apart from using less water, there may be a number of other advantages in using engineering solutions compared with more traditional methods to flood wetlands. For instance, engineering solutions may provide the CEWH with more flexibility in terms of the timing of floods, since they won't necessarily need to coincide with a high-flow event. This will become more important if climate change leads to more extreme events, such as extended droughts, with engineering solutions likely to provide more certainty to the environment (DSE 2009).

The above comparison is somewhat simplistic. For example, it ignores the possibility of the CEWH selling allocations back to irrigators in dry years. It also ignores the potential for floods created by topping up high-flow events to provide ‘whole-of-system’ environmental benefits. For example, topping up a fast-flowing high-flow event is likely to stimulate additional ecological responses (both within a river channel and in flood plain wetlands) than an engineered flood, which is likely to involve the slow inundation of a wetland. The additional water may also be able to water several wetlands. Despite these additional benefits, the big difference in cost estimates identified in the example above suggests that the economic viability of investing in engineering solutions as an option for satisfying intermittent environmental needs should at least be investigated.

5 Conclusion

The MDBA has been given the responsibility for identifying new environmentally sustainable diversion limits (SDLs) for consumptive water in the Basin. These new diversion limits will effectively reallocate water away from consumptive use (mainly irrigation) to the environment. A range of concerns has led to significant debate over the need to 'balance' the environmental, economic and social effects of new diversion limits to be set under the Basin Plan. One of the major issues is that while the costs of this reallocation are likely to be concentrated in towns and communities closely linked to irrigated agriculture, the benefits are spread across the wider community.

In October 2010, the MDBA released the *Guide to the proposed Basin Plan,* containing three SDL scenarios. These scenarios implied reductions in long-run average consumptive diversions of 22, 26 and 29 per cent. ABARES has estimated that reducing irrigation diversions by 26 per cent will reduce GVIAP in the Basin by around 15 per cent, and GRP by around 1.3 per cent. When mitigating policies in the form of the WftF program and additional purchases needed to close the gap between water recovered via the WftF and the SDLs are taken into account, the effect on GVIAP declines by around one-third, to –10 per cent, while the effect on GRP declines by around half, to –0.7 per cent.

The analysis also indicated that reducing irrigation diversions by 26 per cent could lead to a slight decline in employment in the Basin (–0.1 per cent, equivalent to around 900 jobs) in the long term. This estimate assumes that labour and capital are highly mobile. Additional analysis undertaken by ABARES following the release of the reports for the MDBA (ABARE–BRS 2010a) and DSEWPaC (ABARE–BRS 2010b) suggests that the short-run effects on employment in the Basin could be several times higher than the long-run effects, with an estimated short run decline in employment following the introduction of the SDLs of around –0.55 per cent (or around 5000 jobs) under Scenario 1. This estimate assumes the full reduction in water use is sourced at one point in time, and that the mobility of labour and capital between sectors is restricted so as to better capture short-run effects. However, this is likely to overestimate what may actually occur given other government interventions. For instance, water purchases will occur over time, with a significant proportion of these purchases expected to occur before the introduction of the SDLs. This will allow some labour released from the irrigation and related processing sectors to be more easily absorbed into other sectors than would be the case if the reduction in irrigation water availability occurred all at once. In addition, the effect of the SDLs on irrigation water availability is expected to be offset to some extent by water savings from investments in irrigation infrastructure.

While the effects on economic activity at a Basin and broad regional level are likely to be relatively modest, the effects on smaller local areas may be more significant. For example, the analysis indicated that reductions in GVIAP will be greater for irrigated broadacre activities than for horticulture, which suggests that some towns could be significantly affected by reductions in water availability if they are highly reliant on irrigation expenditure and surrounded by irrigated rice, cotton and dairy.

While it would be ideal to identify socioeconomic effects at a finer scale than has been undertaken to date, there are a number of risks in trying to predict socioeconomic effects at too fine a scale. Where these effects will occur will be largely determined by which irrigators decide to sell their entitlements to the government. ABARES irrigation survey data clearly identify a wide variation in farm performance across industries and regions, as well as between irrigators within a region (figure 2). As a result, it is difficult to identify parts of a region as performing relatively poorly and being more likely to participate in water purchase programs. And even if irrigators sell water to the government now, some of these irrigators could purchase water in the market at some point in the future if the net returns justified it. It is important that this is understood when attempting to estimate (or interpret) effects at a local level.

There are also uncertainties about the timing of effects, as the purchase of water is expected to occur over a relatively long time frame. In addition it is difficult to predict when critical thresholds for some businesses are likely to be reached. Other sources of uncertainty include how much water will be saved via investments in water savings infrastructure (this will affect the change in irrigated activity) and how the states will implement the new SDLs, which could have implications for the variability of irrigation water supplies.

In developing responses to the adverse effects of changes in water availability, it will be important to recognise that uncertainty will remain over where effects will occur. The development of effective response options will be assisted through identifying the full scope of effects (for example, transitional employment effects, changes in the pattern of irrigated activities because of changes in supply variability, implications for the provision of services and the range of social effects).

It will be important to monitor effects. Identifying them as they occur will improve the delivery of any programs designed to assist adjustment. The analysis already undertaken by ABARES and others provides an indication of regions that may warrant close monitoring. It will also be important not to implement policies that act to impede beneficial adjustment from occurring.

It will also be important to ensure that the water recovery programs currently being implemented in the Basin deliver value for money. To date these programs have focused on purchasing permanent water entitlements and investing in irrigation infrastructure to reduce water losses. It may be worthwhile investigating whether there are other options that can satisfy environmental needs at a lower cost. For instance, there could be significant savings in broadening the range of water markets the CEWH can participate in and the type of water infrastructure that can be invested in.

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Appendix A

Table 1: Policy scenarios

Scenario	Description
Baseline	Business as usual: irrigation water availability based on that observed in a representative year
Scenario 1	SDLs only: reduction in irrigation water as a result of the SDLs as defined in ABARE–BRS (2010a) (3500 GL scenario).
Scenario 2	SDLs and government actions: net reduction in water availability after accounting for SDLs and government actions (including regional stimulus from WftF expenditure and additional water purchases).

Table 2: Baseline scenario total water use[a], land use, GVIAP and GVAP by activity

	Water use (GL/y)	Land use ('000 ha)	GVIAP ($m/y)	GVAP ($m/y)
Cereals	770	261	185	3 582
Cotton	2 634	405	1 293	1 389
Dairy	1 177	213	909	1 179
Fruit and nuts	469	74	1 006	1 164
Grapes	583	106	715	781
Hay	816	209	171	776
Meat cattle	666	183	612	2 983
Other broadacre	158	42	41	1 410
Rice	2 409	177	476	476
Sheep	551	182	155	2 080
Vegetables	169	37	657	720
Total	**10 403**	**1 890**	**6 220**	**16 539**

a *Total water use refers to the sum of ground and surface water.*

Table 3: WTM estimates of the effect of the 3500 GL Basin Plan, WftF and additional water purchases on Basin water use, GVAP, GVIAP and profit, 2018–19

Scenario 1[a] – SDLs only	Unit	Baseline	Scenario	% change	Value Change
Water use	GL/y	10 403	7 316	–29.7	–3 087
GVAP	$m/y	16 539	15 668	–5.3	–871
GVIAP	$m/y	6 220	5 281	–15.1	–938
Profit	$m/y	1 956	1 804	–7.8	–152
Scenario 2 – SDLs and government actions					
Water use	GL/y	10 403	8 273	–20.47	–2 129
GVAP	$m/y	16 539	15 945	–3.6	–594
GVIAP	$m/y	6 220	5 589	–10.1	–630
Profit	$m/y	1 956	1 866	–4.6	–90

a *There is a small difference between the WTM estimates for the Basin Plan scenario in this report and those in the ABARE–BRS report to the MDBA (ABARE–BRS 2010a), due to slightly different assumptions for the Goulburn–Broken, Loddon and Campaspe regions.*

Table 4: Effect of SDLs and government actions on GVIAP relative to baseline, by agricultural activity, 2018–19

	Baseline	Scenario 1		Scenario 2	
	$m/y	level change ($m/y)	% change	level change ($m/y)	%change
Irrigated cereals	185	–83	–45.1	–58	–31.4
Cotton	1 293	–297	–22.9	–216	–16.7
Irrigated dairy	909	–93	–10.2	–53	–5.8
Fruit and nuts	1 006	–31	–3.1	–20	–2
Grapes	715	–36	–5.1	–24	–3.4
Irrigated hay	171	–84	–49.1	–54	–31.4
Irrigated meat cattle	612	–59	–9.7	–35	–5.8
Other irrigated broadacre	41	–18	–44	–13	–30.9
Rice	476	–176	–36.9	–119	–25.1
Irrigated sheep	155	–48	–31.3	–29	–19
Vegetables	657	–14	–2.1	–9	–1.3
Total	**6 220**	**–939**	**–15.1**	**–630**	**–10.1**

Table 5: Comparison of various SDL modelling results – Change in GVIAP, Murray–Darling Basin

Results	ABARES	RSMG	CWEEP
3000GL	–13%	NA	–10%
3500GL	–15%	–14%	–13%
4000GL	–17%	NA	–16%

Source: Grafton (2010).

Table 6: Effect of SDLs and government actions on GVIAP relative to baseline, by region, 2018–19

Region	Baseline	Scenario 1[a]		Scenario 2	
	$m/y	level change ($m/y)	% change	level change ($m/y)	% change
Condamine	457	–70	–15.3	–64	–13.9
Border Rivers (Qld)	245	–21	–8.6	–17	–7
Border Rivers (NSW)	185	–24	–13.1	–17	–9
Warrego	7	–1	–11.8	–1	–10.5
Paroo	6	0	0	0	0
Namoi	332	–59	–17.7	–49	–14.7
Macquarie	275	–49	–17.8	–23	–8.4
Moonie	40	–15	–37.1	–13	–32.7
Gwydir	321	–84	–26.1	–44	–13.9
Barwon–Darling	172	–38	–22.1	–38	–22
Lachlan	165	–16	–10	–8	–5
Murrumbidgee	890	–225	–25.3	–157	–17.6
Ovens	56	–2	–3.5	–1	–2.4
Goulburn–Broken	704	–85	–12.1	–41	–5.8
Campaspe	134	–14	–10.6	–8	–6.2
Wimmera	13	0	0	0	0
Loddon	284	–56	–19.5	–27	–9.5
Murray (NSW)	409	–79	–19.3	–53	–12.9
Murray (Vic)	779	–66	–8.5	–45	–5.8
Lower Murray–Darling	71	–5	–6.6	–3	–4.5
Murray (SA)	514	–30	–5.8	–21	–4
Eastern Mt Lofty Ranges	163	–1	–0.5	–1	–0.5
Total	**6 220**	**–939**	**–15.1**	**–630**	**–10.1**

a *There is a small difference between the WTM estimates for the Basin plan scenario in this report and those in the ABARE–BRS report to the MDBA (ABARE–BRS 2010), due to some slightly different assumptions for the Goulburn–Broken, Loddon and Campaspe regions.*

Table 7: Estimated change in GVIAP ($m/y) – Scenario 2, by region by activity

Region	Industry											
	Cereals	Cotton	Dairy	Fruit & nuts	Grapes	Hay	Meat cattle	Broad-acre	Rice	Sheep	Vegetables	Total
Condamine	–9.0	–42.1	–1.1	–1.0	–0.1	–5.6	–2.2	–1.6	0.0	–0.2	–0.8	–63.6
Border Rivers (Qld)	0.0	–14.8	0.0	–0.2	–0.1	–1.3	–0.3	–0.2	0.0	–0.1	–0.4	–17.2
Border Rivers (NSW)	–1.5	–13.4	0.0	–0.1	0.0	–1.1	–0.2	–0.2	0.0	–0.1	0.0	–16.6
Warrego	0.0	0.0	0.0	0.0	0.0	–0.3	–0.4	0.0	0.0	0.0	0.0	–0.7
Paroo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Namoi	–4.8	–36.9	–0.7	0.0	0.0	–3.7	–1.1	–1.1	0.0	–0.3	0.0	–48.7
Macquarie	–1.6	–15.5	–0.5	–0.2	–0.3	–2.8	–0.5	–0.7	0.0	–0.7	–0.2	–23.0
Moonie	–0.1	–12.3	0.0	0.0	0.0	–0.3	–0.3	0.0	0.0	–0.1	0.0	–13.0
Gwydir	–1.5	–40.9	0.0	–0.5	–0.1	–0.4	–0.1	–0.8	0.0	–0.2	–0.1	–44.5
Barwon–Darling	–1.3	–35.3	0.0	–0.1	–0.1	–0.3	–0.1	–0.2	0.0	–0.4	–0.1	–37.8
Lachlan	–1.6	–2.0	–0.1	–0.4	–0.3	–1.6	–0.4	–0.2	–0.7	–0.5	–0.5	–8.2
Murrumbidgee	–27.2	–2.9	–0.7	–2.2	–3.5	–12.3	–4.0	–6.1	–87.5	–8.7	–1.4	–156.5
Ovens	0.0	0.0	–0.3	0.0	–0.2	–0.2	–0.4	0.0	0.0	–0.1	0.0	–1.4
Goulburn–Broken	–0.7	0.0	–18.2	–1.8	–0.2	–6.1	–9.1	–0.1	–1.4	–2.7	–0.6	–40.9
Campaspe	–0.5	0.0	–3.4	0.0	0.0	–1.3	–1.8	–0.1	0.0	–0.6	–0.4	–8.3
Wimmera	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loddon	–3.0	0.0	–6.1	–1.4	–0.5	–5.6	–3.9	–0.7	0.0	–5.3	–0.6	–27.1
Murray (NSW)	–4.6	0.0	–3.9	–0.2	–0.4	–3.9	–3.9	–0.3	–28.9	–6.4	–0.3	–52.8
Murray (Vic)	–0.4	0.0	–15.8	–5.3	–7.8	–6.6	–6.2	–0.3	–0.7	–1.3	–0.9	–45.3
Lower Murray Darling	–0.1	0.0	0.0	–0.7	–1.9	0.0	0.0	0.0	0.0	–0.4	0.0	–3.2
Murray (SA)	0.0	0.0	–1.7	–5.8	–8.8	–0.5	–0.4	0.0	0.0	–1.1	–2.4	–20.7
Eastern Mt Lofty Ranges	–0.1	0.0	–0.2	0.0	–0.1	–0.1	–0.1	0.0	0.0	–0.1	–0.1	–0.8
Total	**58.0**	**–216.0**	**–52.7**	**–20.0**	**–24.5**	**–53.9**	**–35.3**	**–12.7**	**–119.3**	**–29.3**	**–8.7**	**–630.4**

Table 8: Estimated change in real GRP and GDP, 2018–19

	Baseline	Scenario 1		Scenario 2	
	$b/y	% change	level change ($b/y)	% change	level change ($b/y)
Northern NSW	19.5	–0.9	–0.18	–0.4	–0.08
Riverina NSW	14.87	–1.9	–0.29	–0.8	–0.13
Western NSW	2.26	–1.6	–0.04	–1.2	–0.03
North East Vic	12.38	–1.7	–0.22	–1	–0.12
North West Vic	14.43	–1.0	–0.15	–0.5	–0.08
Queensland MDB	11.23	–1.4	–0.15	–1.2	–0.14
South Australia MDB	4.63	–1.1	–0.05	–0.5	–0.02
MDB [a]	79.31	–1.3	–1.01	–0.7	–0.57
Australia	1 102.48	–0.1	–1.28	–0.1	–1.27

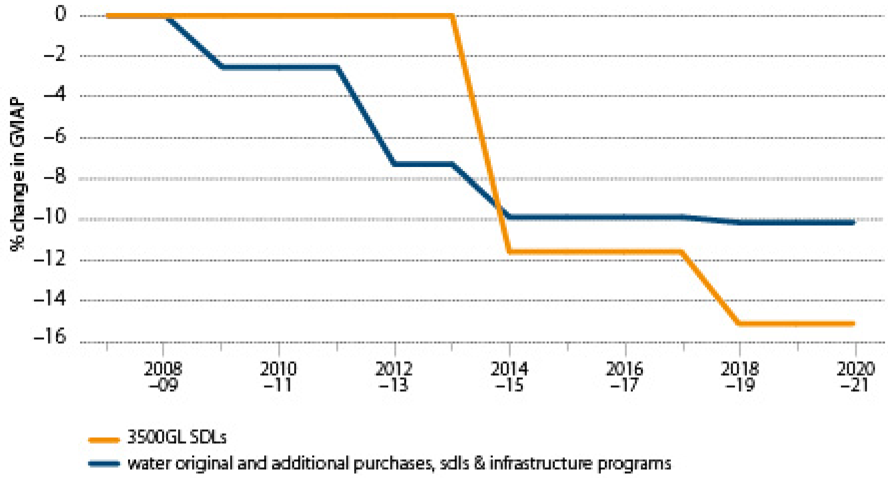
[a] *Excluding the Australian Capital Territory.*

Table 9: Estimated change in GVIAP ($m/y) – Scenario 2, most affected regions in Basin

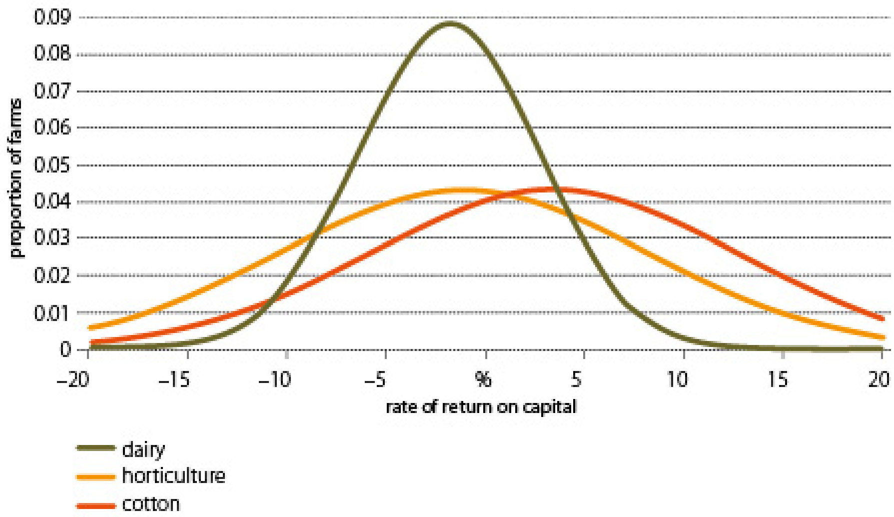
Region	Change in GVIAP
	($m/y)
Murrumbidgee	–157
Condamine	–64
Murray (NSW)	–53
Namoi	–49
Murray (Vic)	–45
Gwydir	–44
Goulburn–Broken	–41

Appendix B

1 Basin-wide effects of the Basin plan, WftF and additional water purchases on GVIAP



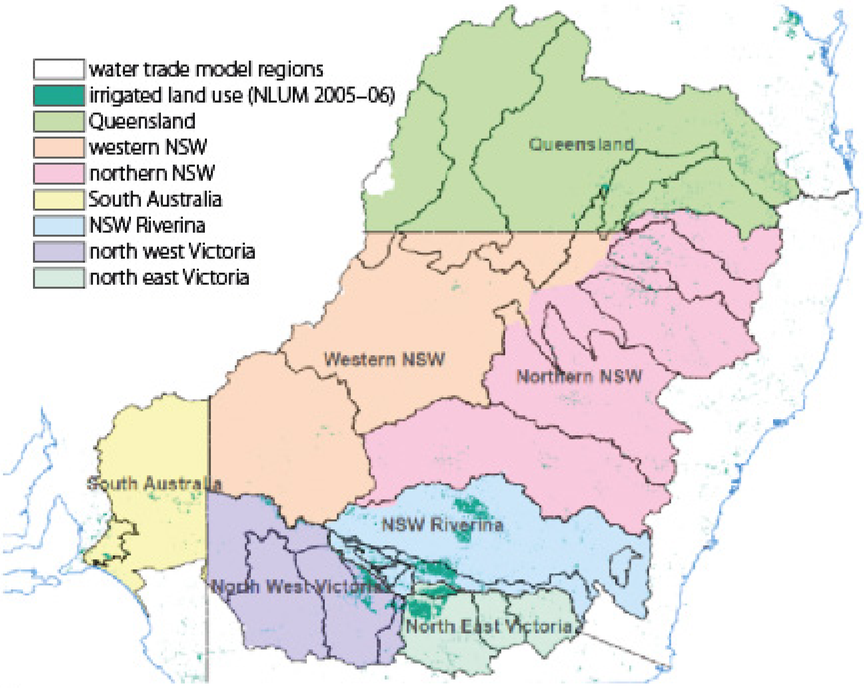
2 Distribution of returns, by industry, 2006–07



Source: ABARE irrigation survey data.

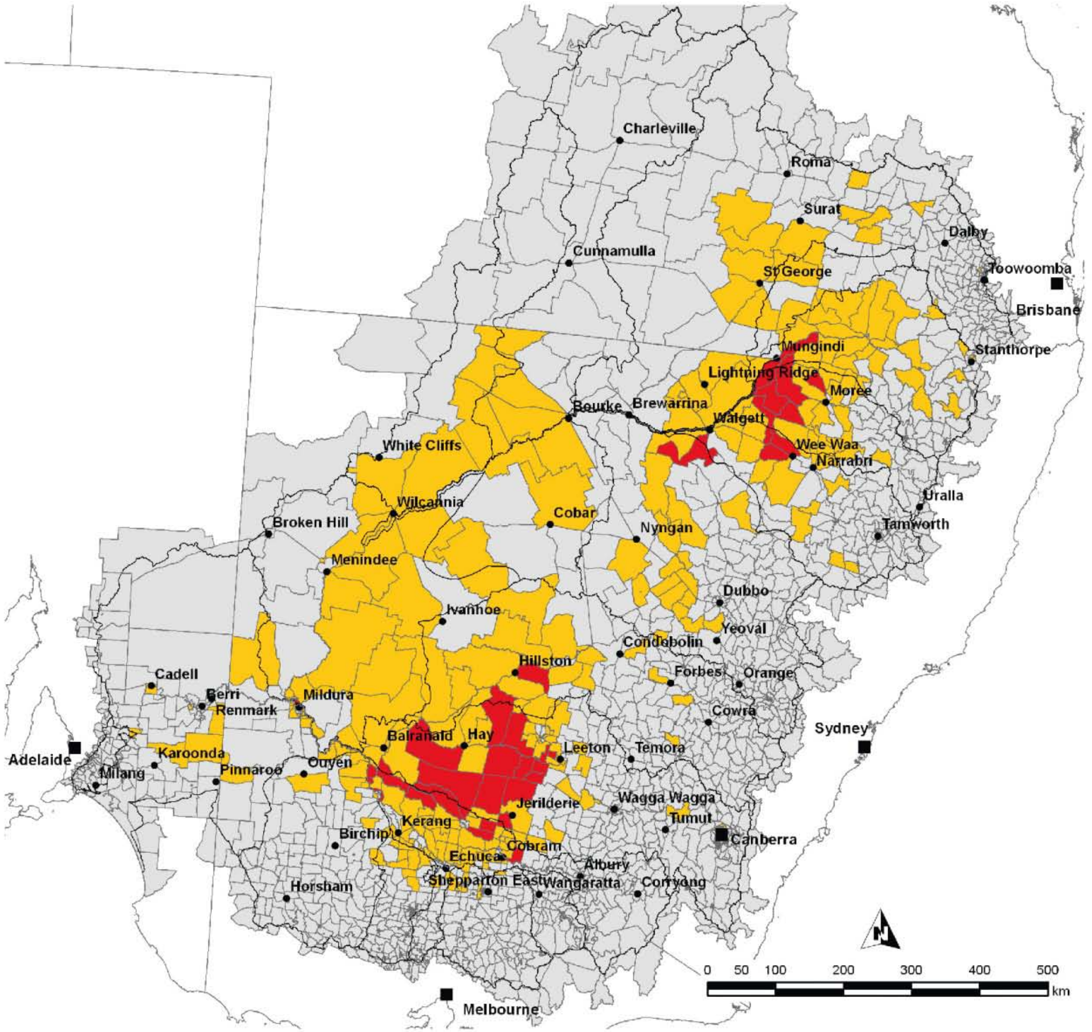
Appendix C

map 1 AusRegion regions (compared with WTM regions[a])



a AusRegion regions are coloured; WTM regional demarcations are shown in black.

map **2** MDBA Indicators of community vulnerability [a] and adaptive capacity across the Murray–Darling Basin



[a] Community vulnerability is defined as the likelihood of communities in the Murray-Darling Basin (MDB) being susceptible to changes to water availability primarily to agriculture.