The regional economic impacts of Sustainable Diversion Limits

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Report prepared for the Murray-Darling Basin Authority

5 November 2010

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Executive summary

This study examines the regional economic impacts of SDLs applied to the Murray-Darling Basin (MDB). The following assumptions apply:

- Since the process is voluntary, with willing farmers selling part of their water entitlements to the Commonwealth, it proceeds slowly. That is, we assume that permanent water sales fit in with the forward planning of farmers.
- In each scenario, target volumes for environmental flows are not reached until 2022.
- Farmers are compensated at market prices for entitlements sold to the Commonwealth. This assumption applies to three scenarios but is dropped for a fourth scenario.
- Target volumes already include the 796 GL of entitlements sold to the Commonwealth by the end of January 2010.

The relevance of a slow process is that technological gains that result in savings in water requirements in irrigation help alleviate losses in farm output over time. MDB communities have had to live with environmental challenges, including severe and prolonged drought over much of the past decade. Irrigators have made substantial water savings in the past through the use of new irrigation technologies. However, the adoption of new technologies takes time. In addition, without sudden reductions in local farm outputs that would result from large and concentrated water sales in a short space of time, the impacts on downstream processing sectors are smaller than otherwise.

Moreover, MDB communities at present are recovering from drought. Farmers are concentrating on the recovery phase, rather than future restructuring of their operations, implying that sales of water to the Commonwealth are likely to be small for several years.

This study reports the simulated impacts of three different target volumes: 3000 GL, 3500 GL and 4000 GL, each inclusive of the 796 GL already sold. The Commonwealth continues to purchase water on the water market, which pushes up the price of irrigation water. From the perspective of farmers, they will gain through an increase in the asset price of water relative to what it would be without Commonwealth purchases. However, the gains that farmers realise as holders of water assets are partly offset by a fall in the asset value of farmland in the basin. This implies that some farmers will do better than others out of selling water to the Commonwealth.

Farmers whose water has a high asset value relative to the value of their land holdings will do better than farmers with a lower ratio of water to land assets. For example, vineyard and orchard growers may not do as well from sales to the Commonwealth as growers of annual crops. Growers of perennials may be keener to maintain the health of their vineyard or orchard than to sell their water.

Aggregate consumption in the 3500 GL scenario peaks at 0.3% above forecast across the MDB in 2022. This reflects full compensation at market prices for water, and that farmers remain in the basin. Among regions, the Lower Murrumbidgee region has the largest increase in aggregate consumption relative to forecast, because it has relatively high water to land value ratio. The regions that gain least in terms of aggregate consumption are those in which irrigated agriculture is a relatively small share of the regional income base.

The slightly lower levels of farm investment and consequent lower levels of farm capital result in a small deterioration in regional outcomes over time (that is, after water sales to the Commonwealth have been completed in 2022). We assume that farmers spend only that percentage of buyback payments that maintains the real value of payments over time. Thereafter, real consumption moves gradually back towards forecast after the assumed payments end in 2022. At the same time, employment across the MDB drops slightly below forecast, reaching almost 0.1% below forecast by 2026. This amounts to around 500 jobs lost across the region relative to forecast. Basin-wide employment in services sectors, which depend on household spending and are relatively labour-intensive, remain slightly above forecast in 2026.

Reaching the SDL targets will impose some upward pressure on farm output prices. The largest impact will by on rice, which rise to 7% above forecast by 2026. In the same year, irrigation output in the basin falls more than $800 million below forecast, but this is partly offset by an increase in dry-land output of $400 million.

From the Commonwealth’s perspective, the greater the volume of water purchased, the higher the cost, as the irrigation water entitlement price rises as more water is purchased and diverted to environmental uses. Since the Commonwealth’s purchases push up the price of water, the real cost to the Commonwealth will not be proportional to the volume of water purchased by the Commonwealth. Rather, the total cost will increase by a larger percentage than the increase in the target volume.

TERM-H2O: a general equilibrium model with considerable basin detail

TERM-H2O is the model used in this study. TERM-H2O has the following features, the combination of which is unique to a small-region model:

- It includes irrigation and dry-land farm sectors, with some farm factor mobility.
- For perennials, including vineyards, orchards and livestock herds, the model includes capital that is not transferable to other sectors.
- Livestock production can move from irrigation to dry-land technologies. In dry-land livestock production, land and fodder inputs are substitutable.
- The model includes on downstream processing of agricultural output, other manufacturing (non-agricultural), utilities, services that support agriculture and other services in each region.
- The model includes water accounts and also accounts for rainfall. This means that in a policy scenario in which a given fraction of irrigation water is taken out of production, there is a smaller fractional reduction in the water available to irrigators as rainfall is unchanged.
- The model is dynamic, meaning that simulations are run over time. The results of policy simulations are compared with baseline simulations. The baseline can include drought, for example, which raises the price of irrigation water and increases the economic costs of diverting water (which is more valuable during drought) to the environment.
- The model includes a dynamic link between annual investment flows and capital stocks. For example, under the SDL policy, water prices rise relative to the baseline

forecast and this reduces perennial specific investment. Hence, specific capital used in perennial sectors shrinks relative to forecast across the basin.

- The model also includes detail of the economic structure of the rest of Australia.

Scenario 1 – SDL target of 3500 GL

Farmers sell permanent water to the government from 2011 to 2022, with sales suspended in two years of moderate drought.

As a first step, we use a back-of-the-envelope calculation to estimate the impact of removing 3500 GL of entitlements from production. Modelled GDP outcomes in most regions are slightly worse than that from the back-of-the-envelope calculation. This is because the removal of water from irrigation production depresses farm land and capital rentals, which in turn reduces farm investment relative to forecast slightly. Consequently, farm capital in the basin falls relative to the baseline forecast. There is also a small reduction in employment in each region over time relative to forecast. Real GDP declines across the basin relative to forecast, but is little more than 0.2 percent below forecast by 2026.

To explain the distributional impacts of SDLs, we need to examine the impact of the policy on farm factors. The price of water rises relative to a baseline with SDLs. This provides a windfall gain to holders of water rights. At the same time, the rentals (values) on irrigable land fall. Since irrigable land can be used for dry-land production when available irrigation volumes fall, dry-land rentals (values) also fall because the supply of land in dry-land production rises. The impact on land of SDLs is a loss in asset values to farmers. The composition of the distribution of water inputs and land inputs in total farm factor income may vary between regions. This results are regional and sectoral differences in outcomes.

The impacts on downstream processing sectors are relatively modest. A movement of farm factors from irrigated to dry-land production partly alleviates reductions in farm output supplies to downstream processors.

Calculating the asset value of water and its impact on regional disposable income

Several steps are required in calculating how much SDL compensation payments impact on regional spending. First, we need to calculate the asset value of a water right. Second, we need to assign a certain proportion of compensation payments to disposable income in each region. TERM-H2O is unique among models used in analysing SDLs in that it accounts for the impact of compensation on each region's household spending. Because there may be debate about the proportion of proceeds that stay within the region of sale, we can vary that proportion: in three scenarios we assume that all proceeds stay within the region of origin In a fourth scenario, we assume that there is no compensation at all for farmers for water taken out of production.

In practice, we might expect at least some of the proceeds of water sales to stay within the basin. In particular, some farmers in making investment plans may use water revenues as a substitute for bank finance. Therefore, it would not be surprising if banks anticipate a reduction in the value of loans they provide in the basin. Some farmers will cash in water rights rather than borrow to fund investments.

If only a fraction of compensation proceeds remain in the basin, the impacts will be less favorable than we have reported. Regions with relatively high proceeds as a share of regional income are more sensitive than others to the assumption concerning the proportion of proceeds that stay within the basin.

Differences in regional outcomes

In terms of regional consumption, the Lower Murrumbidgee region does best because the windfall gain in the value of water dominates the outcome. That is, the region loses little from depressed land rentals. Going by NRM regions, Paroo, Gwydir, Murrumbidgee and Murray NRMs are the biggest winners. On the assumption of full compensation for water, the regions that do least well are the most urbanised in the basin, namely the Loddon and Ovens NRMs.

There are concerns that over time, SDLs will lead to reduced investment in farming across the MDB. TERM-H2O shows that this is so. However, the impacts are small. Across the MDB, mobile farm capital falls by 0.3% relative to forecast by 2026. The impact on specific capital applied to irrigated perennials (i.e, grapes, fruit, dairy cattle and other livestock) is larger in proportional terms. Fixed capital relative to forecast has fallen 5% below forecast by 2026. Among sectors, vegetables output increases in the scenario because the falling price of land more than offsets the rising price of water for the sector.

If SDLs were conducted by involuntary acquisition or without compensation, there would be a loss of investor confidence in MDB regions. The negative impacts would be much greater, particularly in the short term, than we have modelled. There would be the danger that with diminished confidence, farm factors would become idle with a resulting magnification of regional income losses.

What impact does drought have on the policy simulation?

There are two years of moderate drought in the forecast baseline, in 2015 and 2021. These do not affect water allocations but they do increase irrigation water requirements on irrigated land so as to compensate for rainfall deficits. In addition, drought reduces dry-land productivity which results in a movement of farm factors (farm machinery, labour and farmers) in the MDB into irrigation activities. With more farm factors available for each unit of water, water becomes more valuable. The rise in the price of water results in drought worsening the impact of SDLs relative to forecast.

The outcome of the SDL scenario relative to forecast is worse in drought years, as water taken out of production is more valuable than in normal years. In the first decade of the 2000s, recurrent droughts had a large negative impact on farming in the MDB. The temptation has been to mix up the impacts of drought and SDLs. They are quite dissimilar. Recurrent droughts have not only marked impacts on dry-land activity. They have also reduced water allocations for a number of years in regions previously regarded as having reliable water supplies and hence previously regarded as immune from drought in their irrigation sectors. SDLs will not reduce reduce dry-land productivity, nor do they increase irrigation water requirements, as is so during drought. SDLs are more likely to increase dry-land production in the MDB through some movement of factors from irrigation to dry-land activities. The same model used to estimate SDL impacts indicates that drought cost the basin over 6,000 jobs between 2006-07 and 2008-09, a many-fold larger impact than the 500 jobs that may be lost due to SDLs.

We assume that in the two moderate droughts included in our scenarios that sales to the Commonwealth are suspended during drought years. The suspension reflects short-term caution by farmers in response to drought. Our assumption is that the higher temporary value of water slows the movement of water entitlements away from agriculture. Hence, it is assumed that water is used and traded to other irrigators rather than sold off to the Commonwealth. This assumption is reasonable for short-term droughts. It contrasts with the severe and prolonged droughts experienced from 2006-07 to 2008-09. During this period, the Commonwealth buyback scheme became a means of adjustment during a period of extreme financial stress. In addition, depressed grape prices discouraged some farmers from continuing and made them more willing to take the buyback option.

How will environmental managers reach water targets for individual sites?

One of the assumptions in our modelling is that water is tradable between users. In the southern part of the basin, water is tradable within and between regions in TERM-H2O. In the northern part of the basin, the modelling assumption is that water is tradable within regions only. Water trading and voluntary SDL sales leave environmental managers in a similar position as irrigators. That is, to reach certain target volumes in specified regions, environmental managers may have to become buyers and sellers of water. Environmental managers may use the proceeds from sales of water to farmers in one region to purchase water from farmers in other regions. An implication of this is that environmental managers may need to enter the temporary market for water in order to meet specific site volume targets. Any attempt to reach environmental targets without water trading would entail compulsory SDL sales, which are not politically feasible.

Just as we expect farmers to choose water-saving technologies increasingly over time in response to water scarcity, environmental managers over time may also learn to do more with less water. This is a reason why environmental water managers need to have the opportunity to buy and sell water. In addition, it might be that the marginal benefit per unit of environmental water varies between ecological sites, resulting in a change in environmental targets over time. As some ecological sites improve over time due to additional water, reallocation of environmental water among such sites may occur.

Scenarios 2 and 3 – varying SDLs to 3000 GL and 4000 GL

There are two constraints on SDL purchases by the Commonwealth under voluntary arrangements. First, there may be a limit to the volume of water that farmers willingly sell. Second, since unit costs will rise with an increasing volume of purchases, the Commonwealth faces a budget constraint.

The main economic insight to be gained from varying SDL targets in TERM-H2O is that as long as the Commonwealth compensates farmers, the biggest difference between scenarios arises in the costs of compensation to holders of water rights. In the 3500 GL case, the estimated additional cost (that is, in addition to buyback purchases made before the end of January 2010) of reaching the SDL target by 2022 is $4.1 billion (2010 dollars, net present value). This compares with $3.0 billion (2010 dollars) in the case of the 3000 GL target and $5.3 billion (2010 dollars) in the case of the 4000 GL target.

In each case, if we include an expectation of greater water scarcity in the future, the value of water rights increases. In turn, the cost to the Commonwealth and the national and regional economies (as measured by national and regional real GDPs relative to forecast) rises.

Scenario 4 – no compensation for SDLs

If SDLs proceed without compensation, aggregate consumption in each region of the MDB falls relative to scenario 1. Over time, services sectors decline in each region relative to scenario 1. Although the regional losses arising in this scenario are not dramatic, the economic case for compensation is that it is a relatively equitable way of enacting SDLs. If farmers are not compensated for SDLs, over 800 jobs are lost across the MDB relative to forecast by 2026, compared with 500 jobs in scenario 1 which includes compensation.[1] Since a no-compensation scenario would not be voluntary, the economic consequences could be far worse than we have modelled. This is because an absence of compensation would bring with it considerable uncertainty which would impact adversely on regional investment in both farm and non-farm sectors. In the no compensation case, regions with a high water value to GDP ratio in the initial database do relatively worse than other regions. Lower Murrumbidgee, for example, goes from the biggest winner in scenario 1 to one of the bigger losers in scenario 4.

An alternative interpretation of scenario 4 is that it models a 3500 GL target with the assumption that all compensation proceeds leave the basin.

Summary of results

Table ES.1 summarises the national impact of each scenario.

Table ES.1: Summary of each scenario

Scenario	Target volume GL	Cost to C'wealth ($bn, NPV, 2010 dollars)	National real GDP relative to forecast, 2026
1	3500	4.1	-0.009
2	3000	3.0	-0.007
3	4000	5.3	-0.012
4	3500	0.0	-0.009

[1] That is, the employment impacts of SDLs without compensation are similar to those of the ABARE (Hone *et al.*, 2010) study.

Introduction

The health of the Murray-Darling Basin (MDB) has become a major policy issue. Since the turn of the millennium, recurrent droughts have imposed economic hardship on the region. Regions with previously reliable water entitlements found themselves with recurrent shortfalls in allocations in the wake of droughts.

Sustainable diversion limits (SDLs) are part of a strategy to improve the environmental health of the basin. These entail reducing the amount of water used for irrigation in the basin. There are concerns that SDLs will impose further hardships on communities that have already suffered substantially due to drought and falling prices for some commodities.

The objective of this study is to estimate the impact of SDLs on regions within the MDB. It uses TERM-H2O, a dynamic computable general equilibrium model that includes water accounts. By including the whole economy of each region, including dry-land farming, irrigation farming, downstream processing, utilities and services sectors in detail, TERM-H2O puts change in irrigation farming conditions into perspective. It is not sufficient to estimate the contribution of irrigation activity agriculture to the regional economy and then subtract a fraction of that to estimate the loss in output. This is because farm factors can move between activities. Any decrease in irrigation output arising from reduced irrigation water availability will be offset at least to some extent by an increase in dry-land farming output in the MDB.

In TERM-H2O, we first run a forecast baseline. This includes the 796 GL of buyback purchases that occurred prior to February 2010. In 2015 and 2020, there are moderate droughts. The droughts are sufficient to reduce dry-land productivity substantially, but neither sufficiently severe nor prolonged to reduce water allocations. Even though irrigation water availability does not worsen, its price rises as dry-land productivity falls – and as rainfall decreases, irrigation water requirements increase.

Next, we run the policy scenario in TERM-H2O. There are four scenarios in all, outlined below. We report all policy results in this study as cumulative deviations from the baseline forecast. The results for the moderate drought years show that policy deviations do depend to some extent on baseline assumptions.

Summary of the scenarios

1. The Commonwealth purchases 3500 GL of entitlements from irrigators in total over the years from 2011 to 2022. The Commonwealth pays compensation at the market price for water. Buyback purchases already made, as appear in Table 1.2 of the PC report (Productivity Commission, 2010), are subtracted from the 3500 GL. Buyback purchases are included in the baseline.
2. Using the same baseline as 1, the Commonwealth purchases 3000 GL of entitlements from irrigators in total over the years from 2011 to 2022.
3. Using the same baseline as 1, the Commonwealth purchases 4000 GL of entitlements from irrigators in total over the years from 2011 to 2022.
4. Repeat of 1 in which no compensation is paid for water taken out of production between 2011 and 2022.

How SDLs differ from drought

A misperception that SDLs are similar to or worse than drought exists. Drought affects the water available for both dry-land farming and irrigators. A severe drought may wipe out a large proportion of dry-land productivity in a given year. It also increases the water requirements of irrigators for two reasons. First, for every 100 mm of rainfall deficit, the irrigation water requirement grows by one megalitre per hectare. Second, drought may increase evaporation which further increases irrigation water requirements. Not one of these effects applies to SDLs. Rather, SDLs reduce irrigation water availability from what it has been, but have only small impacts on regional agricultural output. Resource movements in response to water sales to the Commonwealth allow a substantial proportion of lost irrigation output to be compensated for by increased dry-land output.

TERM-H2O is the only model that has been used to estimate the impact of the droughts from 2006-07 to 2008-09 on the MDB.[2] Therefore, it is the only model in which we can calibrate the estimated employment impacts of SDL scenarios against the impacts of drought. Whereas SDLs lower regional real GDP by less than one percent in all regions (Table 6), drought can have dramatic impacts. Modelled regional income losses for 2007-08 relative to no drought were close to 20% in some regions, with drought-induced employment losses of up to 4.5% in some regions. Job losses using TERM-H2O across the MDB due to drought exceeded 6,000 (Wittwer and Griffith 2010, Figures 5 and 6). The study showed that prolonged drought leads to permanent reductions in employment, investment and farm capital, even after recovery. The slightly negative impacts of SDLs on employment and farm capital as shown in Figure 6 are small in comparison.

Scenario I

- The Commonwealth purchases 3500 GL of permanent water rights from irrigators.
- The Commonwealth pays compensation at the market price for water.
- The policy simulation includes purchases of 2704 GL, subtracting the 796 GL of entitlements purchased by the Commonwealth prior to February 2010. These are in the baseline.
- 2704 GL of purchases proceed gradually from 2011 to 2022, with two years of moderate drought in which there are no SDL sales.

TERM-H2O is a dynamic, CGE model which presents results on a year-by-year basis. Appendix A contains more details on TERM-H2O. The model requires a year-by-year baseline plus a year-by-year policy simulation. We first run the policy simulation with the buyback volumes shown in Table 2 included in the baseline. The main difference between including buyback volumes in the baseline and not including them is that baseline irrigation water prices are higher with inclusion.

[2] Other models are likely to produce corner solutions (in which some sectors fall to zero outputs or imports replace domestic production entirely) or not solve at all when subjected to massive inward supply shifts necessary to depict drought.

Irrigation activity in the context of regional economies

Irrigation agriculture makes an important contribution in the MDB. In the statistical sub-division of Lower Murrumbidgee (LMrmbNSW in Table 1a), irrigation accounted for 15.3 percent of regional income in 2006. This figure will vary from year to year depending on dry-land productivity, irrigation water availability, commodity prices and structural change. Structural change here refers to agriculture's declining share of economic activity over time. Due to presence of a number of major regional centres in the Murray Darling Basin (including Albury-Wodonga, Bendigo, Dubbo, Mildura and Tamworth), agriculture's share of GDP in the region overall was only an estimated 15.0% in 2006 (9.4% from dry-land and 5.6% from irrigated activities).[3] Services tend to account for a large share of income (over 75%) in major regional centres.[4] A report commissioned by the MDBA contains more details on economic profiles within the MDB (ABS, ABARE & BRS 2009).

Table 1a: GDP breakdown by sector – MDB regions (2006, %)

	DrylandAg	IrigAg	FoodDrinks	Textile	OthManuf	Mining & OthPrmary	Utilities	Services	TotGDP $m
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TmwthNSlpNSW	11.6	2.4	4.1	0.7	5.7	1.9	2.7	70.9	3117
NCentralNSW	17.4	12.0	1.2	3.0	5.8	0.5	1.2	58.8	1167
MacquarieNSW	10.4	2.4	3.4	0.2	4.4	5.6	3.3	70.3	3163
McqrieBarNSW	25.4	6.5	0.6	1.4	3.3	6.2	5.0	51.5	679
UpDarlingNSW	6.1	4.4	0.4	0.3	2.1	44.9	4.1	37.7	602
CntralWstNSW	3.5	1.4	5.1	0.2	9.4	13.6	7.7	59.1	3735
LachlanNSW	17.2	3.0	2.4	0.3	8.0	10.3	1.2	57.7	2062
WagCntMrmNSW	8.3	1.9	4.4	0.3	6.8	0.5	1.9	76.0	4038
LMrmbNSW	8.4	15.3	14.3	0.1	3.8	0.3	2.4	55.4	1845
MurrayNSW	4.5	6.5	4.7	0.3	11.0	0.5	1.9	70.6	3835
MrryDrlngNSW	6.4	12.1	7.4	0.0	5.4	2.5	2.7	63.5	345
MalleeVic	12.4	10.4	7.3	0.1	5.5	1.0	3.0	60.4	3362
LoddonVic	3.3	1.3	4.5	0.5	8.4	3.1	2.2	76.8	6336
GoulburnVic	6.4	6.9	7.6	0.3	8.5	0.6	3.2	66.5	7295
OvnsMurryVic	3.8	2.8	7.1	1.2	9.0	0.6	2.0	73.6	3508
DrlngDwnsQld	21.9	9.9	2.4	0.9	6.4	8.9	1.7	47.8	4588
SouthWQld	17.1	4.6	1.0	0.9	1.2	42.2	1.2	31.8	2195
MurraySA	8.0	14.1	11.5	0.1	4.2	0.7	3.9	57.5	2259
All MDB	9.4	5.6	5.3	0.5	7.0	5.5	2.8	64.0	54130

Sources: ABS national accounts; ABS census data; ABS catalogue 4610.0.55.008; TERM-H2O database.

Within the Murray Darling Basin, there are 52 hectares of dry-land farming for every hectare of irrigation agriculture (ABS 2008, Table 4.16). Therefore, in years of average rainfall, income earned by dry-land farming exceeds that earned by irrigation agriculture in a number

[3] In 1955-56, farming's share of GDP for Australia was 15.9% (Maddock and McLean, 1987). That is, all of Australia was more reliant on agriculture in its income base than the Murray Darling Basin is now.
[4] Even in relatively rural Griffith, services accounted for 68% of employment in the 2006 ABS census.

of regions in the MDB. This is evident when we compare columns (1) and (2) in Table 1a. It is important given this background information that any model of farming within the MDB represents both irrigation and dry-land sectors, with mobility of farm sectors between irrigation and dry-land activities. TERM-H2O and the ABARE model both do so.

In models with farm factor mobility between dry-land and irrigation actitivities, if available irrigation water falls (as will happen with SDLs), farm factors will move to dry-land production. That is, some farm factors are mobile rather than sunk.

Table 1b: GDP breakdown by sector – NRM regions (2006, %)

	DrylandAg	IrigAg	FoodDrinks	Textile	OthManuf	Mining & OthPrmary	Utilities	Services	TotGDP $m
Paroo	23.6	4.6	0.2	0.1	0.2	36.9	1.8	32.6	164
Namoi	10.4	3.9	3.7	1.4	5.7	2	2.6	70.3	3443
Gwydir	24.9	9.2	1.6	1.1	5.4	0.1	1.1	56.5	760
Border	21.5	15.8	2.2	0.9	6.1	4.5	0.9	48.1	1202
Moonie	44.8	8.4	0.1	0.3	3.9	15.7	0.6	26.3	154
CondamBalone	19.4	6.9	2	1	4.8	20.5	1.8	43.4	5177
Warrego	16.2	6.1	3.5	0.4	1.6	8	2.7	61.5	293
MacCastlr	7.8	2.2	4.1	0.3	6.9	9.6	5.7	63.4	7299
BarwonDarlng	6.9	2.7	0.3	0.2	2.2	52.2	3	32.5	549
Lachlan	17.2	3	2.4	0.3	8	10.3	1.2	57.7	2062
MrmbidgeeNSW	8.4	6.4	7.5	0.2	5.8	0.4	2.1	69.2	5981
MurrayNSW	4.5	6.1	4.5	0.3	11.1	0.5	1.9	71	3828
LowerDarling	4.3	13	8.6	0	4.7	3.1	2.6	63.7	254
MurrayVic	5.6	6.4	8	0.2	7.7	0.6	2.1	69.5	4540
WimmAvoca	41.4	5.5	2	0.1	2.4	3.6	2	43	321
Loddon	3.3	1.3	4.5	0.5	8.4	3.1	2.2	76.8	6336
GoulbnBroken	6.2	6.1	6.8	0.4	8.8	0.6	3.2	67.7	5945
Campaspe	7.4	10.1	11.1	0.1	6.9	0.4	3.1	61	1349
Ovens	6	4.5	5.9	2.3	7.6	0.8	3.1	69.9	1560
MurraySA	8	14.1	11.5	0.1	4.2	0.7	3.9	57.5	2259
All NRMs shown	9.3	5.5	5.3	0.5	7	5.3	2.8	64.3	53473

Sources: ABS national accounts; ABS census data; ABS catalogue 4610.0.55.008; TERM-H2O database.

The MDBA plan entails SDLs at the NRM level. NRMs are not neat combinations of the regions in TERM-H2O. An appendix shows the mapping used in this study from TERM-H2O regions to NRM regions. Table 1b summarises the economic structure for NRM regions. Table 1b shows the share of economic activity accounted for by broad sectors across approximate NRM regions. When we include major regional towns in a region, the share of total income accounted for by service sectors rises. For example, Namoi includes Tamworth, which accounts for half of the employment in the region. In turn, data from the ABS 2006 census indicates that 80% of Tamworth's employment (in Tamworth Part A statistical local area, covering the town) is in service and utility sectors. Outside Tamworth, the economic activity accounted for by agriculture is much higher.

Purchases that have already occurred and subsequent SDL volumes

Table 2 shows buyback purchases that had occurred by the end of January 2010. The first column of numbers in the table shows entitlement volumes and the second the expected average annual volumes associated with each entitlement.

Table 2: Buyback purchases to 31 January 2010

	Purchase GL	Expected average annual GL
Border Rivers Qld	6.8	2.3
Gwydir	104.8	35.0
Barwon-Darling	30.4	30.4
Namoi	5.8	4.4
Macquarie	63.1	26.1
Lachlan	82.0	34.6
Murrumbidgee	85.2	44.1
Murray above choke NSW	145.8	118.1
Murray below choke NSW	28.8	23.3
Other NSW	3.2	1.0
Campaspe	5.1	4.8
Goulburn-Broken	90.7	80.4
Lodden	1.0	1.0
Ovens	0.05	0.05
Murray above choke Vic	41.9	35.6
Murray below choke Vic	64.8	57.7
Other Vic	0.9	0.3
Murray SA	36.1	32.5
Total	796.7	531.9

Source: PC (2010), Table 1.2.

In the context of modelling economic impacts in TERM-H2O, the second column contains the relevant volumes. The initial year in the TERM-H2O database was 2005-06, in which water allocated in the MDB was below the historical average, but nevertheless well above allocations in the three drought-affected years that followed.

Table 3: SDL targets inclusive of buybacks

	3500 GL (1)	3000 GL (2)	4000 GL (3)	Water course diversion GL (4)
	%	%	%	
Condamine-Balonne	33.1	29.2	37.2	706
Border Rivers (Qld)	22.0	19.1	24.9	223
Border Rivers (NSW)	23.6	20.5	26.7	210
Warrego	40.0	40.0	45.0	45
Paroo	0.0	0.0	0.0	.2
Namoi	21.9	19.6	24.3	343
Macquarie Castlereagh	27.5	24.5	30.7	425
Moonie	40.0	36.6	45.0	32
Gwydir	32.3	27.4	37.1	326
Barwon-Darling	25.2	21.9	28.5	197
Lachlan	23.1	21.3	25.4	302
Murrumbidgee (NSW)	37.7	32.1	43.1	2,061
Ovens	40.0	40.0	45.0	25
Goulburn Broken	32.6	27.9	37.3	1,055
Campaspe	34.7	29.9	39.5	397
Wimmera-Avoca	0.0	0.0	0.0	74
Loddon	34.5	31.0	39.3	365
Murray NSW	32.3	27.5	36.9	1,721
Murray VIC	31.3	26.7	35.8	1,656
Lower Darling	33.5	28.6	38.3	55
Murray SA	30.5	26.0	34.8	665

Table 3 shows the proportion of water to be set aside for the environment (columns (1), (2) and (3)) out of total diversions (column (4)). Column (4) differs from the water accounts embedded in TERM-H2O for two reasons. First, the regions in TERM-H2O follow ABS statistical sub-divisions and statistical divisions rather than NRMs.[5] Second, and more importantly, the final column in Table 3 does not show average annual diversions. Average annual volumes are relevant in running TERM-H2O simulations.[6] The base water use volumes in TERM-H2O in some cases are much lower than those implied by the final column of Table 3. ABS (2008, Table 4.20) indicates that water consumption in agriculture in the MDB totalled 7,720 GL in 2005-06 compared with 10,516 GL in 2001-02. We treat our baseline year 2005-06 as an average year.

[5] The regions shown in Table 3 align more closely with NRMs than TERM-H2O regions. Appendix A2 details the mapping between TERM-H2O and NRM regions.
[6] The database in TERM-H2O, based on 2005-06 water accounts, regional economic data and a national input-output table, may be thought of as a typical year relative to the drought years that followed, but entails smaller diversions for economic use than in most years prior to 2005-06.

Table 4: Reductions in water allocations due to past buyback and future SDLs (3500 GL target) (based on 2005-06 allocations)

	2008 (1)	2009 (2)	Remainder to reach target (3)	Total GL (4)
TmwthNSlpNSW	3.9	3.9	39.0	46.8
NCentralNSW	15.7	15.7	85.0	116.4
MacquarieNSW	10.5	10.5	32.4	53.4
McqrieBarNSW	9.1	9.1	21.4	39.6
UpDarlingNSW	6.1	6.1	13.0	25.2
CntralWstNSW	2.6	2.6	35.2	40.4
LachlanNSW	17.3	17.3	18.0	52.6
WagCntMrmNSW	4.4	4.4	80.4	89.2
LMrmbNSW	17.6	17.6	349.9	385.1
MurrayNSW	69.8	69.8	230.9	370.5
MrryDrlngNSW	1	1	16.7	18.7
MalleeVic	28.8	28.8	67.4	125.0
LoddonVic	2.9	2.9	39.7	45.5
GoulburnVic	40.2	40.2	219.3	299.7
OvnsMurryVic	17.8	17.8	28.5	64.1
DrlngDwnsQld	1.1	1.1	266.9	269.1
SouthWQld	0	0	79.7	79.7
MurrayLndsSA	16.3	16.3	72.6	105.2
Total	265.3	265.3	1696.0	2226.2

Note that in Table 4, the sum of diversions totals only 2226 GL rather than 3500 GL. This is because the base year, 2005-06, entailed less than 100% allocations across the MDB. The economic importance of the lower number (i.e., 2226 GL) is that water is more valuable when allocations are lower, and makes a larger contribution to factor income. Demand for water is relatively inelastic, so that as scarcity worsens, the total value of irrigation water increases.[7]

As will become evident when we examine results, the income losses arising from SDL targets worsen in years when water is relatively scarce.

The impacts of scenario I

Table 5 shows the impacts of the scenario in 2026 relative to 2026 without the SDLs (but including buyback purchases already made by the Commonwealth prior to February 2010). Columns (1) and (2) provide us with a first estimate of the regional impacts. (1) shows the reduction in available water: we include rainfall in the production functions, so that rainfall-inclusive water availability falls by a smaller percentage than the proportion of water set aside for environmental purposes in each region. That is, rainfall which accounts for part of the water available to irrigators remains unchanged. Our first estimate is a back-of-the-envelope (BoTE) calculation of real GDP, shown in column (2): this is equal to (1) multiplied by water's value-share of GDP in the initial database.

[7] The earlier ABARE study (Hone *et al.*, 2010) commissioned by the MDBA used a combination of 2000-01 and 2005-06 water allocations, resulting in a higher base number and a volume of diversions that was closer to the 3500 GL target.

Table 5: Comparing 2026 modelled outcomes relative to forecast with first estimate (scenario 1)

	First	*Estimate*	*Modelled outcomes*		
	(1)	(2)	(3)	(4)	(5)
	water[a]	GDP %	GDP %	net water sold GL	B/C[b]
TmwthNSlpNSW	-13.3	-0.04	-0.06	0	0.15
NCentralNSW	-14.4	-0.33	-0.99	0	0.91
MacquarieNSW	-11.7	-0.04	-0.04	0	0.16
McqrieBarNSW	-10.9	-0.14	-0.31	0	0.55
UpDarlingNSW	-13.4	-0.13	-0.23	0	0.52
CntralWstNSW	-18.0	-0.03	-0.03	0	0.13
LachlanNSW	-6.4	-0.03	-0.01	0	0.23
WagCntMrmNSW	-25.9	-0.06	-0.10	18	0.24
LMrmbNSW	-28.2	-0.57	-0.19	-221	2.39
MurrayNSW	-14.5	-0.19	-0.28	185	0.92
MrryDrlngNSW	-21.7	-0.14	-0.15	-12	0.57
MalleeVic	-8.2	-0.06	-0.18	68	0.42
LoddonVic	-20.5	-0.02	-0.07	7	0.06
GoulburnVic	-17.8	-0.09	-0.28	-19	0.43
OvnsMurryVic	-11.8	-0.03	-0.15	9	0.14
DrlngDwnsQld	-20.7	-0.19	-0.77	0	0.60
SouthWQld	-21.0	-0.15	-0.58	0	0.61
MurraySA	-15.3	-0.10	-0.22	-35	0.44
All MDB	-17.3	-0.13	-0.25	0	0.41

Key:
a % of allocated water removed from production in addition to buybacks that have already taken place
b Compensation spending (5% of asset value) as a share of aggregate consumption

(3) shows the modelled GDP result for 2026 relative to forecast. In most regions, the BoTE calculation of the GDP loss is smaller than the modelled outcome. This is because there is a small decrease in farm capital and regional employment across the basin over time (see Figure 4 for mobile farm capital impacts, Figure 5 for specific farm capital impacts and Figure 8 for the employment impacts). Losses of productive factors from the basin relative to forecast worsen the BoTE calculation of real GDP over time.

Lower Murrumbidgee is an exception. All regions are net exporters of water with most exports going to the Commonwealth (shown in Table 4, column 3) in the scenario. This implies that regions can realise income gains from water sales as the policy induces a higher price for water. Water accounts for a large share of Lower Murrumbidgee's income in the initial database. Despite purchasing water from other regions in the policy simulation, Lower Murrumbidgee remains a net exporter of water, as the volume it sells the Commonwealth (349.9 GL in Table 4) exceeds the volume it buys from irrigators in other regions (221 GL in Table 5). More valuable water leads to an increase in employment and capital in Lower Murrumbidgee relative to forecast. As is the case elsewhere, there is a substantial change in the composition of farm production in the region: there is more dry-land livestock, vegetable and fruit production, and less irrigated cereals, rice and irrigated livestock production.

Column (5) shows the annualised buyback proceeds as a percentage share of aggregate consumption by region. We calculate the consumption shift as though farmers take payments for permanent water and spend 5 percent of the lump sum each year. We get a good indication of what impact it would have on regional economies if no buyback proceeds took place in the basin by subtracting the percentages shown in column (5) of Table 5 from modelled aggregate consumption outcomes. For example, Figure 8 shows basin-wide aggregate consumption rising to 0.25% above forecast by 2026. Removing the buyback proceeds (0.41% in bottom row, Table 5) would leave aggregate consumption 0.16% below forecast in 2026.

If farmers are paid the market price for water, they should be no worse off from SDLs. Looking at columns (2) and (5), in each case the impact on spending is a larger percentage than the BoTE GDP loss. There are two reasons. First, consumption is only one component of GDP on the expenditure side, so that for a given dollar amount, the percentage impact on consumption is larger than that on GDP. Second, there is a windfall gain in the price of water which in isolation will benefit holders of water rights. However, that is not the end of the story concerning factor prices.

Among regions, the Lower Murrumbidgee region has the largest increase in aggregate consumption relative to forecast, because it has relatively high water to land value ratio. The region (Loddon) that gains least in terms of aggregate consumption has a relatively small share of irrigated agriculture in its regional income base.

Impact of SDLs on factor prices

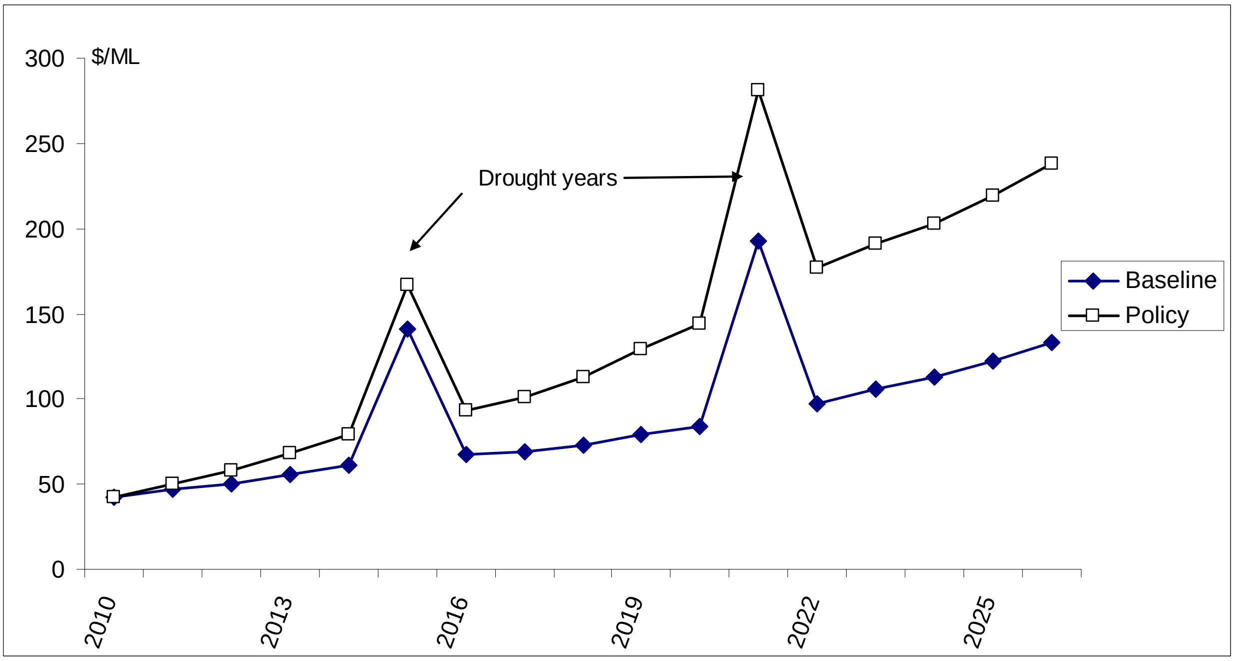
Some farm factors are mobile both between farms and between regions in the long run. If rates of return on mobile capital fall, investment falls so that capital stocks fall over time. In addition, labour is mobile between regions so that if the labour market weakens in one region relative to another, adjustment occurs via migration of workers to the other region.

Water and agricultural land are two factors in TERM-H2O in which long-run price adjustments may occur. Although water is tradable between some regions of the MDB in TERM-H2O, supplies for all uses (that is, economic plus environmental uses) are determined by rainfall conditions. Similarly, land is fixed in each region although it is possible to move irrigable land between irrigation and dry-land production in response to changes in water availability. In addition, specific capital adjusts quite slowly.

Given that land and water endowments cannot change in aggregate in each region in response to market signals, we next examine the impact of SDLs on water and land prices over time. Figure 1 shows baseline and policy water prices. The baseline price is higher than it would be without the buyback purchases that occurred prior to 2010.[8] As shown in Figure 1, the price of water rises to about $100 per megalitre above forecast by 2026 as a consequence of the Commonwealth purchases. This provides windfall gain to holders of water rights. The other feature of Figure 1 is that the price of water rises sharply in both baseline and policy runs due to moderate droughts in 2015 and 2021. Although we assume no cuts in average year water allocations, irrigation water requirements per hectare increase as rainfall drops. In addition, reduced dry-land productivity alone leads to more farm factors being available in irrigation sectors, further pushing up the marginal product of water.

[8] We treat all buyback purchases that occurred up until 31 January 2010 as though they took place in 2008 and 2009 in the baseline.

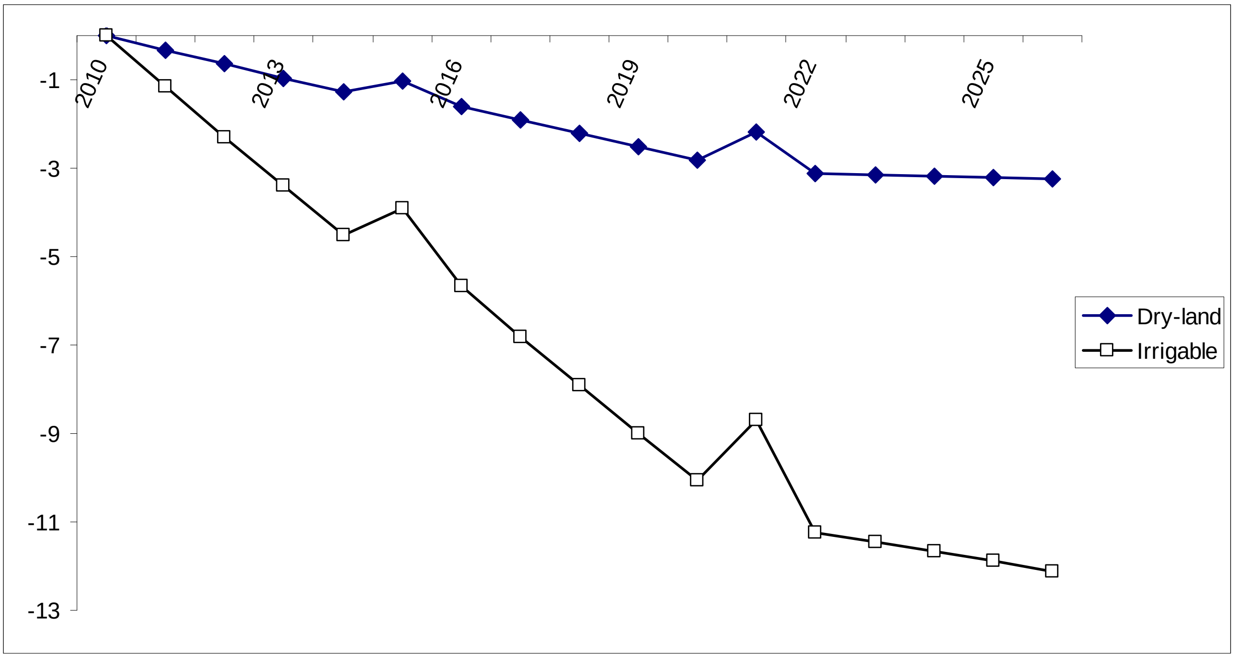
Figure 1: Price of irrigation water in MDB (scenario 1)



Next, we examine the impact on the price of land in agriculture, both irrigable and dry-land. Figure 2 shows that the price of irrigable land falls gradually as Commonwealth purchases build up over time. Since there is a land-water constraint in each sector (that is, the water requirement per hectare for a given crop and a given technology is constant), there is a tendency for more irrigable land to become available for dry-land agriculture. This in turn pushes down the price of dry land in the MDB as the quantity of land used in dry-land production increases. This has two effects.

Figure 2: Price of agricultural land in MDB (scenario 1)

% change from forecast



First, the windfall gain to holders of water rights is partly offset by the loss in land values due to enactment of SDLs. This means that irrigators who do best will be those with a large water allocation relative to the value of the land they own. This provides a key to working out which regions do best and which regions do not do so well from SDLs. Although the purchase of water at the market price by the Commonwealth to implement SDLs should be sufficient compensation for farmers, some will do better than others because of the impact on the price of agricultural land.

Second, the direct loss in irrigation output in MDB is partly offset by an increase in dry-land farming. Figure 3 shows the deviation in farm output from forecast in the MDB due to implementation of SDLs. Approximately half of the lost output in the irrigation sectors is offset by increased dry-land output as farm factors shift to dry-land production with reduced irrigation water availability.

Figure 3: MDB farm output (scenario 1)
$m change from forecast

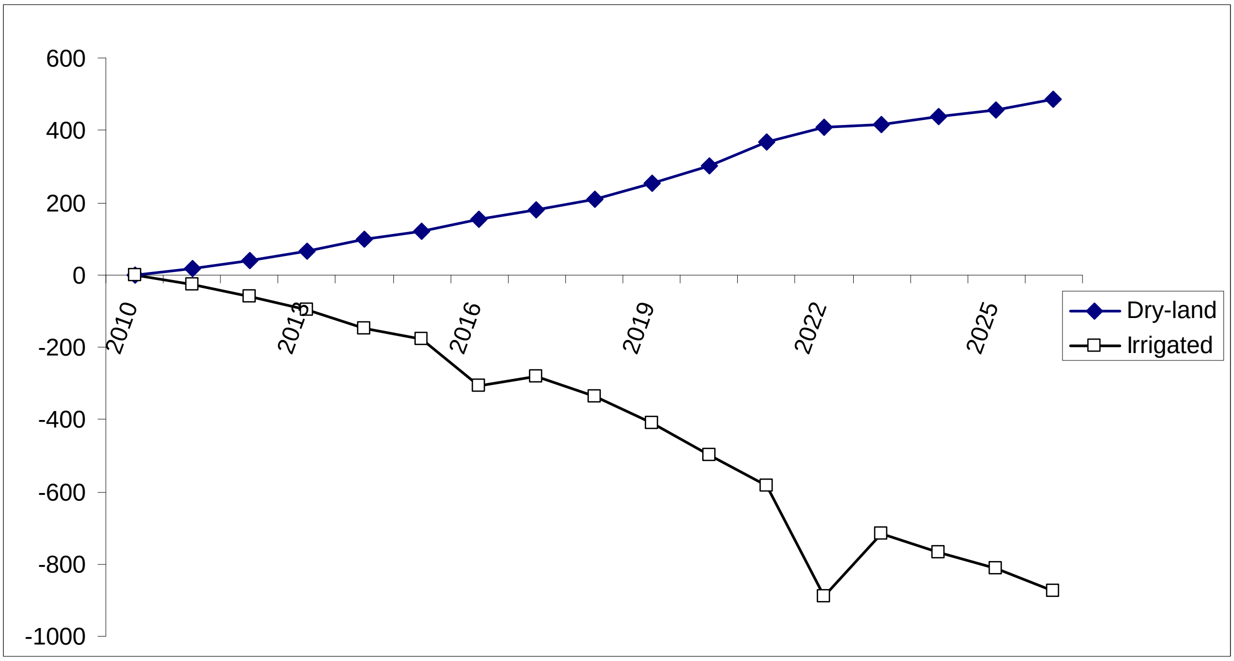


Figure 4: Price and quantity of mobile farm capital in MDB (scenario 1)
% change from forecast

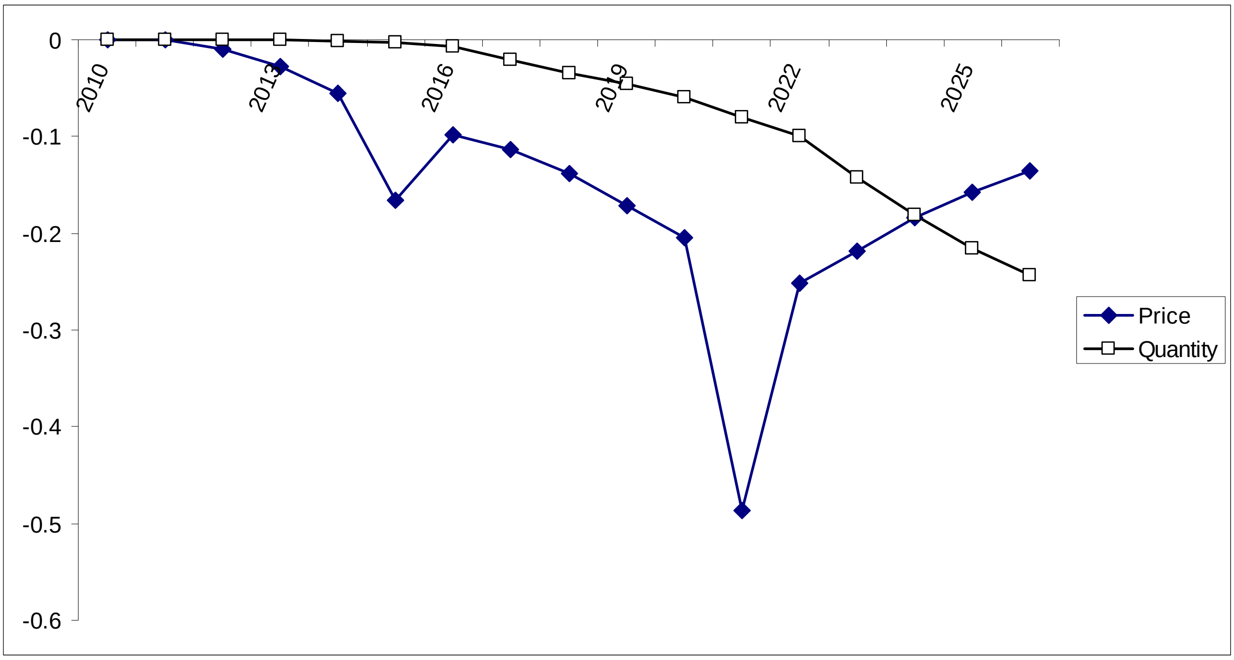
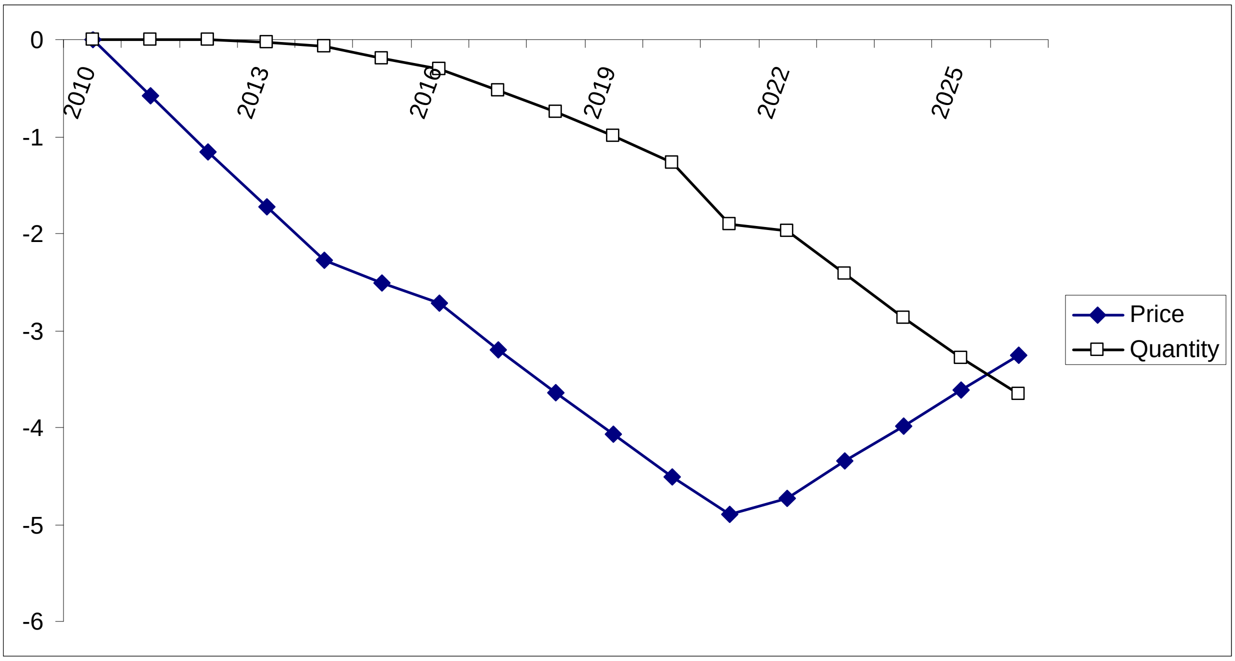


Figure 5: Price and quantity of fixed farm capital in MDB (scenario 1)
% change from forecast

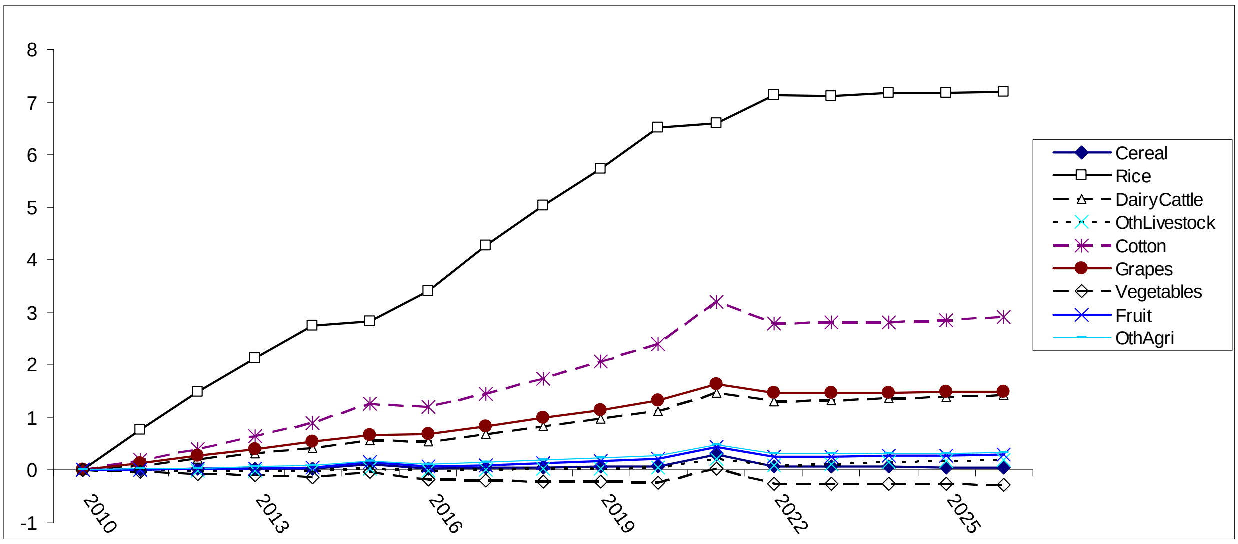


Nevertheless, despite resource movement into dry-land farming, returns to farm factors decline in the MDB over time. We can see this by looking at the impact of the SDL implementation on the price and quantity of mobile farm capital and specific capital in the MDB.

Mobile capital is negatively affected by SDLs but the impact is relatively weak. Except in years of drought, there is slow decline in the farm capital rental (price) relative to forecast. In drought, irrigation water becomes more valuable, so reduced availability due to SDLs worsens the impact relative to the baseline. Reduced investment relative to forecast gradually reduces mobile farm capital over time, so that the capital rental (price) climbs back towards forecast by the end of the simulation period (Figure 4).

Specific capital in TERM-H2O applies to irrigated perennials, including dairy cattle, other livestock, grapes and fruit orchards. We expect reduced water availability to impact negatively on specific capital rentals, the investment response to this and consequent capital accumulation relative to forecast. Specific capital rentals have not returned to forecast levels by 2026: full price adjustment will take many more years (Figure 5).

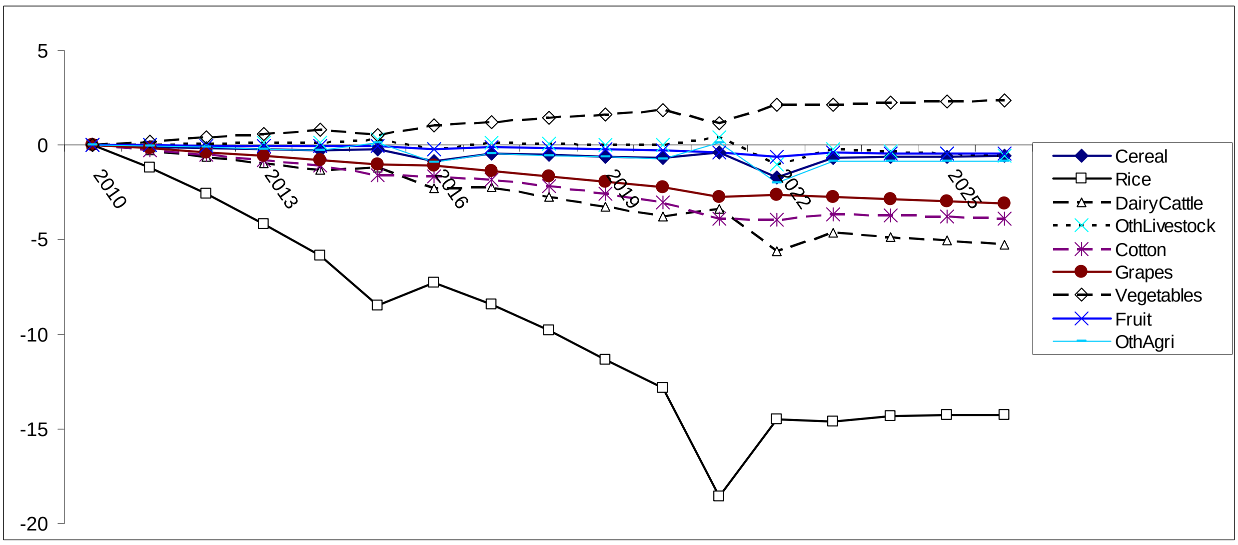
Figure 6: Farm output prices, MDB (scenario 1)
% change from forecast



Given that water price hikes are substantially offset by falls in land rentals, the impact on output prices relative to forecast is small. Figure 6 shows the impact of SDLs on farm output prices relative to forecast. The largest impact is on rice, the output of which falls most relative to forecast (Figure 7). Rice is a large user of water per dollar of output.

One curious outcome is that for vegetables. The price of vegetables falls relative to forecast: declines in the rental price of land result in falls in the production costs of vegetables, a sector with relatively modest water requirements per dollar of output. Consequently, the output of vegetables rises relative to forecast despite an increase in the price of water.

Figure 7: Farm output quantities, MDB (scenario 1)
% change from forecast

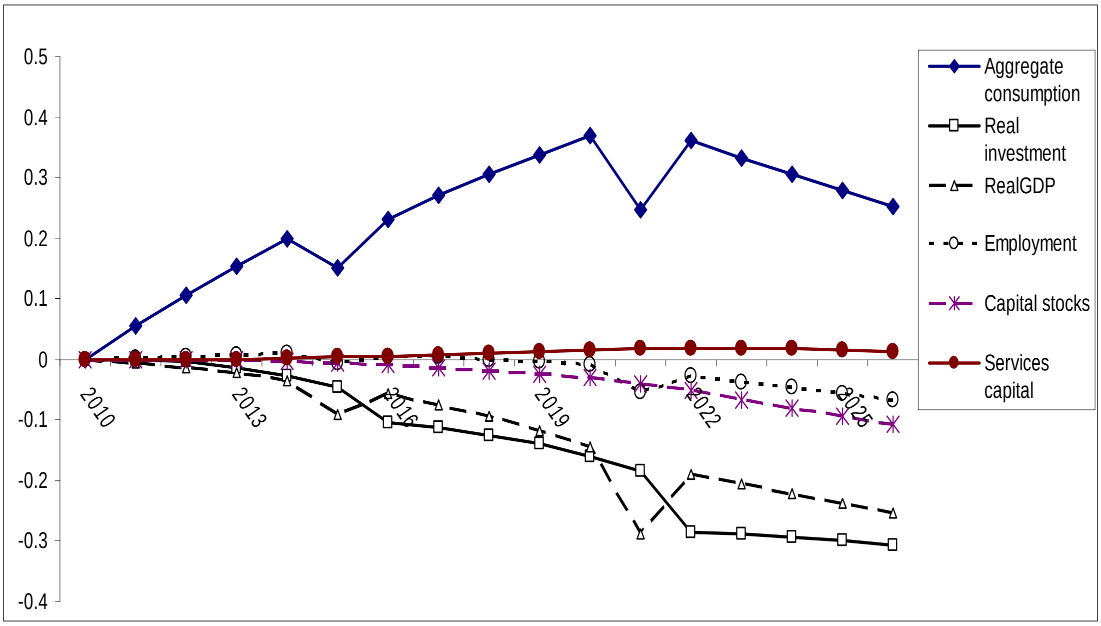


Regional macro impacts

Before presenting macroeconomic results for individual NRM regions within the MDB, we start with aggregate impacts for the basin overall. Figures 4 and 5 show us that farm capital in the basin declines after the initial year relative to forecast, so that we might expect some regional GDP losses to worsen relative to forecast over time. But there is an offsetting effect. Column (5) in Table 5 shows us the percentage impact of compensation proceeds on aggregate spending: this potentially could more than offset real GDP losses in some regions.

The spending effect arising from compensation proceeds could result over time in increased investment relative to forecast in sectors that sell a large proportion of output to households. The most obvious candidate in TERM-H2O is the services sector. Therefore, even with a decline in farm income relative to forecast over time, it does not follow that all regions will suffer worsening income losses relative to forecast over time.

Figure 8: Macroeconomic impacts, MDB (scenario 1)
% change from forecast



Real GDP declines across the basin relative to forecast, but is little more than 0.2 percent below forecast by 2026 (Figure 8). Removal of water from irrigation production results in a decline in rates of return on farm factors. This in turn reduces investment, with a consequent fall in capital relative to forecast over time. Figure 8 shows that aggregate capital stocks fall by a similar percentage as employment (around 0.1 percent). That real GDP falls by a larger percentage than either capital or labour reflects the impact of water removed from production.

Next, we turn to macro results by NRM region. By 2026, there are real GDP losses of up to 1% relative to forecast in NRM regions. As a consequence of falling returns to farm capital and land, farm investment across the MDB falls relative to forecast over time. This leads to a small reduction in regional income across the basin despite full compensation for water.

Table 6: Real GDP by NRM region[a]

% change from forecast

	2011	2014	2017	2020	2023	2026
Paroo	0.00	-0.04	-0.11	-0.21	-0.33	-0.42
Namoi	-0.01	-0.04	-0.10	-0.20	-0.30	-0.39
Gwydir	-0.02	-0.12	-0.25	-0.47	-0.65	-0.77
Border	-0.02	-0.12	-0.27	-0.55	-0.79	-0.96
Moonie	-0.04	-0.18	-0.35	-0.62	-0.82	-0.93
CondamBalone	-0.02	-0.14	-0.29	-0.54	-0.76	-0.92
Warrego	-0.01	-0.08	-0.18	-0.34	-0.49	-0.61
MacCastlr	0.00	-0.02	-0.03	-0.06	-0.08	-0.09
BarwonDarlng	-0.01	-0.05	-0.08	-0.14	-0.19	-0.21
Lachlan	0.00	-0.01	-0.02	-0.03	-0.03	-0.03
MrmbidgeeNSW	-0.01	-0.07	-0.10	-0.16	-0.17	-0.14
MurrayNSW	-0.03	-0.13	-0.24	-0.40	-0.51	-0.55
LowerDarling	-0.01	-0.03	-0.05	-0.07	-0.09	-0.09
MurrayVic	-0.01	-0.04	-0.08	-0.13	-0.17	-0.19
Loddon	0.00	-0.02	-0.03	-0.05	-0.07	-0.08
GoulbnBroken	-0.01	-0.04	-0.09	-0.15	-0.22	-0.27
Campaspe	-0.03	-0.13	-0.24	-0.38	-0.50	-0.57
Ovens	-0.01	-0.04	-0.09	-0.15	-0.21	-0.25
MurraySA	-0.01	-0.04	-0.07	-0.12	-0.17	-0.20
All MDB	-0.01	-0.03	-0.08	-0.14	-0.21	-0.25

a Wimmera-Avoca omitted as its allocations are not reduced under the SDL plan.

Table 7: Employment by NRM region[a]

% change from forecast

	2011	2014	2017	2020	2023	2026
Paroo	0.01	0.01	-0.02	-0.07	-0.17	-0.28
Namoi	0.01	0.02	0.02	0.01	-0.02	-0.06
Gwydir	0.02	0.05	0.04	-0.01	-0.11	-0.22
Border	0.01	0.00	-0.06	-0.18	-0.32	-0.47
Moonie	0.00	-0.02	-0.08	-0.19	-0.32	-0.46
CondamBalone	0.00	-0.02	-0.08	-0.19	-0.33	-0.46
Warrego	0.01	0.01	-0.01	-0.06	-0.15	-0.26
MacCastlr	0.00	0.01	0.02	0.03	0.03	0.02
BarwonDarlng	0.01	0.02	0.02	0.02	0.02	0.00
Lachlan	0.00	0.01	0.01	0.02	0.02	0.02
MrmbidgeeNSW	0.01	0.05	0.08	0.12	0.14	0.15
MurrayNSW	0.01	0.04	0.05	0.06	0.04	0.02
LowerDarling	0.01	0.02	0.03	0.04	0.04	0.04
MurrayVic	0.00	-0.01	-0.02	-0.03	-0.05	-0.07
Loddon	0.00	0.00	-0.01	-0.01	-0.02	-0.03
GoulbnBroken	0.00	0.00	-0.01	-0.03	-0.06	-0.08
Campaspe	0.00	-0.02	-0.05	-0.08	-0.12	-0.15
Ovens	0.00	-0.01	-0.03	-0.05	-0.07	-0.10
MurraySA	0.00	0.00	-0.01	-0.01	-0.03	-0.04
All MDB	0.00	0.01	0.00	-0.01	-0.04	-0.07

a Wimmera-Avoca omitted as its allocations are not reduced under the SDL plan.

Condamine-Balonne loses over 200 jobs relative to forecast by 2026 (Table 8). This reflects an inability to trade water with other region and a regional economy with a high dependence on agriculture (as noted in MDBA (2010), p. 84).

Table 8: Employment by NRM region[a]

Number employed relative to forecast

	2011	2014	2017	2020	2023	2026
Paroo	0	0	0	-1	-2	-3
Namoi	3	9	8	5	-7	-22
Gwydir	1	4	3	0	-8	-16
Border	1	0	-7	-20	-37	-54
Moonie	0	0	-1	-2	-3	-5
CondamBalone	0	-10	-36	-85	-145	-204
Warrego	0	0	0	-2	-4	-7
MacCastlr	3	11	15	22	22	18
BarwonDarlng	0	1	1	1	1	0
Lachlan	0	1	2	4	4	5
MrmbidgeeNSW	8	34	52	80	93	101
MurrayNSW	5	19	23	27	18	7
LowerDarling	0	1	1	1	1	1
MurrayVic	0	-3	-9	-18	-30	-39
Loddon	0	-2	-5	-10	-16	-22
GoulbnBroken	0	-1	-9	-23	-42	-60
Campaspe	-1	-4	-7	-13	-19	-24
Ovens	0	-2	-5	-9	-14	-18
MurraySA	0	0	-1	-3	-8	-12
All MDB[b]	20	58	25	-46	-196	-354

a Wimmera-Avoca omitted as its allocations are not reduced under the SDL plan.
b Numbers do not all up identically to those for the regions shown in Figure A2, as there is an imperfect matching between statistical and NRM regions. See Appendix A2.

Table 9: Aggregate consumption by NRM region[a]

% change from forecast

	2011	2014	2017	2020	2023	2026
Paroo	0.12	0.44	0.60	0.79	0.71	0.54
Namoi	0.05	0.20	0.28	0.40	0.40	0.34
Gwydir	0.14	0.55	0.78	1.08	1.05	0.88
Border	0.12	0.42	0.55	0.67	0.51	0.28
Moonie	0.12	0.40	0.51	0.63	0.47	0.24
CondamBalone	0.11	0.39	0.50	0.63	0.48	0.26
Warrego	0.11	0.40	0.54	0.73	0.66	0.50
MacCastlr	0.02	0.07	0.11	0.16	0.16	0.14
BarwonDarlng	0.07	0.26	0.38	0.56	0.59	0.55
Lachlan	0.02	0.05	0.07	0.11	0.12	0.11
MrmbidgeeNSW	0.13	0.47	0.66	0.94	0.92	0.82
MurrayNSW	0.11	0.40	0.54	0.76	0.69	0.53
LowerDarling	0.08	0.28	0.38	0.54	0.53	0.45
MurrayVic	0.03	0.09	0.12	0.16	0.14	0.09
Loddon	0.00	0.01	0.00	-0.01	-0.02	-0.04
GoulbnBroken	0.05	0.17	0.23	0.31	0.26	0.18
Campaspe	0.04	0.15	0.20	0.26	0.20	0.12
Ovens	0.00	0.00	-0.01	-0.03	-0.07	-0.10
MurraySA	0.04	0.15	0.20	0.28	0.25	0.19
All MDB	0.04	0.15	0.20	0.28	0.25	0.19

a Wimmera-Avoca omitted as its allocations are not reduced under the SDL plan.

Regional employment in the majority of regions falls relative to forecast across the basin. However, there are exceptions. Regions with high water to farmland asset values do better than others. These include the Murrumbidgee region where, based on the assumption that proceeds of water sales stay in the region, there is an increase in consumption relative to forecast driven by increased employment in sectors reliant on household spending (i.e., services).

Aggregate consumption rises relative to forecast with gradual sales to the government. This is because water rights are purchased by the Commonwealth at market prices, which in turn are boosted by reduced availability of water for economic uses. The biggest winners from sales are likely to be regions in which the increase in the value of water is not substantially offset by declines in agricultural land values. After 2022, aggregate consumption turns back towards forecast, driven down slightly as farm investment and employment fall relative to forecast (Figure 8).

Sectoral impacts

Table 10 shows detailed sectoral output changes relative to forecast in 2026. Table 11 repeats the detail for 2020, and Table 12 for 2026. The main impact evident in each of the years as the sectoral level is in the movement from irrigation to dry-land activities. Irrigated cereals, for which there is a ready dry-land substitute, and rice, the crop with the largest water requirements per dollar of output, have the largest cuts in output.

There is an increase in vegetable production in a number of regions. As noted earlier in reference to Figure 7, vegetables do well because cheaper land and more expensive water improve the cost competitiveness of the sector against other irrigation activities that use more water and less land than vegetables per dollar of output.

At the downstream level, there are quite small proportional reductions in the output of dairy products and ginned cotton. These losses gradually increase over time, eventually exceeding 1% in some regions in 2026. For example, in the Goulburn-Broken region, processed dairy output falls to 1.1% below forecast in 2026 (Table 12).

Cost to the Commonwealth

The Commonwealth pays for permanent water at a market price. This stock price is determined by calculating a present value for future prices, as detailed in appendix B. In the scenario, water purchased by the Commonwealth between 2011 and 2022 costs $4,067 million (2010 dollars, net present value). This is in addition to buyback purchases made prior to the end of January 2010.

National impact

By 2026, national real GDP is 0.0094% below forecast.

Table 10: Output by NRM region, 2014 % change from forecast

	Paroo	Namoi	Gwydir	Border	Moonie	CondamBalone	Warrego	MacCastlr	BarwonDarlng	Lachlan	MrmbidgeeNSW	MurrayNSW	LowerDarling	MurrayVic	Loddon	GoulbnBroken	Campaspe	Ovens	MurraySA
CerealDryL	0.9	0.6	0.9	1.0	1.0	1.0	0.9	0.5	0.6	0.2	1.6	7.1	0.9	1.5	1.5	1.2	1.8	1.8	1.4
CerealIrig	-15.0	-10.9	-13.5	-14.0	-13.9	-13.9	-15.1	-8.8	-11.7	-3.1	-10.3	-9.5	-8.3	-14.4	-14.4	-15.8	-17.7	-17.7	-15.1
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.8	0.0	0.6	-5.8	-4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DairyCatDryL	0.0	2.4	0.0	0.0	0.0	2.7	0.0	2.6	0.0	1.2	3.5	8.4	0.0	4.3	0.0	4.0	5.8	5.8	4.2
DairyCatIrig	0.0	-2.0	-3.4	-3.1	0.0	-3.3	0.0	-1.9	0.0	-0.5	-3.0	-0.9	0.0	-2.4	-2.2	-2.7	-2.4	-2.4	-2.5
OthLivstoDry	0.8	0.4	0.5	0.8	0.9	0.8	0.8	0.4	0.6	0.1	1.2	5.6	0.7	1.1	1.1	0.8	1.4	1.4	1.1
OthLivstoIrg	-4.2	-2.6	-2.8	-3.9	-4.1	-4.1	-4.1	-2.1	-3.3	-0.8	-3.1	-6.8	-2.2	-3.4	-3.2	-4.1	-3.8	-3.8	-3.5
CottonDryL	5.5	5.8	6.0	5.7	5.6	5.5	5.3	4.7	5.3	3.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CottonIrig	-2.6	-1.1	-1.5	-2.2	-2.5	-2.4	-2.0	0.4	-1.9	1.9	-1.4	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Grapes	-1.9	-1.0	0.0	-1.8	0.0	-1.8	-1.3	-0.5	-1.3	0.0	0.1	0.1	-0.6	-0.9	-0.9	-1.4	-1.7	-1.7	-1.3
Vegetables	0.0	0.0	0.2	0.6	0.0	0.5	0.0	0.2	0.0	0.0	2.8	5.4	0.9	0.7	0.7	0.0	0.8	0.8	0.4
FruitDryL	0.0	0.8	0.9	1.1	0.0	1.1	0.0	0.9	0.0	0.2	1.9	5.2	0.9	1.7	0.0	1.4	2.0	2.0	1.5
FruitIrig	0.0	-0.4	-0.4	-0.5	-0.5	-0.5	-0.5	-0.3	-0.5	-0.1	0.3	1.1	-0.1	-0.3	-0.3	-0.6	-0.4	-0.4	-0.5
OthAgriDry	1.7	1.3	1.4	1.8	1.9	1.9	1.7	1.4	1.6	0.5	2.1	3.4	1.3	2.7	2.7	2.8	3.6	3.6	2.8
OthAgriIrig	-2.6	-1.4	-1.6	-1.9	-2.0	-2.0	-2.5	-1.3	-2.2	-0.4	-0.9	1.0	-1.0	-2.1	-2.1	-2.6	-2.6	-2.6	-2.5
AgriSrvces	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	-0.1	0.0	-0.1	-0.1	0.0	-0.1	-0.1	0.0	-0.1	-0.1	0.0
GinnedCotton	0.0	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ForestFish	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MeatProds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
DairyProds	0.0	-0.1	0.0	-0.2	0.0	-0.2	0.0	-0.1	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.2	-0.1	-0.2	-0.2	-0.1
FruitVeg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthFodTobDrk	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
FlourCereals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1
SugarRef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WineSpirits	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TCFs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WoodPaper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PrintPublish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthManufact	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ElectricGas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WaterDrains	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

OtherSrvces	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 11: Output by NRM region, 2020 % change from forecast

	Paroo	Namoi	Gwydir	Border	Moonie	CondamBalone	Warrego	MacCastlr	BarwonDarlng	Lachlan	MrmbidgeeNSW	MurrayNSW	LowerDarling	MurrayVic	Loddon	GoulbnBroken	Campaspe	Ovens	MurraySA
CerealDryL	2.0	1.5	2.2	2.4	2.5	2.3	2.1	1.1	1.5	0.4	3.5	16.3	2.0	3.4	3.4	2.6	4.1	4.1	3.2
CerealIrig	-41.0	-29.0	-37.4	-37.0	-36.4	-36.8	-41.2	-22.6	-32.5	-6.9	-22.5	-21.2	-17.7	-29.7	-29.6	-32.6	-36.8	-36.8	-32.2
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.2	0.0	1.3	-12.7	-11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DairyCatDryL	0.0	6.6	0.0	0.0	0.0	7.3	0.0	7.1	0.0	3.0	9.5	21.1	0.0	11.6	0.0	10.6	15.7	15.7	11.6
DairyCatIrig	0.0	-6.0	-10.4	-9.8	0.0	-10.1	0.0	-5.5	0.0	-1.3	-8.1	-2.7	0.0	-6.4	-5.8	-7.2	-6.4	-6.4	-6.9
OthLivstoDry	1.9	1.1	1.3	2.0	2.1	2.0	1.9	1.1	1.6	0.3	2.5	13.3	1.6	2.6	2.5	2.2	3.5	3.5	2.8
OthLivstoIrg	-13.0	-7.8	-8.5	-12.0	-12.4	-12.5	-12.9	-6.3	-9.9	-2.3	-8.5	-18.7	-5.7	-9.4	-9.0	-11.7	-11.1	-11.1	-9.9
CottonDryL	10.4	11.6	11.8	11.1	10.8	10.5	10.6	9.8	10.5	7.3	8.9	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0
CottonIrig	-6.4	-3.3	-4.4	-5.6	-6.2	-6.0	-5.1	0.4	-4.8	4.3	-2.9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Grapes	-6.4	-3.5	0.0	-5.9	-5.9	-6.2	-4.5	-1.7	-4.5	0.0	0.3	0.4	-1.6	-2.5	-2.5	-4.1	-5.2	-5.2	-3.8
Vegetables	0.0	-0.1	0.3	0.9	0.0	0.8	0.0	0.4	0.0	0.0	6.5	12.7	2.3	1.7	1.7	0.1	1.8	1.8	0.9
FruitDryL	0.0	2.4	2.9	3.2	0.0	3.1	0.0	2.4	0.0	0.7	4.3	12.4	2.3	4.3	0.0	3.6	5.5	5.5	4.2
FruitIrig	0.0	-1.4	-1.5	-2.0	-2.0	-2.1	-2.0	-0.9	-2.0	-0.3	0.9	3.4	-0.2	-0.9	-0.9	-1.7	-1.2	-1.2	-1.4
OthAgriDry	4.0	3.2	3.4	4.1	4.3	4.2	4.0	3.3	3.7	1.0	4.5	8.0	2.6	5.9	5.8	6.0	8.1	8.1	6.4
OthAgriIrig	-7.0	-3.6	-4.2	-5.2	-5.5	-5.6	-6.9	-3.0	-5.8	-0.8	-1.9	2.5	-1.9	-4.5	-4.4	-5.7	-5.9	-5.9	-5.5
AgriSrvces	0.0	-0.5	-0.7	-1.3	-1.4	-1.4	-0.7	-0.1	-0.5	-0.2	-0.3	-0.4	-0.2	-0.4	-0.4	0.1	-0.6	-0.6	0.0
GinnedCotton	0.0	-1.2	-1.2	-1.4	-1.4	-1.4	-1.2	-1.0	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ForestFish	0.0	0.0	0.0	-0.3	-0.3	-0.3	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MeatProds	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.2	0.0
DairyProds	0.0	-0.3	0.0	-0.9	0.0	-0.9	0.0	-0.2	0.0	-0.3	-0.2	-0.2	0.0	-0.4	-0.6	-0.3	-0.7	-0.7	-0.4
FruitVeg	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthFodTobDrk	-0.2	-0.1	-0.1	-0.2	-0.3	-0.3	-0.2	0.0	-0.1	0.0	0.1	0.0	0.0	-0.1	-0.1	0.0	-0.2	-0.2	-0.1
FlourCereals	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	-0.3	-0.5	0.0	-0.2	0.0	-0.1	-0.2	-0.2	-0.2
SugarRef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WineSpirits	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	0.0	-0.3	-0.1	-0.2	-0.2	0.0	-0.1	-0.1	-0.1	-0.1
TCFs	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.2	-0.1	-0.2	0.1	-0.1	0.0	0.0	0.0	0.0	-0.1
WoodPaper	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PrintPublish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthManufact	-0.2	0.0	-0.2	-0.2	-0.3	-0.2	-0.2	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ElectricGas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

WaterDrains	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
OtherSrvces	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Table 12: Output by NRM region, 2026 % change from forecast

	Paroo	Namoi	Gwydir	Border	Moonie	CondamBalone	Warrego	MacCastlr	BarwonDarlng	Lachlan	MrmbidgeeNSW	MurrayNSW	LowerDarling	MurrayVic	Loddon	GoulbnBroken	Campaspe	Ovens	MurraySA
CerealDryL	2.1	1.8	2.8	2.8	2.8	2.6	2.2	1.1	1.8	0.4	3.7	16.8	2.2	3.9	2.9	4.6	4.6	3.6	2.2
CerealIrig	-57.4	-38.5	-51.8	-49.2	-47.9	-49.2	-58.0	-28.8	-46.3	-7.4	-23.3	-20.7	-18.5	-30.7	-34.0	-38.3	-38.3	-33.7	-24.7
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-14.8	0.0	1.0	-14.1	-11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DairyCatDryL	0.0	8.7	0.0	9.5	0.0	9.5	0.0	9.1	0.0	3.9	12.4	23.6	0.0	14.8	13.7	20.1	20.1	15.0	10.4
DairyCatIrig	0.0	-8.9	-15.6	-14.7	0.0	-15.2	0.0	-7.7	0.0	-1.6	-10.8	-2.6	0.0	-8.3	-9.4	-8.4	-8.4	-9.0	-6.9
OthLivstoDry	2.2	1.6	1.9	2.4	2.5	2.4	2.2	1.4	2.1	0.5	2.8	14.9	1.8	3.3	2.9	4.5	4.5	3.6	2.1
OthLivstoIrg	-19.9	-11.9	-12.8	-18.0	-18.6	-18.9	-19.7	-9.5	-14.8	-3.0	-11.7	-25.7	-7.5	-13.2	-16.1	-16.1	-16.1	-14.3	-11.2
CottonDryL	9.1	11.0	11.1	10.0	9.5	9.3	9.8	9.2	9.8	7.1	9.3	0.0	9.3	19.3	0.0	0.0	0.0	0.0	0.0
CottonIrig	-7.5	-4.5	-5.9	-6.8	-7.2	-7.1	-6.2	-0.4	-5.8	4.3	-2.3	0.0	0.5	0.4	0.0	0.0	0.0	0.0	0.0
Grapes	-10.3	-5.7	0.0	-9.3	-9.3	-9.9	-7.1	-2.7	-7.1	0.2	0.8	1.4	-2.0	-3.4	-5.8	-7.7	-7.7	-5.4	-2.9
Vegetables	0.0	-0.1	0.6	0.9	0.0	0.8	0.0	0.6	0.0	0.1	7.7	16.4	3.0	2.4	0.7	2.7	2.7	1.7	2.1
FruitDryL	0.0	3.8	4.5	4.3	0.0	4.2	0.0	3.0	0.0	0.9	4.8	13.3	2.8	5.7	4.8	7.3	7.3	5.5	3.3
FruitIrig	0.0	-2.3	-2.5	-3.4	-3.4	-3.5	-3.3	-1.2	-3.3	-0.3	1.5	6.2	0.0	-1.1	-2.2	-1.5	-1.5	-1.8	-1.1
OthAgriDry	4.2	3.5	3.9	4.4	4.5	4.5	4.2	3.5	4.1	1.1	4.6	7.4	2.7	6.0	6.1	8.4	8.4	6.5	3.8
OthAgriIrig	-9.1	-4.5	-5.2	-6.7	-7.0	-7.2	-8.9	-3.5	-7.2	-0.8	-1.5	4.8	-1.7	-4.4	-5.7	-6.0	-6.0	-5.6	-3.7
AgriSrvces	0.0	-1.0	-1.6	-2.6	-2.7	-2.7	-1.4	-0.3	-1.0	-0.5	-0.6	-0.9	-0.4	-0.8	0.1	-1.1	-1.1	-0.5	-0.3
GinnedCotton	0.0	-2.1	-2.2	-2.4	-2.5	-2.5	-2.1	-1.8	-2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ForestFish	0.0	-0.1	0.0	-0.5	-0.6	-0.6	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
MeatProds	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.1	0.0	-0.1	-0.4	0.0	0.0	-0.1	0.1	0.1	0.0	-0.1
DairyProds	0.0	-0.5	0.0	-1.8	0.0	-1.8	0.0	-0.2	0.0	-0.4	-0.2	-0.2	0.0	-0.9	-0.5	-1.1	-1.1	-0.6	-0.4
FruitVeg	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
OthFodTobDrk	-0.6	-0.1	-0.2	-0.5	-0.7	-0.6	-0.5	-0.1	-0.2	-0.1	0.1	0.0	0.0	-0.1	-0.1	-0.4	-0.4	-0.2	-0.1
FlourCereals	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.2	0.0	-0.1	-0.4	-0.5	0.0	0.0	-0.1	-0.3	-0.3	-0.3	0.0
SugarRef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WineSpirits	0.0	0.0	0.0	-0.2	0.0	-0.2	0.0	-0.1	0.0	0.0	-0.3	0.0	-0.2	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
TCFs	-0.4	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.3	0.1	-0.3	-0.3	-0.6	0.1	0.0	-0.1	0.0	0.0	-0.3	0.0
WoodPaper	0.0	0.0	-0.1	0.0	0.1	0.0	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PrintPublish	0.0	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthManufact	-0.4	0.0	-0.3	-0.5	-0.5	-0.5	-0.4	0.0	-0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0

ElectricGas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WaterDrains	-0.4	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	0.0	-0.2	0.0	0.5	0.1	0.1	0.0	-0.1	-0.1	-0.1	-0.1	0.0
OtherSrvces	-0.2	0.0	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0

Scenarios 2 and 3

- Scenario 2: as for scenario 1, except that the Commonwealth purchases only 3000 GL of permanent water rights from irrigators.
- Scenario 3: as for scenario 1, except that the Commonwealth purchases 4000 GL of permanent water rights from irrigators.

One of the most significant outcomes that arises from comparing scenarios 1, 2 and 3 is that the costs of compensation rise by a larger percentage than the volume of water set aside for the environment. In going from 3000 GL to 3500 GL, there is a 22.7% increase in volume (after subtracting the 796 GL already sold to the Commonwealth). Yet the value of compensation rises by 30.7%. The cost to the Commonwealth for 3000 GL is $3.0 billion, compared with $4.1 billion for 3500 GL and $5.3 billion for 4000 GL (2010 dollars, net present value) (see Appendix B). This is so because the larger the volume of water restored to the environment, the higher the price of water used in irrigation, as is evident from Figure 1 and Figure 9.

National real GDP by 2026 in the 3000 GL scenario has fallen to 0.007% below forecast. In the 4000 GL scenario, real GDP falls to 0.012% below forecast.

Figure 9: Price of irrigation water in MDB (scenarios 2 and 3)

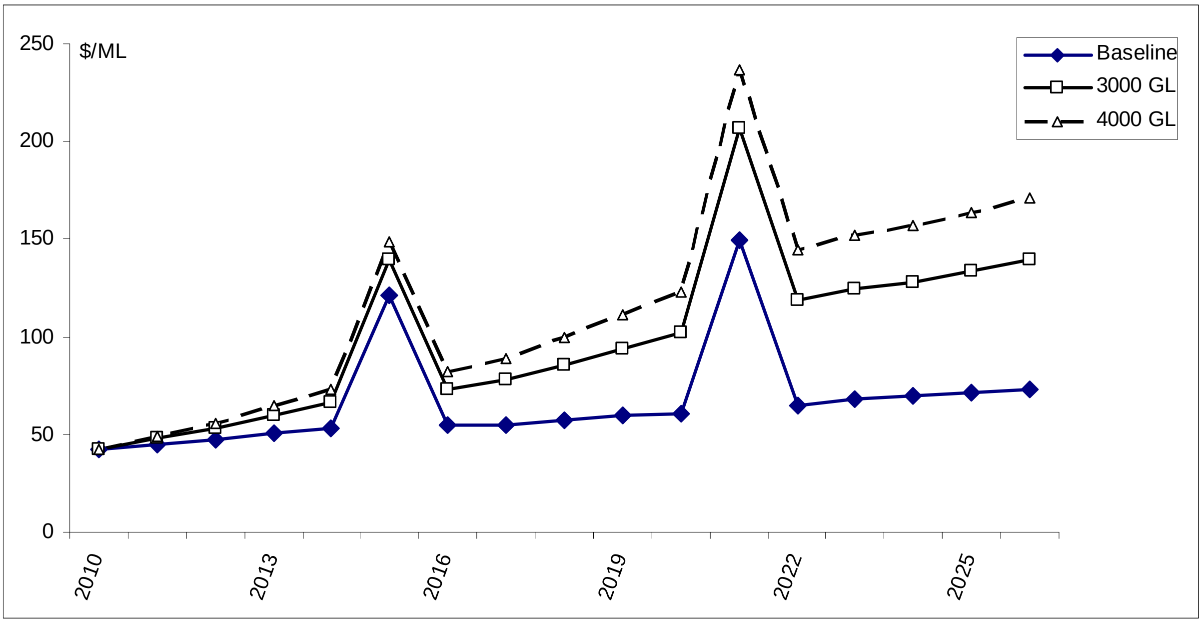


Figure 10: Price of agricultural land in MDB (scenarios 2 and 3)
% change from forecast

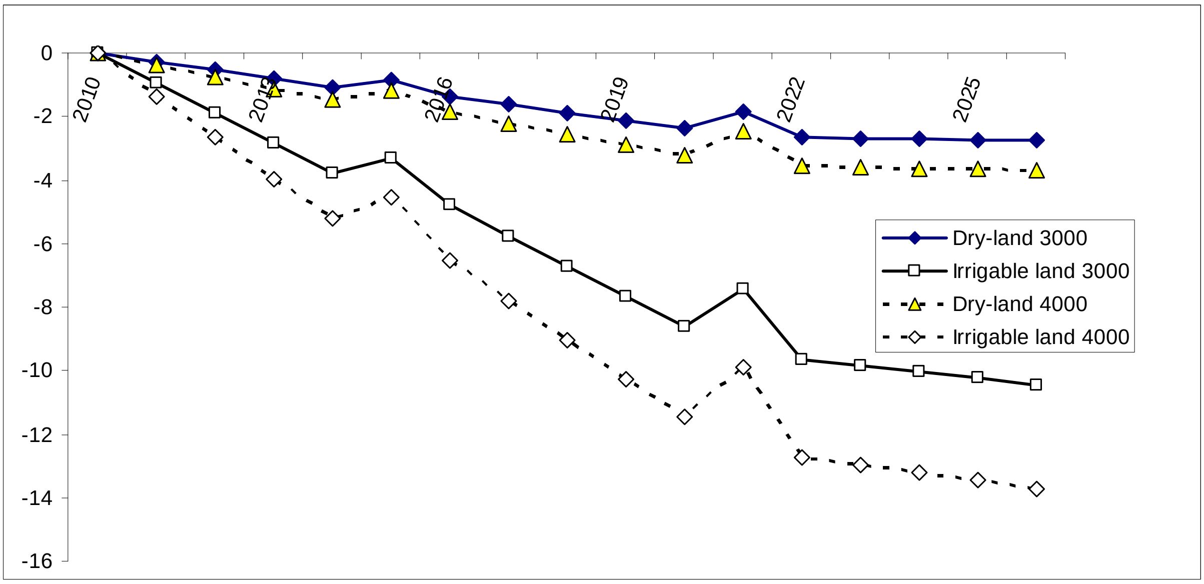


Figure 11: MDB farm output (scenarios 2 and 3)
$m change from forecast

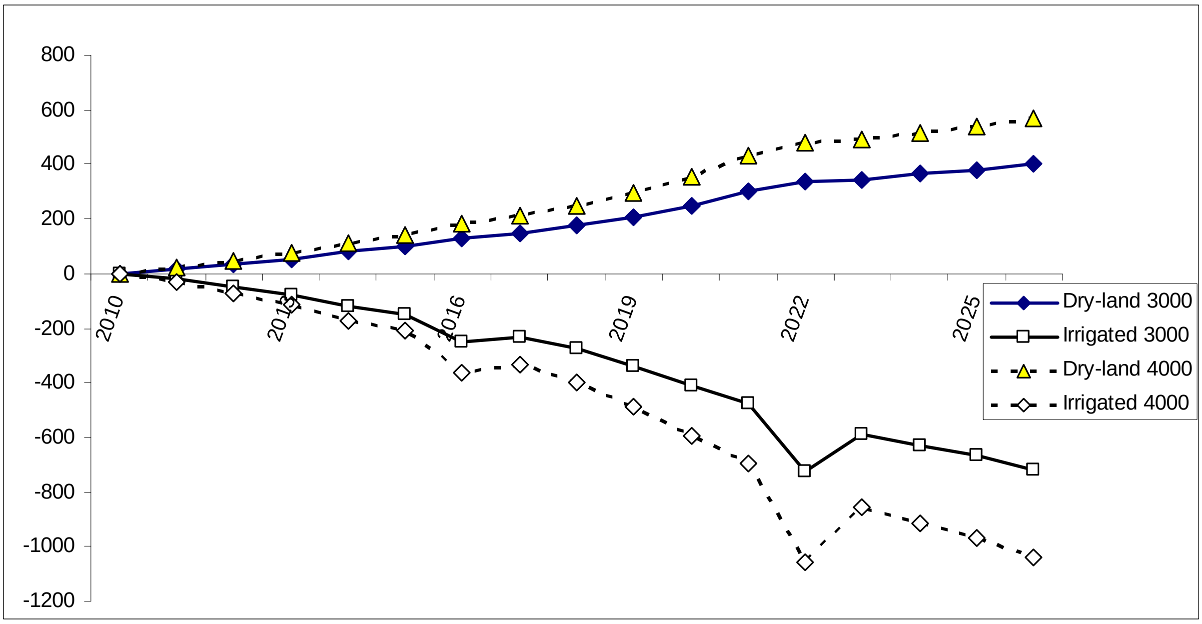


Figure 12: Price and quantity of mobile farm capital in MDB (scenarios 2 and 3)
% change from forecast

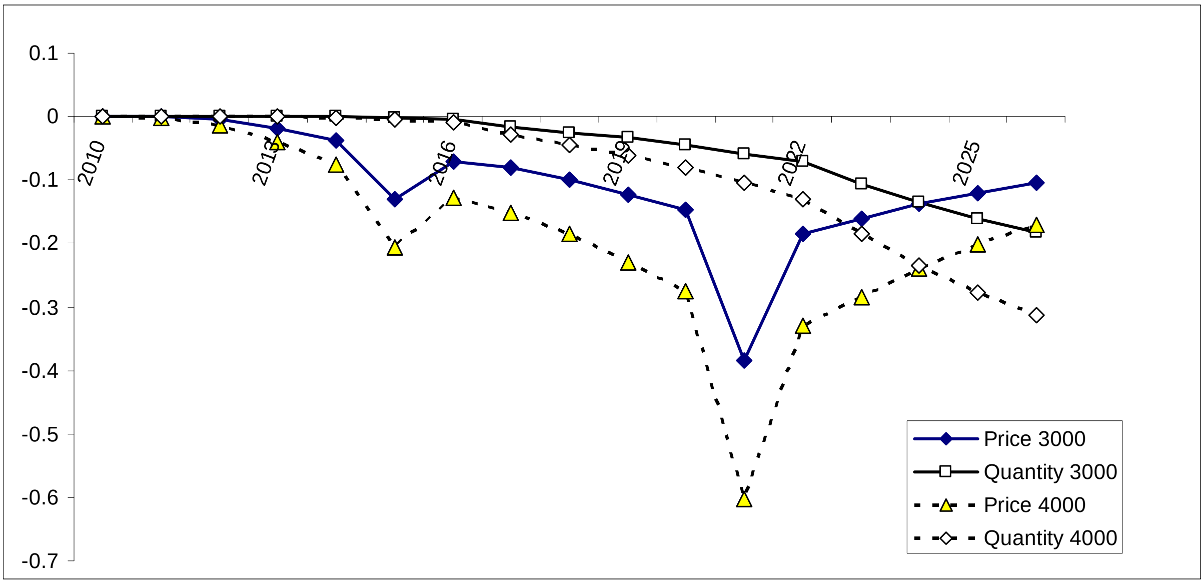


Figure 13: Price and quantity of fixed farm capital in MDB (scenarios 2 and 3)
% change from forecast

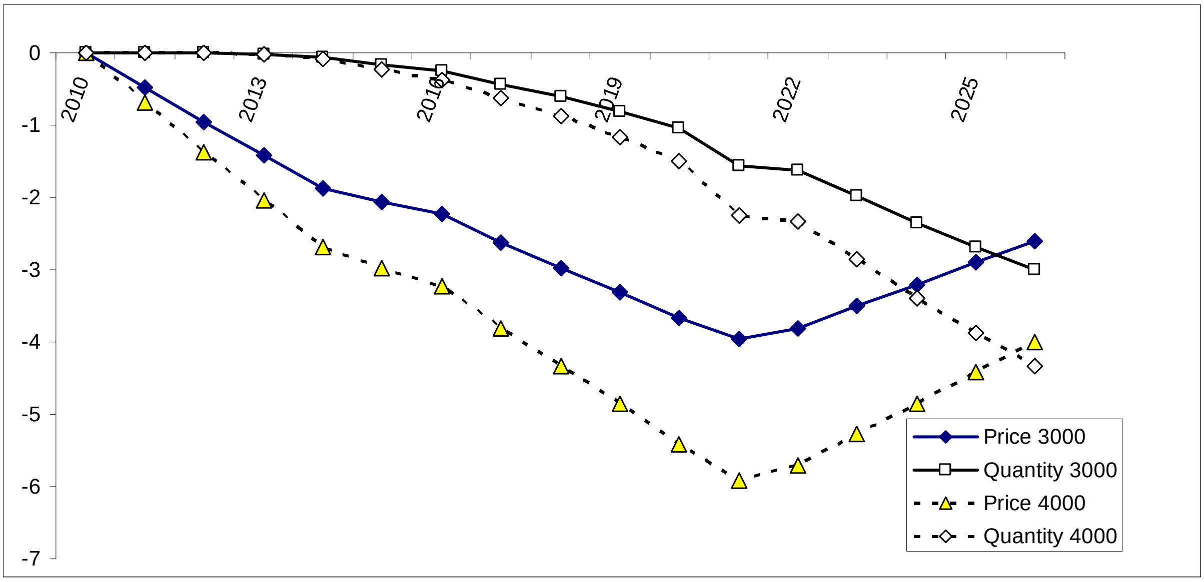


Figure 14a: Farm output prices, MDB (scenario 2)
% change from forecast

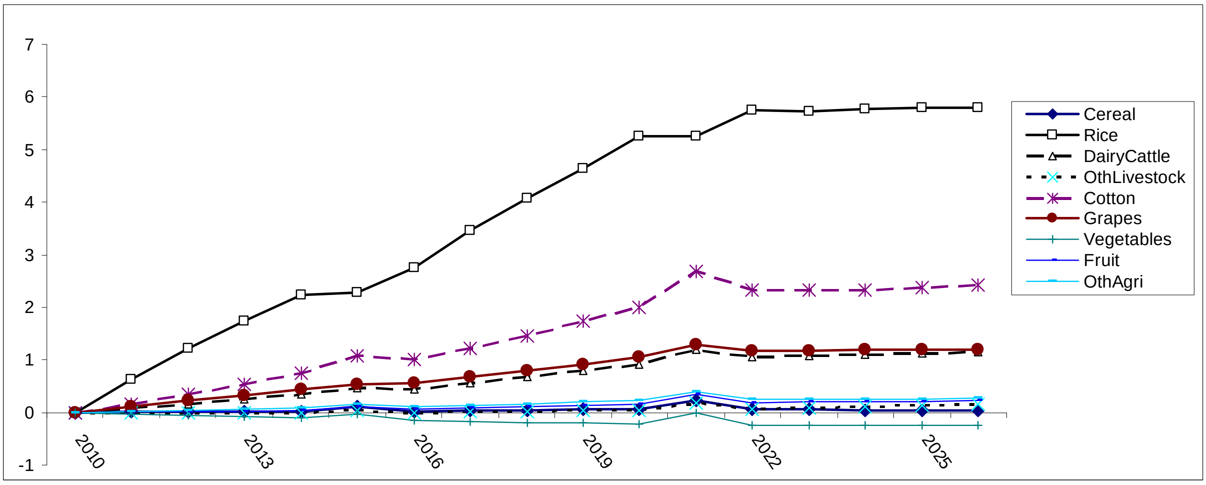


Figure 14b: Farm output prices, MDB (scenario 3)
% change from forecast

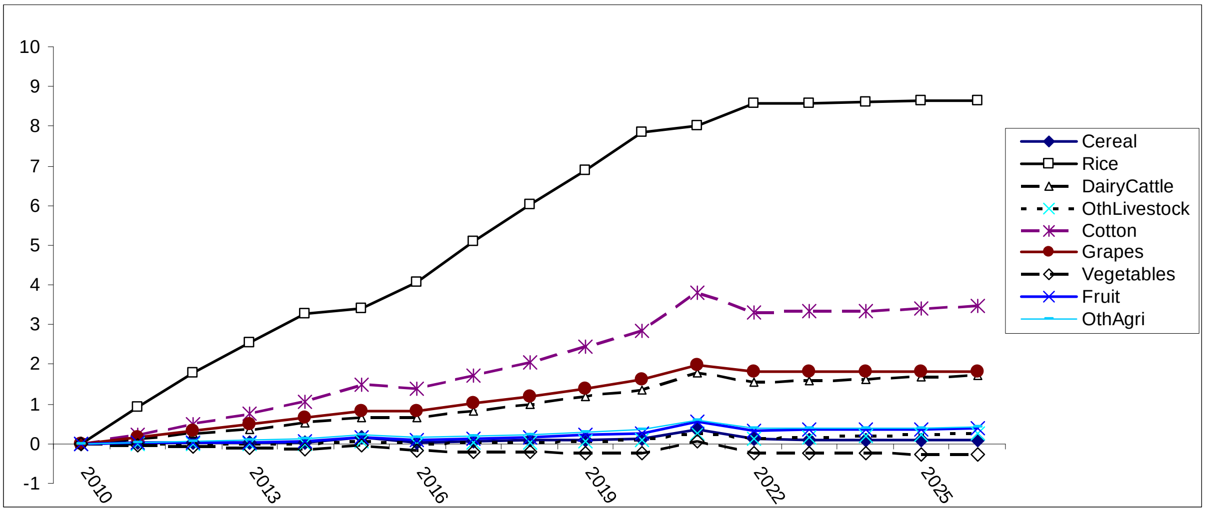


Figure 15a: Farm output quantities, MDB (scenario 2)
% change from forecast

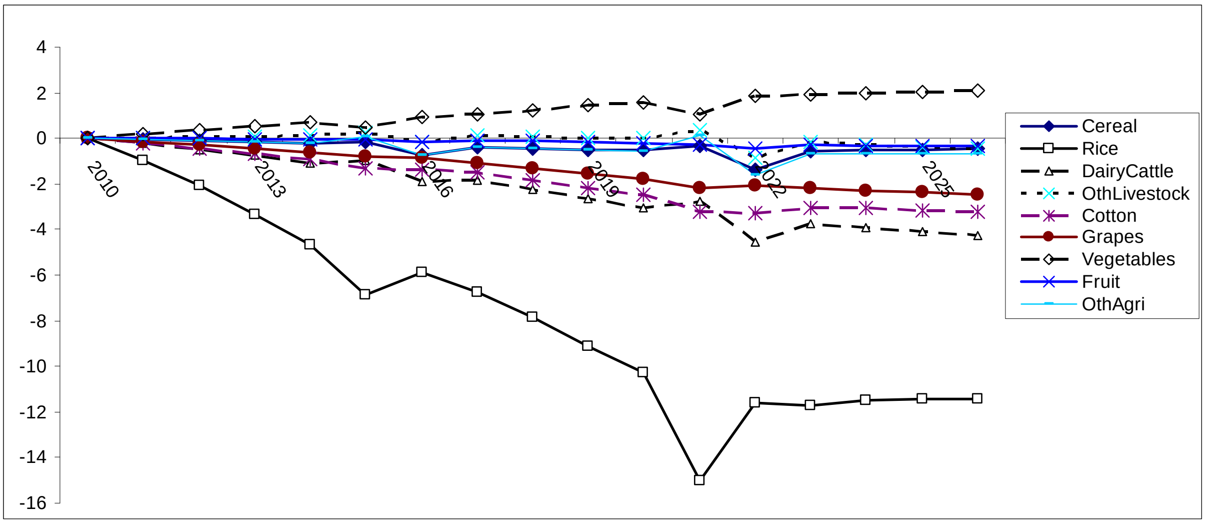


Figure 15b: Farm output quantities, MDB (scenario 3)
% change from forecast

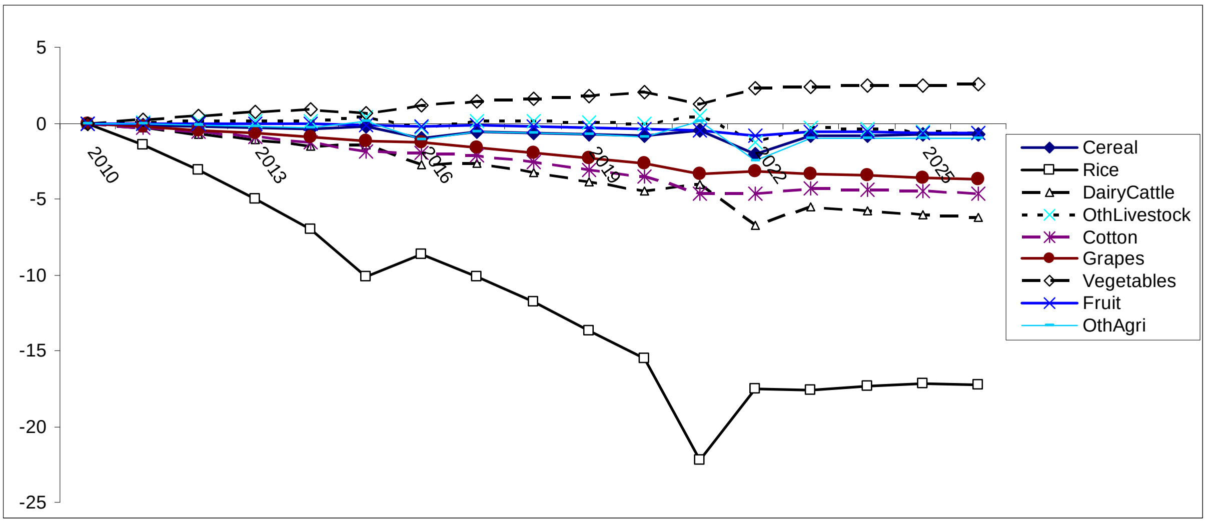


Figure 16a: Macroeconomic impacts, MDB (scenario 2)
% change from forecast

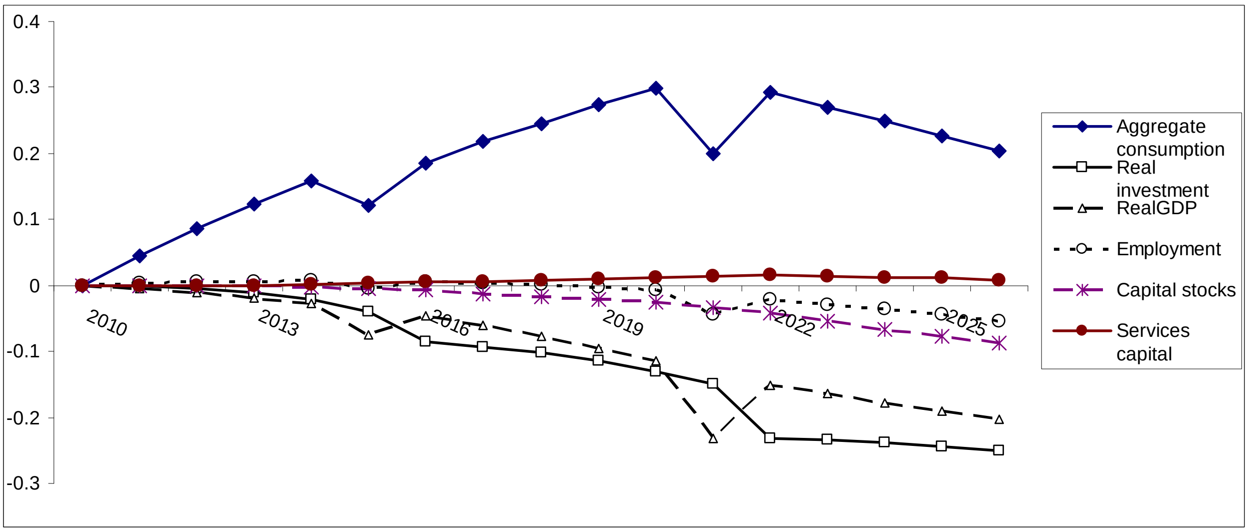
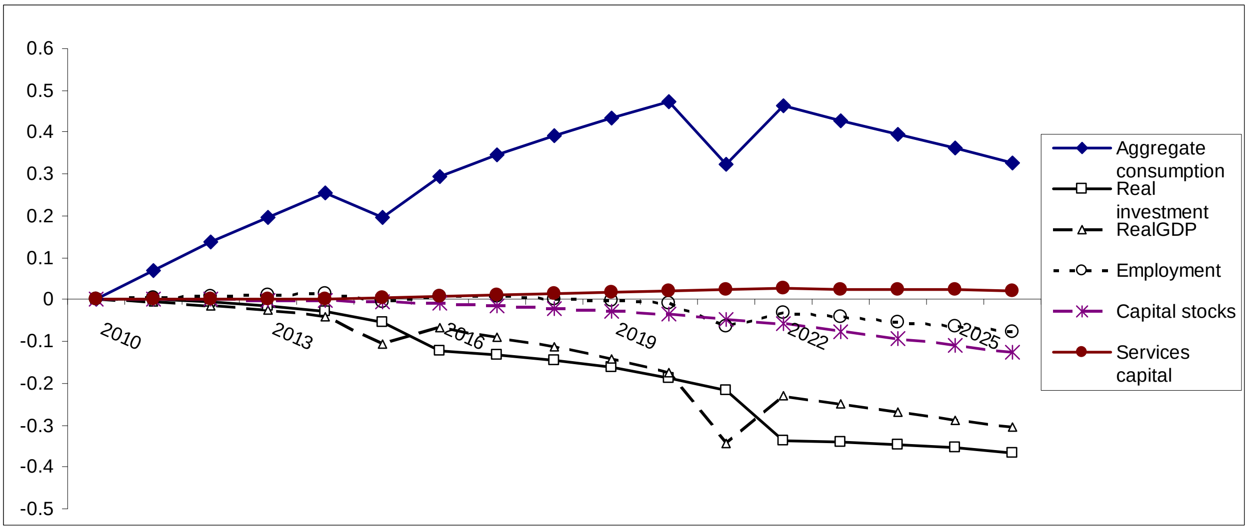


Figure 16b: Macroeconomic impacts , MDB (scenario 3)
% change from forecast



Scenario 4

Scenario 4 repeats scenario 1 with one difference: there is no compensation for SDLs beyond the buyback purchases made prior to the end of January 2010. We could interpret this scenario in two ways. Either it models a 3500 GL target assuming that all compensation proceeds leave the basin or it models the target assuming that farmers are not compensated for water taken out of production.

Our assumption in scenario 1 is that farmers spend only that percentage of proceeds from water sales to the Commonwealth that keeps the real value of proceeds unchanged over time. We get an idea of how different scenario 4 is from scenario 1 by examining column (5) in Table 5. This shows spending of SDL compensation as a share of aggregate consumption in each region in 2026. In scenario 1, MDB aggregate consumption is 0.25% above forecast in 2026 (Figure 8). Aggregate consumption in scenario 4 is -0.14% relative to forecast in 2026 (Figure 17), or 0.39% lower than scenario 1. From Table 5 (bottom row of column (5)), the basin-wide average SDL compensation share of aggregate consumption is 0.41%, which is similar to the 0.39% gap in basin-wide consumption between the two scenarios.[9]

Without buyback revenues to spend, regions lose out at the macro level relative to scenario 1. Capital in the services sectors falls relative to forecast over time, albeit by only a small percentage (-0.07% in 2026, Figure 17). Aggregate employment in the basin falls further relative to forecast than in scenario 1, reaching 0.16% below forecast in 2026. This is equivalent to a job loss in excess of 880 relative to forecast. Outputs by industry in farm and downstream sectors differ little from scenario 1. The sector that changes most relative to scenario 1 is other services, reflecting reduced local spending in each region. Although results are not dramatically different from scenario 1, the aggregation of the model (i.e., a single household in each region) masks the losses that uncompensated reductions in water availability would impose on individual farmers.

Moreover, TERM-H2O does not capture the uncertainty and loss of investor confidence that would arise in the MDB from removal of water without compensation or via involuntary acquisition. The negative impacts would be much greater, particularly in the short term, than we have modelled. There would be the danger that with diminished confidence, farm factors would become idle with a resulting magnification of regional income losses. The impact on the MDB would be unnecessarily severe, at least in the short to medium term.

[9] From this, we could calculate the regional impacts of only a fraction of compensation proceeds staying within the basin. For example, if only half of the proceeds stay, this would reduce the MDB-fraction shown in Table 5 to 0.205%, and reduce aggregate consumption in 2026 across the MDB almost to zero (0.045% = 0.25% - 0.5*0.41%).

Figure 17: Macroeconomic impacts , MDB (scenario 4)

% change from forecast

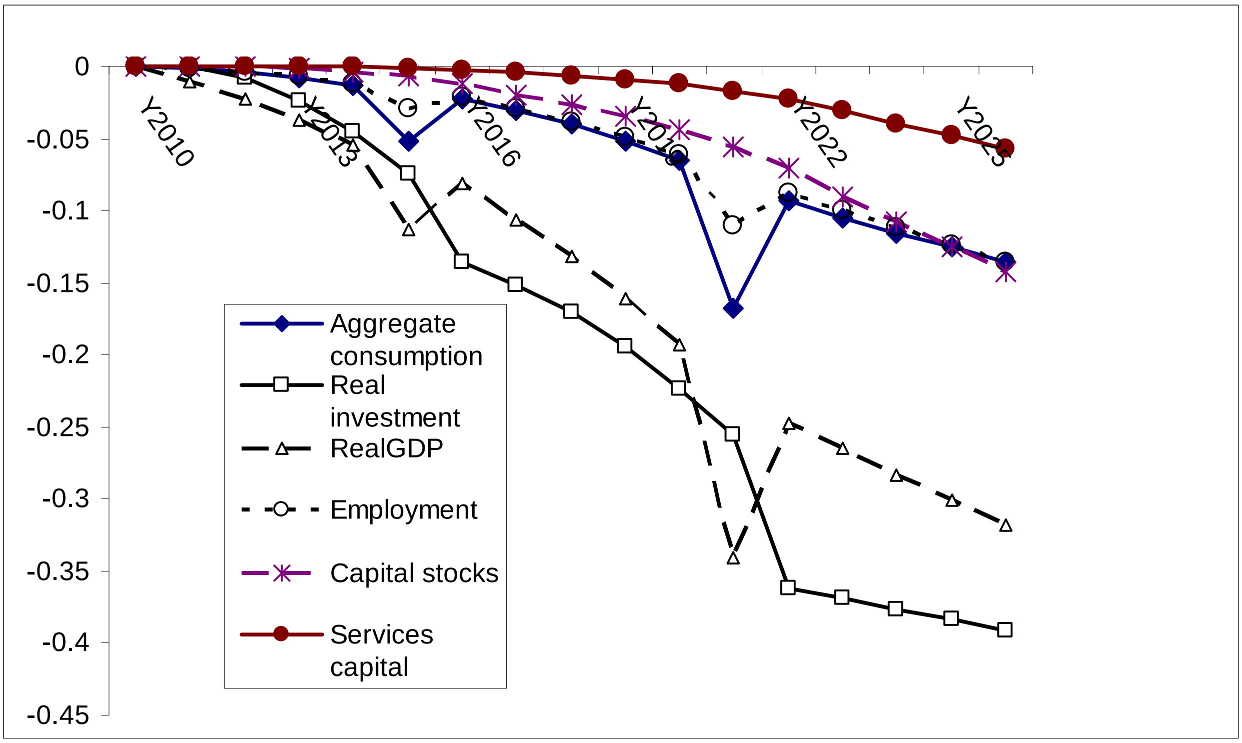


Table 13: Real GDP by NRM region[a] (Scenario 4)

% change from forecast

	2011	2014	2017	2020	2023	2026
Paroo	-0.01	-0.05	-0.12	-0.24	-0.37	-0.47
Namoi	-0.01	-0.05	-0.11	-0.22	-0.33	-0.43
Gwydir	-0.02	-0.13	-0.27	-0.51	-0.71	-0.84
Border	-0.02	-0.14	-0.30	-0.60	-0.85	-1.03
Moonie	-0.04	-0.19	-0.36	-0.65	-0.85	-0.97
CondamBalone	-0.03	-0.15	-0.31	-0.58	-0.82	-0.99
Warrego	-0.02	-0.10	-0.21	-0.39	-0.56	-0.70
MacCastlr	0.00	-0.02	-0.04	-0.07	-0.09	-0.10
BarwonDarlng	-0.01	-0.05	-0.09	-0.15	-0.20	-0.23
Lachlan	0.00	-0.02	-0.03	-0.04	-0.04	-0.05
MrmbidgeeNSW	-0.02	-0.10	-0.15	-0.23	-0.27	-0.27
MurrayNSW	-0.03	-0.15	-0.28	-0.47	-0.60	-0.66
LowerDarling	-0.01	-0.04	-0.08	-0.12	-0.15	-0.16
MurrayVic	-0.01	-0.05	-0.09	-0.15	-0.20	-0.22
Loddon	0.00	-0.02	-0.04	-0.06	-0.08	-0.09
GoulbnBroken	0.00	-0.02	-0.04	-0.06	-0.08	-0.09
Campaspe	-0.01	-0.05	-0.11	-0.19	-0.26	-0.32
Ovens	-0.03	-0.14	-0.26	-0.41	-0.54	-0.62
MurraySA	-0.01	-0.05	-0.10	-0.17	-0.23	-0.27

a Wimmera-Avoca omitted as its allocations are not reduced under the SDL plan.

Table 14: Output by NRM region, 2014 (scenario 4) % change from forecast

	Paroo	Namoi	Gwydir	Border	Moonie	CondamBalone	Warrego	MacCastlr	BarwonDarlng	Lachlan	MrmbidgeeNSW	MurrayNSW	LowerDarling	MurrayVic	Loddon	GoulbnBroken	Campaspe	Ovens	MurraySA
CerealDryL	0.9	0.6	0.9	1.0	1.0	1.0	0.9	0.5	0.6	0.2	1.6	7.1	0.9	1.5	1.5	1.2	1.8	1.8	1.4
CerealIrig	-15.0	-10.9	-13.5	-14.0	-13.9	-13.9	-15.1	-8.8	-11.7	-3.1	-10.3	-9.5	-8.3	-14.4	-14.4	-15.8	-17.7	-17.7	-15.1
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-5.8	0.0	0.6	-5.8	-4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DairyCatDryL	0.0	2.4	0.0	0.0	0.0	2.7	0.0	2.6	0.0	1.2	3.5	8.5	0.0	4.3	0.0	4.0	5.8	5.8	4.2
DairyCatIrig	0.0	-2.0	-3.4	-3.1	0.0	-3.3	0.0	-1.9	0.0	-0.5	-3.0	-0.9	0.0	-2.4	-2.2	-2.7	-2.4	-2.4	-2.5
OthLivstoDry	0.8	0.4	0.5	0.8	0.9	0.8	0.8	0.4	0.6	0.1	1.2	5.6	0.7	1.1	1.1	0.8	1.4	1.4	1.1
OthLivstoIrg	-4.2	-2.6	-2.8	-3.9	-4.1	-4.1	-4.1	-2.1	-3.3	-0.8	-3.1	-6.8	-2.2	-3.4	-3.2	-4.1	-3.8	-3.8	-3.5
CottonDryL	5.5	5.8	6.0	5.8	5.7	5.5	5.3	4.7	5.3	3.5	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CottonIrig	-2.6	-1.1	-1.5	-2.2	-2.5	-2.4	-2.0	0.4	-1.9	1.9	-1.4	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
Grapes	-1.9	-1.0	0.0	-1.8	0.0	-1.9	-1.3	-0.5	-1.3	0.0	0.1	0.1	-0.6	-0.9	-0.9	-1.4	-1.7	-1.7	-1.3
Vegetables	0.0	0.0	0.2	0.6	0.0	0.5	0.0	0.2	0.0	0.0	2.8	5.4	0.9	0.7	0.7	0.0	0.8	0.8	0.4
FruitDryL	0.0	0.8	0.9	1.2	0.0	1.1	0.0	0.9	0.0	0.2	1.9	5.2	0.9	1.7	0.0	1.3	2.0	2.0	1.5
FruitIrig	0.0	-0.4	-0.4	-0.5	-0.5	-0.5	-0.5	-0.3	-0.5	-0.1	0.3	1.1	-0.1	-0.3	-0.3	-0.6	-0.4	-0.4	-0.5
OthAgriDry	1.7	1.3	1.4	1.8	1.9	1.9	1.7	1.4	1.6	0.5	2.1	3.5	1.3	2.7	2.7	2.8	3.6	3.6	2.8
OthAgriIrig	-2.6	-1.4	-1.6	-1.9	-2.0	-2.0	-2.5	-1.3	-2.2	-0.4	-0.9	1.1	-1.0	-2.1	-2.1	-2.6	-2.6	-2.6	-2.5
AgriSrvces	0.0	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	-0.1	0.0
GinnedCotton	0.0	-0.2	-0.2	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ForestFish	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MeatProds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
DairyProds	0.0	-0.1	0.0	-0.2	0.0	-0.2	0.0	-0.1	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.2	-0.1	-0.2	-0.2	-0.1
FruitVeg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthFodTobDrk	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
FlourCereals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1
SugarRef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WineSpirits	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TCFs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WoodPaper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PrintPublish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthManufact	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ElectricGas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WaterDrains	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OtherSrvces	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 15: Output by NRM region, 2020 (scenario 4) % change from forecast

	Paroo	Namoi	Gwydir	Border	Moonie	CondamBalone	Warrego	MacCastlr	BarwonDarlng	Lachlan	MrmbidgeeNSW	MurrayNSW	LowerDarling	MurrayVic	Loddon	GoulbnBroken	Campaspe	Ovens	MurraySA
CerealDryL	2.0	1.5	2.2	2.4	2.5	2.3	2.1	1.1	1.5	0.4	3.6	16.3	2.0	3.4	3.4	2.6	4.1	4.1	3.2
CerealIrig	-41.0	-29.0	-37.4	-37.0	-36.4	-36.8	-41.2	-22.6	-32.5	-6.9	-22.5	-21.2	-17.7	-29.7	-29.6	-32.6	-36.8	-36.8	-32.2
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-13.2	0.0	1.3	-12.7	-11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DairyCatDryL	0.0	6.6	0.0	0.0	0.0	7.4	0.0	7.1	0.0	3.0	9.5	21.2	0.0	11.6	0.0	10.7	15.7	15.7	11.6
DairyCatIrig	0.0	-6.0	-10.4	-9.8	0.0	-10.1	0.0	-5.5	0.0	-1.3	-8.1	-2.7	0.0	-6.4	-5.8	-7.2	-6.4	-6.4	-6.9
OthLivstoDry	1.9	1.1	1.3	2.0	2.1	2.0	1.9	1.1	1.6	0.3	2.6	13.4	1.6	2.6	2.5	2.2	3.5	3.5	2.8
OthLivstoIrg	-13.0	-7.8	-8.5	-12.0	-12.4	-12.5	-12.9	-6.3	-9.9	-2.3	-8.5	-18.7	-5.7	-9.4	-9.0	-11.7	-11.1	-11.1	-9.9
CottonDryL	10.4	11.6	11.8	11.1	10.8	10.6	10.6	9.8	10.5	7.4	8.9	0.0	10.1	0.0	0.0	0.0	0.0	0.0	0.0
CottonIrig	-6.4	-3.2	-4.4	-5.6	-6.1	-6.0	-5.1	0.4	-4.8	4.3	-2.9	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Grapes	-6.5	-3.5	0.0	-5.9	-5.9	-6.3	-4.5	-1.7	-4.5	0.0	0.4	0.4	-1.6	-2.5	-2.5	-4.1	-5.2	-5.2	-3.8
Vegetables	0.0	-0.2	0.3	0.9	0.0	0.8	0.0	0.4	0.0	0.0	6.4	12.6	2.3	1.7	1.7	0.1	1.7	1.7	0.9
FruitDryL	0.0	2.4	2.9	3.2	0.0	3.1	0.0	2.4	0.0	0.6	4.4	12.4	2.3	4.4	0.0	3.6	5.5	5.5	4.2
FruitIrig	0.0	-1.4	-1.5	-2.0	-2.0	-2.1	-2.0	-0.9	-2.0	-0.3	0.9	3.4	-0.2	-0.9	-0.9	-1.7	-1.2	-1.2	-1.4
OthAgriDry	4.0	3.2	3.4	4.1	4.3	4.3	4.0	3.3	3.7	1.0	4.6	8.1	2.7	5.9	5.8	6.0	8.1	8.1	6.4
OthAgriIrig	-7.0	-3.6	-4.2	-5.2	-5.4	-5.6	-6.9	-3.0	-5.8	-0.8	-1.8	2.6	-1.8	-4.5	-4.4	-5.7	-5.9	-5.9	-5.5
AgriSrvces	0.0	-0.4	-0.7	-1.3	-1.4	-1.4	-0.7	-0.1	-0.5	-0.2	-0.3	-0.4	-0.2	-0.4	-0.4	0.1	-0.6	-0.6	0.0
GinnedCotton	0.0	-1.2	-1.2	-1.3	-1.4	-1.4	-1.2	-1.0	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ForestFish	0.0	0.0	0.0	-0.3	-0.3	-0.3	-0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1
MeatProds	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.0	0.1	0.0	0.1	0.1	0.0
DairyProds	0.0	-0.3	0.0	-0.9	0.0	-0.9	0.0	-0.2	0.0	-0.3	-0.2	-0.2	0.0	-0.4	-0.5	-0.3	-0.6	-0.6	-0.4
FruitVeg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
OthFodTobDrk	-0.2	-0.1	-0.1	-0.2	-0.3	-0.3	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.2	-0.2	-0.1
FlourCereals	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0	-0.1	-0.2	-0.4	0.0	-0.2	0.0	-0.1	-0.2	-0.2	-0.2
SugarRef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WineSpirits	0.0	0.0	0.0	-0.1	0.0	-0.1	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	0.0	-0.1	-0.1	-0.1	-0.1
TCFs	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	0.0	-0.1	-0.1	-0.2	0.1	-0.1	0.0	0.0	0.0	0.0	-0.1
WoodPaper	0.0	0.0	-0.1	0.1	0.1	0.1	0.0	0.0	-0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PrintPublish	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthManufact	-0.2	0.0	-0.1	-0.2	-0.3	-0.3	-0.2	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ElectricGas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WaterDrains	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
OtherSrvces	-0.1	0.0	-0.1	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 16: Output by NRM region, 2026 (scenario 4) % change from forecast

	Paroo	Namoi	Gwydir	Border	Moonie	CondamBalone	Warrego	MacCastlr	BarwonDarlng	Lachlan	MrmbidgeeNSW	MurrayNSW	LowerDarling	MurrayVic	Loddon	GoulbnBroken	Campaspe	Ovens	MurraySA
CerealDryL	2.1	1.8	2.8	2.9	2.8	2.6	2.2	1.1	1.8	0.4	3.7	16.8	2.2	3.9	2.9	4.6	4.6	3.6	2.2
CerealIrig	-57.4	-38.5	-51.9	-49.2	-47.9	-49.2	-58.0	-28.8	-46.3	-7.4	-23.3	-20.7	-18.5	-30.7	-34.0	-38.3	-38.3	-33.7	-24.7
Rice	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-14.8	0.0	1.0	-14.1	-11.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DairyCatDryL	0.0	8.7	0.0	9.5	0.0	9.5	0.0	9.1	0.0	3.9	12.4	23.6	0.0	14.8	13.7	20.1	20.1	15.0	10.4
DairyCatIrig	0.0	-8.9	-15.6	-14.7	0.0	-15.2	0.0	-7.7	0.0	-1.6	-10.8	-2.6	0.0	-8.3	-9.4	-8.4	-8.4	-9.0	-6.9
OthLivstoDry	2.2	1.6	1.9	2.4	2.5	2.4	2.2	1.4	2.1	0.5	2.9	14.9	1.8	3.3	3.0	4.5	4.5	3.6	2.1
OthLivstoIrg	-19.9	-11.9	-12.8	-18.0	-18.6	-18.9	-19.7	-9.5	-14.8	-3.0	-11.7	-25.7	-7.5	-13.2	-16.1	-16.1	-16.1	-14.3	-11.2
CottonDryL	9.1	11.0	11.1	10.0	9.5	9.3	9.8	9.2	9.8	7.1	9.3	0.0	9.3	0.0	0.0	0.0	0.0	0.0	0.0
CottonIrig	-7.5	-4.5	-5.9	-6.8	-7.1	-7.1	-6.2	-0.4	-5.8	4.3	-2.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0
Grapes	-10.4	-5.7	0.0	-9.4	-9.4	-10.0	-7.1	-2.7	-7.1	0.2	0.8	1.4	-2.0	-3.4	-5.8	-7.7	-7.7	-5.4	-2.9
Vegetables	0.0	-0.1	0.6	0.9	0.0	0.8	0.0	0.6	0.0	0.1	7.6	16.3	3.0	2.4	0.7	2.7	2.7	1.7	2.1
FruitDryL	0.0	3.8	4.5	4.3	0.0	4.2	0.0	3.0	0.0	0.9	4.9	13.3	2.8	5.7	4.8	7.3	7.3	5.5	3.3
FruitIrig	0.0	-2.3	-2.5	-3.4	-3.4	-3.5	-3.3	-1.2	-3.3	-0.3	1.6	6.2	0.0	-1.1	-2.3	-1.5	-1.5	-1.8	-1.1
OthAgriDry	4.2	3.6	3.9	4.4	4.5	4.5	4.2	3.5	4.1	1.1	4.6	7.5	2.7	6.0	6.1	8.4	8.4	6.5	3.8
OthAgriIrig	-9.1	-4.5	-5.2	-6.7	-7.0	-7.2	-8.9	-3.5	-7.3	-0.8	-1.5	4.9	-1.7	-4.4	-5.7	-6.0	-6.0	-5.6	-3.7
AgriSrvces	0.0	-1.0	-1.5	-2.6	-2.7	-2.7	-1.4	-0.3	-1.0	-0.5	-0.5	-0.9	-0.3	-0.8	0.1	-1.1	-1.1	-0.4	-0.2
GinnedCotton	0.0	-2.1	-2.1	-2.4	-2.5	-2.5	-2.1	-1.8	-2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ForestFish	0.0	-0.1	0.0	-0.6	-0.6	-0.6	-0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mining	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1
MeatProds	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	-0.5	0.0	0.0	-0.1	0.1	0.1	-0.1	-0.1
DairyProds	0.0	-0.5	0.0	-1.9	0.0	-1.9	0.0	-0.2	0.0	-0.4	-0.2	-0.2	0.0	-0.9	-0.5	-1.1	-1.1	-0.6	-0.4
FruitVeg	0.0	0.0	0.0	-0.1	0.0	-0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
OthFodTobDrk	-0.6	-0.2	-0.2	-0.5	-0.7	-0.7	-0.6	-0.1	-0.2	-0.1	0.0	0.0	0.0	-0.1	-0.1	-0.4	-0.4	-0.2	-0.1
FlourCereals	0.0	-0.1	0.0	0.0	0.0	-0.1	0.0	-0.2	0.0	-0.1	-0.3	-0.5	0.0	0.0	-0.2	-0.3	-0.3	-0.3	0.0
SugarRef	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WineSpirits	0.0	0.0	0.0	-0.3	0.0	-0.3	0.0	-0.1	0.0	-0.1	-0.2	-0.1	-0.2	0.0	-0.1	-0.2	-0.2	-0.2	-0.2
TCFs	-0.5	-0.2	-0.2	-0.2	-0.2	-0.2	-0.4	-0.3	0.1	-0.3	-0.3	-0.6	0.1	0.0	-0.1	0.0	0.0	-0.3	0.0
WoodPaper	0.0	0.0	-0.1	0.1	0.1	0.1	0.0	0.0	-0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PrintPublish	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OthManufact	-0.5	-0.1	-0.3	-0.5	-0.6	-0.5	-0.4	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ElectricGas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WaterDrains	-0.4	-0.1	-0.2	-0.2	-0.3	-0.3	-0.3	0.0	-0.2	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1
OtherSrvces	-0.3	-0.1	-0.3	-0.4	-0.4	-0.4	-0.3	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1

Conclusion

Modelling of SDLs using a general equilibrium approach shows that the impact on regional communities will be relatively modest. If farmers are compensated at the market price for water removed from production under SDLs, the impact on real GDP across the MDB will be negative but small, while the impact on aggregate household consumption relative to forecast will be weakly positive.

There has been a recurring tendency by some lobbyists to assert that SDLs could be as detrimental to agriculture in the MDB as drought.[10] This is not true. SDLs will not stop the rain. SDLs will not increase irrigation water requirements per hectare as drought does. For every hectare of irrigated land in the MDB, there are 52 hectares of dry-land farming. In average years, dry-land farming accounts for more than half of the basin's farm output. In drought, dry-land farm productivity falls dramatically. Far from reducing dry-land output, SDLs unlike drought, will increase dry-land output through a movement of farm factors from irrigation to dry-land activities.

Not all factors used in irrigation production are mobile. TERM-H2O includes specific capital (vineyards, orchards and livestock herds) in perennial irrigation activities. Even so, dairy farmers, for example, have had to cope with much severe shortfalls of water than imposed by SDLs and collapsing dry-land productivity in the wake of drought since the turn of the millennium. Dairy farmers have increased feeding of fodder and reduce reliance on irrigated pasture to deal with the crisis. Mobility between irrigation and dry-land activities is a feature of farming included in the TERM-H2O and ABARE models commissioned by the MDBA. Such resource movements have been ignored by some analysts who have received much press in exaggerating the impacts of the proposed SDL plan. Movements of farm factors are important in TERM-H2O simulations in reducing economic losses. In practice, such resource movements have been important in the MDB over the past decade in helping farmers manage drought.

It is understandable that there are memories of when agriculture formed a much larger share of GDP. In the late 1950s, the share of agriculture in GDP for all of Australia was larger than it is in the MDB now. This implies that MDB communities are changing. The economic base of the MDB is increasingly becoming service oriented. From the perspective of lifestyles within the MDB, it is important that these communities maintain their share of the public funds for health care, education, utilities, telecommunication networks, aged care and other community care. This will influence the sustainability of regions within the MDB much more than fighting for every drop of irrigation water. Nevertheless, after a decade or recurring and prolonged droughts, farming communities in the basin are now feeling as though they have the chance to get back on their feet. Any plans to proceed with water purchases for the environment will need to proceed slowly and voluntarily, as farmers go through a recovery phase.

[10] The only foundation for this assertion is if water taken out of production is done so via compulsory acquisition or without compensation. In such circumstances, the resulting uncertainty would lead to disinvestment in farm sectors or the possibility of farm factors falling into disuse.

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Appendix

A1: Unique features of TERM-H2O

TERM-H2O differs from TERM in that it includes water accounts and theoretical modifications in agriculture. It differs from TERM-Water (Wittwer 2003) in that irrigated sectors include a land-water constraint. That is, irrigable land for a given activity requires a certain amount of water, which can vary between activities. In turn, if water becomes scarcer, irrigable land and other inputs may move to dry-land production.

In addition, TERM-H2O includes supply-side modifications: farm factors including owner-operator inputs, mobile capital, irrigable land and dry land follow a CET functional form. That is, factors are allocated between different activities to maximize profits. If, for example, the price of cereals rises relative to other annuals, irrigators may move factors (land, owner-operators, labour, mobile capital and water) so as to increase cereals production and reduce production of other annuals.

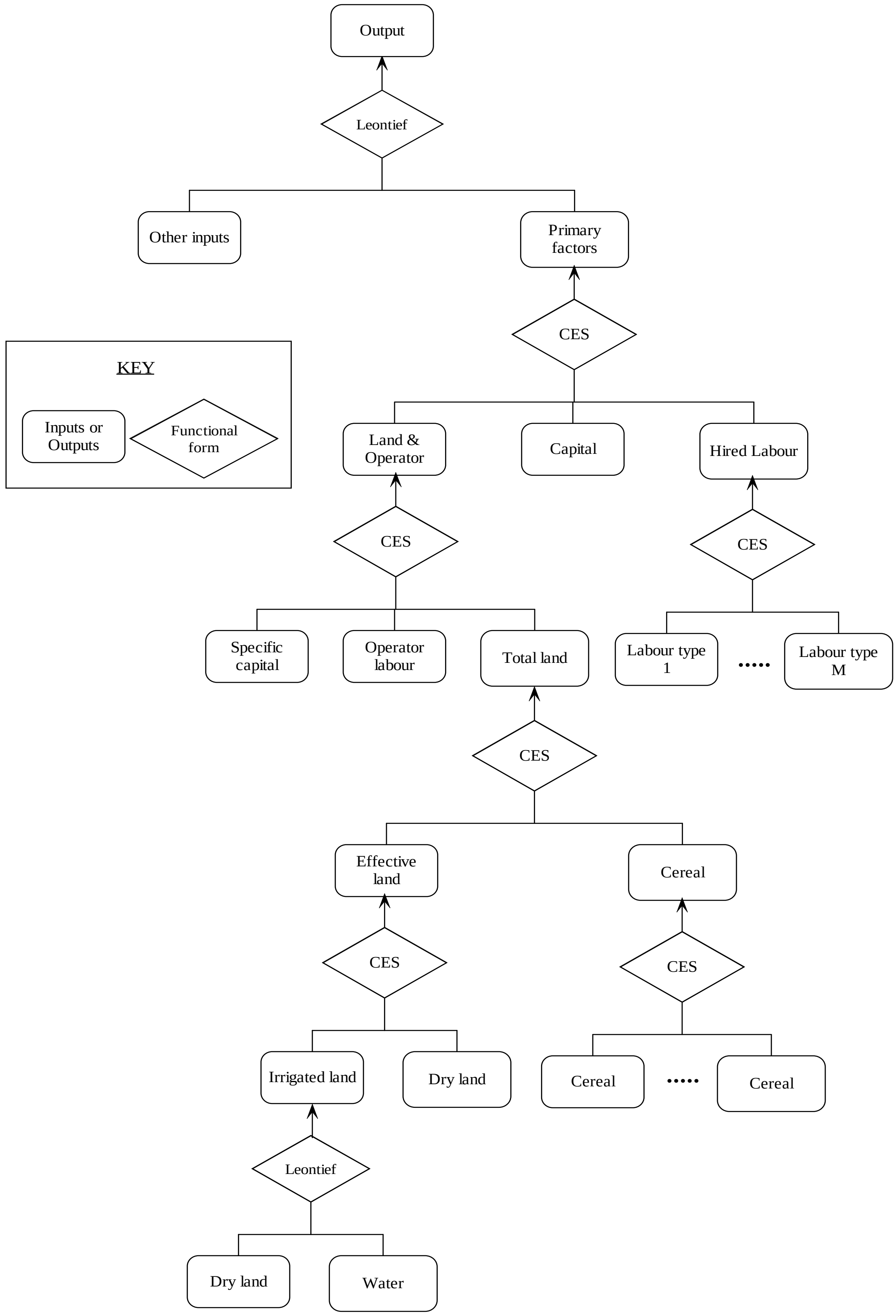
Figure A1 outlines the theoretical structure of production in farm sectors in TERM-H2O. It does not show the CET form, although this is implied by the land-water constraint. The CET possibilities are an important modification that help the model track observed changes in usage between activities in response to changes in water scarcity. We see these in Table A1 for the Murray-Darling basin. Livestock pasture, rice, cereals and cotton exhibited much wider variability in water use than grapes and fruit, vegetables or other agriculture in the period from 2001-02 to 2005-06.

Table A1: Water consumption, Murray-Darling Basin, 2001-02 to 2005-06

	2001–02	2002–03	2003–04	2004–05	2005–06
Water consumption (GL)					
Livestock pasture	2,971	2,343	2,549	2,371	2,571
Rice	1,978	615	814	619	1,252
Cereals (excl. rice)	1,015	1,230	876	844	782
Cotton	2,581	1,428	1,186	1,743	1,574
Grapes & fruit	868	916	871	909	928
Vegetables	152	143	194	152	152
Other agriculture	504	475	596	564	460
Total Agriculture	**10,069**	**7,150**	**7,087**	**7,204**	**7,720**
Index (2001-02 = 100)					
Livestock pasture	100	79	86	80	87
Rice	100	31	41	31	63
Cereals (excl. rice)	100	121	86	83	77
Cotton	100	55	46	68	61
Grapes & fruit	100	106	100	105	107
Vegetables	100	94	128	100	100
Other agriculture	100	94	118	112	91
Total Agriculture	100	71	70	72	77

Source: ABS (2008), Table 3.20.

Figure A1: Production function for farm sectors



Of particular interest is what happened from 2001-02 to 2002-03. Table A1 shows that water used dropped from 10,069 GL to 7,150 GL or 29 percent. In the same period, water usage in rice production fell by 69 percent, and by 21 percent in livestock pasture usage. Yet irrigated cereals usage increased by 21 percent. To explain why cereal usage rose, we need two additional details. First, dry-land production of cereals fell sharply in 2002-03 due to a national drought. Second, the cuts in water allocations at least in the southern part of the basin were concentrated in the Goulburn region, in which irrigation activities are dominated by dairy production.

Irrigators appear to have responded to cereal prices, which rose due to the impact of drought on dry-land production, by switching to cereal production. Some of the water used in rice production the previous year appears to have moved to cereals. The theory of TERM-H2O allows rice producers to move factors into other irrigated crops in response to changing relative output prices. In addition, rice producers may have sold part of their annual allocation to other producers as the price of water rose with worsening scarcity.

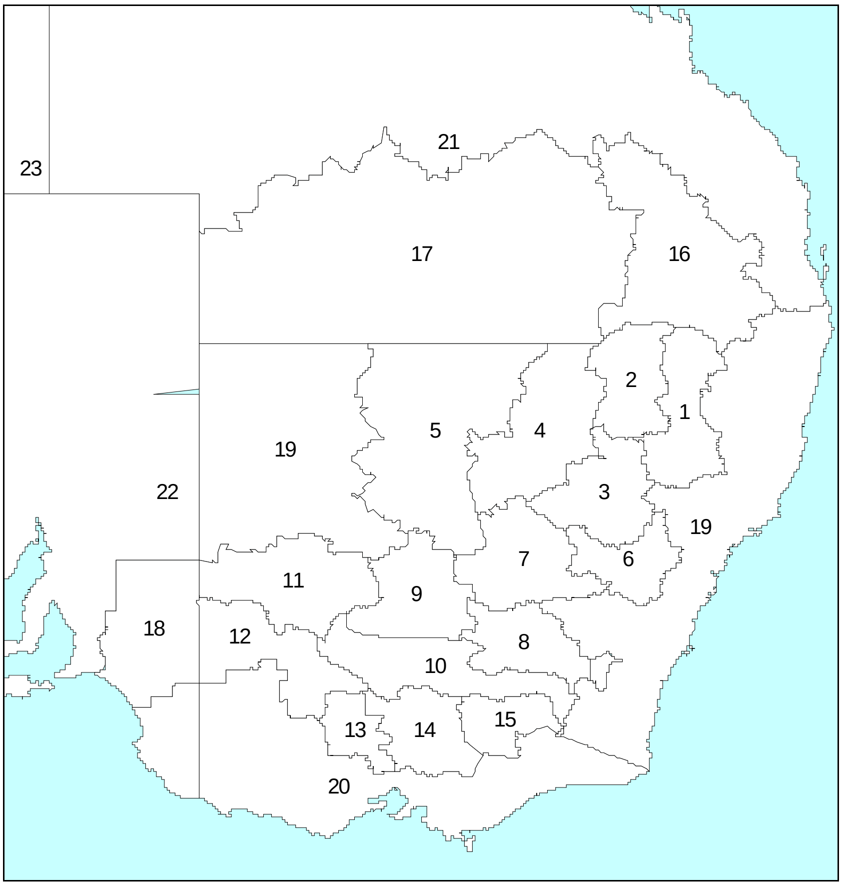
Meanwhile, dairy producers in the Goulburn may have purchased some water to compensate for shortfalls in allocations. Their water shortages may also have led to a substantial switch to dry-land production, which in turn suffered from drought with a consequent substitution towards use of cereal inputs. The increased demands of Goulburn dairy producers may have contributed to rising cereal prices. This substitution possibility is included in TERM-H2O theory. An earlier version of TERM allowed such substitution, but did not have the same factor mobility in response to changing output prices and water availability (Wittwer 2003). This earlier version consequently was less responsive on the supply side and would not, for example, have been able to track the fall in water usage in rice production from 2001-02 to 2002-03.

Dixon *et al*. (2010) details the theoretical modifications unique to TERM-H2O.

A2: Regional representation in TERM-H2O

In addition to modelling the 18 MDB regions in a bottom-up manner (that is, with each region having its own supply and demand equations, with prices and quantities solved independently of other regions), we map the 18 regions to 163 top-down regions. Table A2 shows a mapping of the 163 top-down regions to each of the 18 bottom-up regions in TERM-H2O. In top-down modelling, the larger region's model solution is combined with top-down database weights to calculate the impact on the smaller region.

Figure A2: Bottom-up regions in this version of TERM-H2O



1	TmwthNSlpNSW
2	NCentralNSW
3	MacquarieNSW
4	McqrieBarNSW
5	UpDarlingNSW
6	CntralWstNSW
7	LachlanNSW
8	WagCntMrmNSW
9	LMrmbNSW
10	MurrayNSW
11	MrryDrlngNSW
12	MalleeVic
13	LoddonVic
14	GoulburnVic
15	OvnsMurryVic
16	DrlngDwnsQld
17	SouthWQld
18	MurrayLndsSA
19	RofNSW
20	RoVIC
21	RoQLD
22	RoSA
23	RoA

Table A2: Top-down regions in this version of TERM-H2O

SLA	TERM-H2O region	SLA	TERM-H2O region	SLA	TERM-H2O region	SLA	TERM-H2O region
TamworthRegi	TmwthNSlpNSW	Temora	WagCntMrmNSW	MountAlexand	LoddonVic	DalbyT	DrlngDwnsQld
Gunnedah	TmwthNSlpNSW	TumutShire	WagCntMrmNSW	MountAlexan2	LoddonVic	GoondiwindiT	DrlngDwnsQld
Gwydir	TmwthNSlpNSW	WaggaWaggaB	WagCntMrmNSW	MacedonRange	LoddonVic	InglewoodS	DrlngDwnsQld
InverellPtA	TmwthNSlpNSW	Carrathool	LMrmbNSW	MacedonRang2	LoddonVic	JondaryanSP3	DrlngDwnsQld
LiverpoolPla	TmwthNSlpNSW	Griffith	LMrmbNSW	MacedonRang3	LoddonVic	MillmerranS	DrlngDwnsQld
TamworthReg2	TmwthNSlpNSW	Hay	LMrmbNSW	GrShepparton	GoulburnVic	MurillaS	DrlngDwnsQld
MoreePlains	NCentralNSW	Leeton	LMrmbNSW	CampaspeSEch	GoulburnVic	PittsworthS	DrlngDwnsQld
Narrabri	NCentralNSW	Murrumbidgee	MurrayNSW	CampaspeSKya	GoulburnVic	RosalieSPtB	DrlngDwnsQld
DubboPtA	MacquarieNSW	Albury	MurrayNSW	CampaspeSRoc	GoulburnVic	StanthorpeS	DrlngDwnsQld
DubboPtB	MacquarieNSW	GreaterHumeS	MurrayNSW	CampaspeSSou	GoulburnVic	TaraS	DrlngDwnsQld
Gilgandra	MacquarieNSW	CorowaShire	MurrayNSW	GrShepparto2	GoulburnVic	TaroomS	DrlngDwnsQld
MidWesternRe	MacquarieNSW	GreaterHumeB	MurrayNSW	GrShepparto5	GoulburnVic	WaggambaS	DrlngDwnsQld
Narromine	MacquarieNSW	Tumbarumba	MurrayNSW	MoiraSEast	GoulburnVic	WamboS	DrlngDwnsQld
Warrumbungle	MacquarieNSW	Urana	MurrayNSW	MoiraSWest	GoulburnVic	WarwickSCent	DrlngDwnsQld
Wellington	MacquarieNSW	Berrigan	MurrayNSW	BenallaRCBen	GoulburnVic	WarwickSEast	DrlngDwnsQld
Bogan	McqrieBarNSW	Conargo	MurrayNSW	BenallaRCBal	GoulburnVic	WarwickSNort	DrlngDwnsQld
Coonamble	McqrieBarNSW	Deniliquin	MurrayNSW	MansfieldS	GoulburnVic	WarwickSWest	DrlngDwnsQld
Walgett	McqrieBarNSW	Jerilderie	MurrayNSW	StrathbogieS	GoulburnVic	BalonneS	SouthWQld
Warren	McqrieBarNSW	Murray	MurrayNSW	MountBullerA	GoulburnVic	BendemereS	SouthWQld
Bourke	UpDarlingNSW	Wakool	MurrayNSW	MountStirlin	GoulburnVic	BooringaS	SouthWQld
Brewarrina	UpDarlingNSW	Balranald	MrryDrlngNSW	MitchellSNor	GoulburnVic	BullooS	SouthWQld
Cobar	UpDarlingNSW	Wentworth	MrryDrlngNSW	MitchellSSou	GoulburnVic	BungilS	SouthWQld
BathurstReg2	CntralWstNSW	MilduraRCPtA	MalleeVic	MurrindindiS	GoulburnVic	MurwehS	SouthWQld
Blayney	CntralWstNSW	BulokeSNorth	MalleeVic	Murrindindi2	GoulburnVic	ParooS	SouthWQld
Cabonne	CntralWstNSW	BulokeSSouth	MalleeVic	LakeMountain	GoulburnVic	QuilpieS	SouthWQld
Lithgow	CntralWstNSW	MilduraRCPtB	MalleeVic	IndigoSPtA	OvnsMurryVic	RomaT	SouthWQld
MidWesternR2	CntralWstNSW	GannawarraS	MalleeVic	TowongSPtA	OvnsMurryVic	WarrooS	SouthWQld
Oberon	CntralWstNSW	SwanHillRCCe	MalleeVic	WodongaRC	OvnsMurryVic	BerriBarmera	MurrayLndsSA
Bland	LachlanNSW	SwanHillRCRo	MalleeVic	IndigoSPtB	OvnsMurryVic	BerriBarmer2	MurrayLndsSA
Cowra	LachlanNSW	SwanHillRCBa	MalleeVic	WangarattaRC	OvnsMurryVic	LoxtonWaiker	MurrayLndsSA
Forbes	LachlanNSW	GrBendigoCen	LoddonVic	WangarattaR2	OvnsMurryVic	LoxtonWaike2	MurrayLndsSA
Lachlan	LachlanNSW	GrBendigoEag	LoddonVic	WangarattaR3	OvnsMurryVic	MidMurrayDC	MurrayLndsSA
Parkes	LachlanNSW	GrBendigoInn	LoddonVic	AlpineSEast	OvnsMurryVic	RenmarkParin	MurrayLndsSA
Weddin	LachlanNSW	GrBendigoIn2	LoddonVic	AlpineSWest	OvnsMurryVic	RenmarkPari2	MurrayLndsSA
WaggaWaggaPt	WagCntMrmNSW	GrBendigoIn3	LoddonVic	TowongSPtB	OvnsMurryVic	UnincorpRive	MurrayLndsSA
Coolamon	WagCntMrmNSW	GrBendigoSs	LoddonVic	FallsCreekAl	OvnsMurryVic	KaroondaEast	MurrayLndsSA
Cootamundra	WagCntMrmNSW	CGoldfieldsS	LoddonVic	MountHothamA	OvnsMurryVic	MurrayBridge	MurrayLndsSA
Gundagai	WagCntMrmNSW	CGoldfields2	LoddonVic	CambooyaSPtB	DrlngDwnsQld	SouthernMall	MurrayLndsSA
Junee	WagCntMrmNSW	GrBendigoPtB	LoddonVic	ChinchillaS	DrlngDwnsQld	TheCoorongDC	MurrayLndsSA
Lockhart	WagCntMrmNSW	LoddonSNorth	LoddonVic	CliftonS	DrlngDwnsQld	UnincorpMurr	MurrayLndsSA
Narrandera	WagCntMrmNSW	LoddonSSouth	LoddonVic	CrowsNestS3	DrlngDwnsQld		

Finally, we map the SLAs to Natural Resource Management (NRM) regions. In the northern part of the Murray-Darling Basin, there is no convenient one-to-one correspondence between SLAs and MDBs. Rather, for those SLAs split into more than one NRM, we assign a share of SLA activity to each NRM, as shown in Table B. Given that Moonie and Wimmera-Avoca water allocations are not reduced under SDLs, results for these regions are omitted from the tables showing outcomes by NRM.

The mapping in this study between ABS statistical regions and NRMs has been devised at the Centre of Policy Studies, using available ABS maps. The TERM database relies on 2006 census data for small region detail, with the spatial detail limited to statistical local areas (SLAs). A comprehensive mapping between natural resource management (NRMs) regions and ABS regions would require data at the collection district level (20,000+ districts), for which employment details are not available as they are at the SLA level (1,400+ SLAs). Table A3 provides the mapping used in this version of TERM-H2O. It is an approximation. For example, the Lachlan NRM region is treated as being equivalent to the Lachlan statistical sub-division (SSD). In fact, the Lachlan NRM includes part or all of the SLAs of Young, Boorowa, the two Goulburn-Mulwaree SLAs and Upper Lachlan. The Southern Tablelands SSD of which they are a part was excluded from the Murray-Darling basin in earlier preparation of the TERM-H2O database.

Table A3: Mapping NRMs to SLAs

NRM	SLAs								
Paroo	ParooS (0.8)	BullooS (0.5)	QuilpieS (0.5)						
Namoi	LiverpoolPla	TamworthReg2	Narrabri	Gunnedah	TamworthRegi	Walgett (0.5)			
Gwydir	Gwydir	MoreePlains (0.5)	InverellPtA (0.5)						
Border	InglewoodS	StanthorpeS	GoondiwindiT	WaggambaS (0.8)	TaraS (0.5)	InverellPtA (0.5)	MoreePlains (0.5)		
Moonie	TaraS (0.5)	WaggambaS (0.2)							
CondamBalone	WarwickSCent	WarwickSEast	WarwickSNort	WamboS	RosalieSPtB	BooringaS	BendemereS	MillmerranS	JondaryanSP3
	BalonneS	WarwickSWest	CrowsNestS3	CliftonS	ChinchillaS	CambooyaSPtB	PittsworthS	MurillaS	
	Walgett (0.5)	WarrooS	RomaT	DalbyT	BungilS (0.5)	BullooS (0.5)	Brewarrina (0.5)	ParooS (0.2)	
Warrego	MurwehS	Bourke (0.5)							
MacCastlr	Wellington	Coonamble	Warren	MidWesternRe	Narromine	Warrumbungle	Blayney	Cabonne	Lithgow
	BathurstReg2	Oberon	MidWesternR2	Dubbo	Gilgandra	DubboPtB			
BarwonDarlng	Cobar	Bogan (0.5)	Bourke (0.5)						
Lachlan	Parkes	Lachlan	Forbes	Cowra	Bland	Weddin			
MrmbidgeeNSW	Temora	Narrandera	Lockhart	TumutShire	WaggaWaggaB	Cootamundra	Coolamon		
	WaggaWaggaPt	Gundagai	Junee	Hay	Leeton	Murrumbidgee	Carrathool	Griffith	
MurrayNSW	Balranald	Berrigan	Conargo	Tumbarumba	GreaterHumeB	Wakool	Murray	Jerilderie	
	Deniliquin	Urana	Albury	CorowaShire	GreaterHumeS				
LowerDarling	Wentworth								
MurrayVic	SwanHillRCRo	SwanHillRCCe	MilduraRCPtB	MilduraRCPtA	SwanHillRCBa				
WimmAvoca	BulokeSNorth	GannawarraS	BulokeSSouth						
Loddon	CGoldfields2	CGoldfieldsS	GrBendigoSs	GrBendigoPtB	LoddonSNorth	GrBendigoInn	GrBendigoEag	GrBendigoCen	
	GrBendigoIn2	GrBendigoIn3	MacedonRange	LoddonSSouth	MacedonRang3	MacedonRang2	MountAlexand		
GoulbnBroken	BenallaRCBen	BenallaRCBal	MansfieldS	GrShepparto5	MoiraSEast	MoiraSWest	MitchellSSou	MurrindindiS	
	Murrindindi2	StrathbogieS	MountBullerA	MitchellSNor	GrShepparton	MountStirlin	GrShepparto2		
Campaspe	CampaspeSEch	CampaspeSRoc	CampaspeSKya	CampaspeSSou					
Ovens	IndigoSPtB	WangarattaR2	WangarattaR3	AlpineSEast	LakeMountain	IndigoSPtA	TowongSPtA		
	WodongaRC	FallsCreekAl	MountHothamA	WangarattaRC	AlpineSWest	TowongSPtB			
MurraySA	LoxtonWaike2	MidMurrayDC	RenmarkParin	RenmarkPari2	BerriBarmera	BerriBarmer2	LoxtonWaiker		
	SouthernMall	TheCoorongDC	UnincorpMurr	UnincorpRive	KaroondaEast	MurrayBridge			

B: Calculating the price of a permanent right to a unit of irrigation water in the Southern Murray-Darling Basin

The calculation of permanent water right values is based on Dixon et al. (2010). The earlier study did not assume two dry-land droughts in the simulation period. Rather, it assumed that there were three years of irrigation allocation shortfalls each decade. In the present study, we simulate with the expectation of no years of scarcity worse than 2005-06 allocations but we include two droughts modelled for 2015 and 2021 in the expected price distribution. It would be unrealistic to model future years without taking account of at least moderate periodic droughts. Here, we calculate permanent water prices and Commonwealth costs for both median (i.e., as simulated) and dry water allocation scenarios.

The methodology

We calculate the price [PPerR(t)] that a farmer would need to receive in year t (t = 2011, …, 2022) to induce him/her to give up the permanent right to an annual allocation of one unit of irrigation water according to:

$$\mathrm{PPerR}(t) = \sum_{y=t}^{\infty} \frac{E\left[P(y)\right] * E\left[S(y)\right]}{(1+d)^{y-t}} \qquad t = 2011, \ldots, 2022 \qquad \text{(B1)}$$

where

E indicates expectation;

P(y) is the price of water in year y;

d is the discount rate (assumed to be 0.08 reflecting 3 per cent inflation and a 5 per cent real rate of interest); and

S(y) is the share of water rights in year y that is in fact allocated.

For 2010 to 2026 we set S(y) at one.

We assume that the expected values for P(y) and S(y) are given as follows.

$$E[P(y)] = PS(y), \qquad y = 2010, \ldots, 2026 \qquad \text{(B2)}$$

$$E[S(y)] = S(y), \qquad y = 2010, \ldots, 2026 \qquad \text{(B3)}$$

$$E\left[P(y)\right] = PS(2018) * 1.03^{y-2018} * SF(y) \qquad y>2026 \qquad \text{(B4)}$$

$$E\left[S(y)\right] = S(t) \qquad y>2026,\ t \in \{2010, \ldots, 2026\} \text{ and}$$

$$y = t + 10*n \text{ for n a positive integer} \qquad \text{(B5)}$$

and

$$SF(y) = \begin{cases} 1 \quad \text{if } E[S(y)] = 1 \\ 1.4 \quad \text{if } E[S(y)] = 0.9 \\ 1.84 \quad \text{if } E[S(y)] = 0.8 \\ 2.4 \quad \text{if } E[S(y)] = 0.7 \end{cases} \qquad \text{(B6)}$$

Via (B2) we set expectations for water prices in 2010 to 2026 according to the simulated values [PS(y)] obtained in our policy simulation, that is with the SDL scheme in place.

Via (B3) we set the expected allocation shares in 2010 to 2026 according to the values adopted in our simulation. Via (B4) we allow for 3 per cent inflation in the determination of expected water prices for years beyond 2026. We also introduce a scarcity factor [SF(y)] to reflect periodic drought-induced allocation shortfalls worse than 2005-06 (not used in our simulations, but presented in Table B1). As shown in (B6), in years in which the expected allocation share is less than one, the scarcity factor magnifies the expected price of water. The magnifications (1.4, 1.84 and 2.4) were calculated via simulations in the Dixon et al. (2010) study showing the effects on prices of reduced allocations. Via (B5) we assume that the pattern of droughts (and hence allocation shares) in the years beyond 2026 repeats the pattern assumed for the period from 2010 to 2026. In our scenario, the scarcity factor SF(y) is set to 1.0 for all years, but there are price spikes arising from two years of moderate drought during the simulation period that raise the asset price of water.

Table B1: Permanent water prices and cost to Commonwealth
(2010 dollars)

Water availability expectations	3500 GL		3000 GL		4000 GL	
	Price : $ per expected ML	Cost to C'wealth ($m)	Price : $ per expected ML	Cost to C'wealth ($m)	Price : $ per expected ML	Cost to C'wealth ($m)
	2398	4067	2201	3042	2619	5263

Table B1 shows that the larger the volume of SDLs, the higher the price of water. Therefore, if the Commonwealth compensates farmers for SDLs, the compensation price per unit rises as the volume rises. For example, in raising SDLs from 3000 GL to 3500 GL (after subtracting the 796 GL already purchased from irrigators), a 22.7% increase in volume is accompanied by a 36.7% increase in the cost of compensation. As long as the policy intent is to compensate farmers at the market price of water, rising Commonwealth budget costs will constrain the volume of water set aside for the environment.

C: Statistical local area GDP breakdown

Table C1: GDP breakdown by sector – SLAs (2006, %)

	Agri.	Food Drinks	Textile	Mining/ OthPrim	Oth Manuf	Utilities	Services	GDP $m
TamworthRegi	2.2	6.3	0.3	0.5	5.4	2.3	83.0	1583
Gunnedah	22.1	5.4	3.5	7.9	2.7	1.4	57.0	454
Gwydir	42.1	3.9	0.3	0.1	1.7	1.1	50.7	201
InverellPtA	29.6	4.7	0.1	0.4	4.9	2.1	58.4	162
LiverpoolPla	25.2	4.2	0.3	3.3	1.4	6.2	59.4	309
TamworthReg2	21.9	6.2	0.2	1.4	3.6	3.9	62.7	408
MoreePlains	31.4	6.2	1.6	0.0	1.0	1.0	58.7	597
Narrabri	27.4	5.4	4.3	1.0	1.4	1.5	59.0	570
DubboPtA	2.1	4.7	0.1	0.8	4.2	2.7	85.5	1282
DubboPtB	16.2	5.9	0.2	0.3	3.6	5.3	68.6	161
Gilgandra	34.6	3.2	0.1	1.2	1.1	4.7	55.3	178
MidWesternRe	7.6	4.5	0.1	22.3	4.6	2.4	58.5	693
Narromine	32.5	4.6	1.0	1.3	1.8	5.0	53.8	274
Warrumbungle	30.3	3.8	0.1	1.4	1.5	3.6	59.3	316
Wellington	20.6	3.5	0.0	1.2	1.5	4.4	68.7	259
Bogan	25.3	2.8	0.0	23.4	0.5	5.2	42.7	145
Coonamble	34.9	3.9	0.0	0.1	0.0	5.6	55.5	165
Walgett	28.7	2.6	1.7	2.7	1.3	3.7	59.4	237
Warren	41.1	4.3	4.3	1.2	0.4	6.5	42.2	132
Bourke	23.9	2.6	1.5	1.0	0.8	8.0	62.1	133
Brewarrina	21.7	1.4	0.0	0.8	0.6	11.2	64.4	60
Cobar	4.4	2.0	0.0	65.5	0.2	1.8	26.0	410
BathurstReg2	6.3	9.6	0.4	4.0	8.8	2.3	68.6	363
Blayney	5.4	5.7	0.1	16.0	7.5	1.0	64.3	450
Cabonne	11.3	8.4	0.2	5.0	5.7	1.5	67.8	808
Lithgow	1.0	6.5	0.2	20.7	3.7	16.3	51.6	1579
MidWesternR2	7.3	15.3	0.2	24.5	1.5	0.9	50.4	191
Oberon	4.8	26.3	0.0	1.6	5.2	1.1	61.0	344
Bland	28.0	5.7	0.1	19.8	0.3	0.6	45.5	299
Cowra	13.8	10.5	0.2	1.0	7.2	1.3	66.0	408
Forbes	17.8	8.5	0.9	5.0	3.1	1.7	63.0	344
Lachlan	33.2	10.2	0.0	5.7	0.3	1.4	49.2	272
Parkes	12.2	6.7	0.3	19.3	0.6	1.1	59.8	605
Weddin	37.5	6.1	0.0	0.0	2.5	0.6	53.3	135
WaggaWaggaPt	1.3	6.1	0.3	0.2	4.2	1.4	86.4	2125
Coolamon	31.2	4.0	0.2	0.1	7.6	1.5	55.3	157
Cootamundra	9.3	4.6	0.3	0.7	6.3	1.4	77.4	261
Gundagai	21.2	4.4	0.1	0.6	8.7	0.4	64.7	118
Junee	16.1	2.8	0.3	0.1	6.0	0.8	73.9	205
Lockhart	35.5	4.8	0.0	0.2	0.8	1.8	56.9	133
Narrandera	24.3	4.9	0.1	0.2	11.0	1.5	58.0	232
Temora	23.3	3.4	0.4	0.6	1.8	2.6	67.9	216
TumutShire	9.3	19.8	0.0	2.7	1.0	5.9	61.3	398

	Agri.	Food Drinks	Textile	Mining/ OthPrim	Oth Manuf	Utilities	Services	GDP $m
WaggaWaggaB	31.4	4.8	0.3	0.3	1.8	2.1	59.3	194
Carrathool	71.1	0.4	0.1	0.0	0.5	0.9	27.0	213
Griffith	11.5	4.4	0.0	0.3	18.0	2.1	63.7	996
Hay	43.9	2.0	0.0	0.0	0.7	1.7	51.6	156
Leeton	21.7	4.7	0.2	0.4	17.0	4.1	52.0	479
Murrumbidgee	35.8	3.9	0.1	0.0	10.0	3.3	46.8	98
Albury	0.7	13.4	0.5	0.1	3.6	1.0	80.6	1766
GreaterHumeS	16.3	12.0	0.1	0.2	2.5	2.0	66.9	143
CorowaShire	15.2	9.4	0.1	1.4	7.6	1.1	65.2	361
GreaterHumeB	23.6	12.3	0.2	0.3	0.4	1.7	61.6	213
Tumbarumba	14.0	18.1	0.0	2.7	1.9	13.3	50.0	134
Urana	40.2	3.5	0.0	0.0	1.3	0.0	55.0	45
Berrigan	15.7	7.2	0.0	0.1	8.5	2.1	66.4	285
Conargo	60.9	2.9	0.1	0.1	1.8	1.1	33.2	71
Deniliquin	5.3	7.3	0.3	2.6	9.4	4.0	71.2	275
Jerilderie	41.9	5.5	1.3	0.0	3.4	1.0	46.8	60
Murray	14.5	8.4	0.5	0.2	6.8	0.9	68.8	229
Wakool	31.7	7.2	0.0	0.3	1.7	2.6	56.6	155
Balranald	21.6	7.3	0.0	0.7	4.2	3.1	63.1	91
Wentworth	17.3	4.7	0.0	3.1	8.6	2.6	63.7	254
MilduraRCPtA	9.1	5.8	0.1	1.1	10.7	3.3	69.9	1588
BulokeSNorth	52.4	2.2	0.0	0.0	1.5	3.1	40.8	162
BulokeSSouth	41.5	2.5	0.1	7.2	2.4	0.9	45.3	159
MilduraRCPtB	58.5	3.8	0.0	0.2	2.6	1.4	33.4	232
GannawarraS	31.4	6.1	0.1	0.8	6.8	4.9	49.8	450
SwanHillRCCe	7.5	8.4	0.1	0.0	2.8	2.0	79.3	333
SwanHillRCRo	37.5	4.9	0.0	0.1	7.7	1.5	48.3	145
SwanHillRCBa	39.2	4.5	0.1	0.1	4.0	2.3	49.8	292
GrBendigoCen	1.2	8.1	0.6	3.4	4.0	2.9	79.8	618
GrBendigoEag	2.1	9.0	1.0	3.0	5.9	1.9	77.0	267
GrBendigoInn	1.2	5.9	0.4	4.9	2.8	2.4	82.4	942
GrBendigoIn2	3.2	10.1	0.4	4.3	3.7	3.2	75.1	398
GrBendigoIn3	2.3	7.1	0.6	5.0	5.4	3.1	76.5	637
GrBendigoSs	1.2	5.6	0.3	5.0	2.4	3.5	82.1	299
CGoldfieldsS	1.6	19.0	0.3	2.0	7.8	2.3	67.0	203
CGoldfields2	13.2	12.8	0.5	2.6	6.8	1.5	62.5	151
GrBendigoPtB	10.3	7.1	0.6	5.5	4.3	2.3	69.8	419
LoddonSNorth	47.1	1.9	0.0	0.1	4.6	3.8	42.5	128
LoddonSSouth	31.6	4.9	1.1	1.4	10.5	0.7	49.8	154
MountAlexand	0.7	8.6	1.2	2.1	9.3	0.6	77.4	205
MountAlexan2	6.7	7.3	0.5	2.7	7.3	2.4	73.0	348
MacedonRange	3.8	9.1	0.1	0.4	5.1	2.2	79.3	295
MacedonRang2	2.9	10.4	0.3	0.1	2.5	1.5	82.4	458
MacedonRang3	1.1	10.1	0.2	0.9	2.8	1.1	83.8	816
GrShepparton	6.1	8.1	0.2	0.1	7.2	4.5	73.8	1594
CampaspeSEch	3.0	8.2	0.1	0.0	10.4	1.6	76.7	416
CampaspeSKya	18.8	7.0	0.0	0.0	12.5	3.6	58.0	452
CampaspeSRoc	28.0	5.7	0.2	0.8	11.1	3.7	50.4	335
CampaspeSSou	30.4	5.2	0.0	1.4	8.8	3.9	50.3	146

	Agri.	Food Drinks	Textile	Mining/ OthPrim	Oth Manuf	Utilities	Services	GDP $m
GrShepparto2	28.0	7.6	0.1	0.1	4.8	4.8	54.6	177
GrShepparto5	25.6	5.6	0.2	0.1	12.3	7.4	48.7	350
MoiraSEast	16.9	14.6	0.3	0.1	5.6	1.5	61.1	298
MoiraSWest	23.6	6.0	0.0	0.4	15.8	2.8	51.4	714
BenallaRCBen	3.5	12.5	1.8	0.4	2.2	3.1	76.5	280
BenallaRCBal	27.8	10.0	1.1	0.7	2.1	0.7	57.7	184
MansfieldS	10.5	5.2	0.0	1.7	1.3	1.9	79.3	281
StrathbogieS	23.2	7.0	1.6	0.6	6.6	1.9	59.2	344
MountBullerA	3.3	1.3	0.0	0.0	0.0	0.1	95.2	20
MountStirlin	96.1	0.1	0.0	0.0	0.1	3.2	0.4	1
MitchellSNor	7.3	6.4	0.4	1.1	4.5	1.5	78.8	392
MitchellSSou	2.1	13.7	0.4	0.6	4.5	2.3	76.5	793
MurrindindiS	11.8	9.1	0.2	4.6	1.8	4.3	68.2	216
Murrindindi2	12.6	10.6	0.2	1.8	4.8	2.0	67.9	302
IndigoSPtA	8.2	7.8	0.2	1.0	8.2	1.0	73.6	422
TowongSPtA	8.8	9.1	0.6	0.5	4.4	2.3	74.2	92
WodongaRC	0.8	11.4	0.3	0.2	7.1	1.3	78.9	1317
IndigoSPtB	13.0	4.7	0.1	0.0	20.2	0.6	61.5	118
WangarattaRC	1.5	8.3	5.0	0.2	4.6	2.0	78.4	546
WangarattaR2	13.6	5.8	0.7	0.1	6.3	2.3	71.2	181
WangarattaR3	20.9	7.3	1.5	0.7	9.9	1.7	57.9	232
AlpineSEast	8.1	3.6	0.1	1.2	6.7	5.9	74.4	268
AlpineSWest	8.8	19.6	1.7	2.0	6.6	1.5	59.9	164
TowongSPtB	32.1	2.6	0.1	2.3	2.7	7.5	52.7	141
FallsCreekAl	1.6	0.0	0.0	0.0	0.0	0.2	98.2	24
MountHothamA	2.1	0.0	0.0	0.0	0.0	1.0	96.8	4
CambooyaSPtB	32.7	8.2	0.2	3.2	1.3	0.6	53.8	92
ChinchillaS	25.4	4.8	0.9	15.6	0.3	2.9	50.0	293
CliftonS	48.7	6.0	0.3	2.3	1.9	0.3	40.5	123
CrowsNestS3	24.5	7.5	0.1	5.9	1.8	0.5	59.7	151
DalbyT	5.3	9.0	2.3	17.2	0.9	2.9	62.2	435
GoondiwindiT	16.9	10.9	3.2	0.7	0.5	0.8	66.8	199
InglewoodS	36.6	6.9	0.1	12.6	0.8	0.7	42.3	111
JondaryanSP3	27.3	6.1	0.5	7.9	8.4	1.1	48.7	321
MillmerranS	44.0	5.3	5.8	5.5	0.4	6.9	32.2	177
MurillaS	47.6	4.1	0.0	5.5	1.3	1.2	40.4	141
PittsworthS	36.8	6.7	1.2	8.5	2.4	2.8	41.8	250
RosalieSPtB	35.9	6.3	0.2	14.3	2.5	3.1	37.6	207
StanthorpeS	36.1	4.5	0.3	3.4	4.5	1.0	50.1	412
TaraS	48.8	3.0	0.0	21.4	0.1	0.7	26.0	225
TaroomS	53.3	4.3	0.0	14.9	0.1	0.7	26.8	160
WaggambaS	65.0	6.2	0.9	0.2	0.1	0.5	27.2	208
WamboS	44.6	5.8	1.1	17.5	0.7	0.8	29.6	326
WarwickSCent	4.0	7.5	0.0	1.4	5.8	1.7	79.6	330
WarwickSEast	33.1	6.6	0.2	3.1	4.6	1.0	51.5	179
WarwickSNort	36.7	7.4	0.4	0.4	2.5	0.5	52.1	103
WarwickSWest	19.2	8.4	0.2	7.8	3.9	2.1	58.4	144
BalonneS	45.9	0.7	5.6	9.7	0.7	1.1	36.3	324
BendemereS	39.8	1.5	0.2	34.8	0.3	0.9	22.5	90

	Agri.	Food Drinks	Textile	Mining/ OthPrim	Oth Manuf	Utilities	Services	GDP $m
BooringaS	34.1	3.6	0.1	23.8	0.7	1.0	36.8	113
BullooS	19.6	0.2	0.1	58.6	0.1	1.6	19.8	51
BungilS	23.2	1.7	0.1	57.1	0.3	0.8	16.8	310
MurwehS	21.8	1.3	0.1	10.0	4.2	1.2	61.3	227
ParooS	34.2	0.3	0.1	22.0	0.2	2.0	41.2	108
QuilpieS	22.2	0.1	0.1	50.9	0.3	1.7	24.7	105
RomaT	2.0	1.2	0.0	65.2	0.9	1.3	29.4	763
WarrooS	44.7	0.3	0.1	31.6	0.5	1.8	20.9	105
BerriBarmera	17.3	3.6	0.1	0.8	17.0	6.9	54.4	131
BerriBarmer2	8.7	5.5	0.2	0.9	18.6	4.7	61.3	240
LoxtonWaiker	24.7	3.1	0.0	0.1	13.4	3.2	55.5	263
LoxtonWaike2	25.9	3.0	0.1	0.4	9.8	3.5	57.3	163
MidMurrayDC	27.1	4.3	0.1	0.7	7.9	5.4	54.6	265
RenmarkParin	23.5	4.5	0.2	0.0	11.7	1.9	58.2	69
RenmarkPari2	18.5	4.1	0.0	0.0	10.9	4.6	61.9	242
KaroondaEast	57.6	1.0	0.0	0.3	0.0	0.0	41.1	44
MurrayBridge	11.8	6.2	0.1	1.1	14.0	4.2	62.5	554
SouthernMall	53.4	1.6	0.0	1.4	0.3	0.8	42.5	98
TheCoorongDC	37.7	2.2	0.3	1.6	4.3	1.5	52.6	189

Sources: ABS national accounts; ABS census data; ABS catalogue 4610.0.55.008; TERM-H2O database.