



Social and economic impacts of the Basin Plan in Victoria

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ACRONYMS

ABARES	Australian Bureau of Agricultural Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ANZSIC	Australian and New Zealand Standard Industrial Classification
CEWH	Commonwealth Environmental Water Holder
CEWO	Commonwealth Environmental Water Office
CICL	Colleambally Irrigation Cooperative Ltd
CMA	Catchment Management Authority
DAWR	Department of Agriculture and Water Resources
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
DELWP	Department of Environment, Land, Water and Planning
DOA	Department of Agriculture
DOE	Department of the Environment
ESLT	Environmentally Sustainable Level of Take
GMID	Goulburn-Murray Irrigation District
GMW	Goulburn Murray Water
LMW	Lower Murray Water
IVT	Inter-valley Trade
LTAAY	Long-term annual average yield
LLS	Local Land Services
MDB	Murray-Darling Basin
MDBA	Murray Darling Basin Authority
MG	Murray-Goulburn Cooperative
MI	Murrumbidgee Irrigation Limited
MIL	Murray Irrigation Limited
NRM	Natural Resource Management
NVIRP	Northern Victoria Irrigation Renewal Project
VEFMAP	Victorian Environmental Flows Monitoring and Assessment Program
VEWH	Victorian Environmental Water Holder

GLOSSARY

Barmah Choke A narrow section of the River Murray between Cobram and Echuca that runs through the Barmah-Millewa Forest on the Victorian/NSW Border. Its operating capacity is small relative to other parts of the river. Consequently, when no water is available from the Menindee Lakes to augment supply, the Choke is the main limiting factor in delivering sufficient water to meet peak downstream demands for water use and to meet minimum flow requirements for South Australia.

Carryover The option to hold in storage a portion of unused seasonal allocations for use at a later date.

Coefficient of variation A measure of the spread of data relative to the mean.

Colleambally Irrigation Co-operative Limited (CICL) An irrigation co-operative in NSW owned wholly by its farmer members. Its area of operation is south of Griffith and between Darlington Point and Jerilderie.

Consumptive pool The amount of water in the southern-connected Murray Darling Basin that is available for private benefit consumption including irrigation, industry, urban, and stock and domestic use.

Conveyance losses Losses of water in an irrigation distribution system before on-farm delivery, due mainly to evaporation, seepage and leakage.

Conveyance loss entitlements A category of access entitlement in NSW originally issued to Irrigation Corporations to facilitate delivery of water through their channel systems.

Counterfactual Expected irrigation outcomes if the Basin Plan had not been implemented, as distinct from a description of irrigation before the Basin Plan. The counterfactual is compared with actual irrigation outcomes after Plan implementation. Such comparisons are standard practice in economics.

Delivery share A Victorian Water Access Entitlement that gives the holder the right to have water delivered by a water corporation and a share of the available flow in a delivery system. It provides the security of having water delivered when there is demand for water from other landholders on the channel or network. Delivery share is linked to land.

Delivery system System of delivery of water to the farm. It includes delivery through a network of channels and/or pipelines within an irrigation district or river diversion where irrigators directly pump water from the river.

Environmentally sustainable level of take (ESLT) The level at which water can be taken from a water resource which, if exceeded, would compromise: key environmental assets of the water resource; or key ecosystem functions of the water resource; or productive base of the water resource; or key environmental outcomes for the water resource.

Ex-post After the fact; the actual results rather than the forecasts.

Flood irrigation The irrigation method where water is delivered to the edge of the paddock and allowed to flow over the ground through the crop. It includes furrow irrigation in which water is applied to small parallel channels or trenches in the direction of the predominant slope.

Furrow irrigation see flood irrigation.

Groundwater entitlement An entitlement to water occurring below ground level.

Interruptible industries Annual crops such as rice, cotton and annual vegetables that, if they cannot be grown in a given year in the absence of irrigation, can be planted in another year in the hope of earning enough to offset the income foregone. Unused water can be sold to other irrigators.

Irrigation districts A district in which farms are supplied irrigation water through a system of pumps, channels and/or pipelines and that are managed by either a self governing public corporation, a private company owned by irrigators or a cooperative with irrigator members.

La Niña The extensive cooling of the central and eastern tropical Pacific Ocean, often accompanied by warmer than normal sea surface temperatures in the western Pacific, and to the north of Australia. La Niña events are associated with increased probability of wetter conditions over much of Australia, particularly over eastern and northern areas.

Laser leveling A user guided precision leveling technique used for achieving very fine leveling with desired grade on the agricultural field. Laser leveling uses a laser transmitter unit that constantly emits 360° rotating beam parallel to the required field plane. This beam is received by a laser receiver fitted on a mast on the scraper. The signal received is converted into cut and fill level adjustments and the corresponding changes in scraper level are carried out automatically by a two way hydraulic control valve.

Long-term annual average yield (LTAAY) The unit of account for the total volumes of water recovered from different types of water entitlements in the Murray-Darling Basin.

Millenium Drought A prolonged dry period in much of southern Australia from late 1996 to mid-2010.

Murray Irrigation A private irrigation company in NSW, formed in 1995 when the NSW Government privatised its Murray Irrigation area and districts. The company's irrigators are also shareholders. Its area of operation stretches from Mulawala in the east to Moulamein in the west.

Murrumbidgee Irrigation Limited (MIL) A private irrigation company in the Riverina in NSW, privatised by the NSW government in 1999. The company's irrigators are also shareholders.

Net buyers/sellers Farms that bought/sold more water than they sold/bought.

Non-interruptible industries Perennial crops such as almonds, grapevines, citrus, pome fruits and stone fruits that in the absence of irrigation, may die and will be expensive and time-consuming to replace. Water demands of these crops are essentially fixed.

Pome fruit Members of the plant family Rosaceae, sub-family pmoideae. Includes apples and pears.

Re-use system A system comprising a dam, pump and drains or pipes to collect runoff and/or drainage from irrigation and rainfall for re-circulation into the farm irrigation system.

River diverters Irrigators that pump their own water directly from rivers without being part of an irrigation district.

Semi-interruptible industries An industry such as dairying in which there are substitutes for water in the form of purchased feed. In dairying, parts of the herd can also be agisted in other areas if necessary. However, in the long run, the herds, and the genetics on which they are based, will be expensive and time-consuming to replace if they cannot be maintained.

Snowy advance An agreement between Murray Irrigation and Snowy Hydro Limited to allow early season access to up to 200 GL of water.

Supplementary entitlements A NSW Water Access Entitlement that confers to the holders a right to abstract water during announced periods when flows exceed those required to meet other licensed obligations and environmental needs.

Surface water Water in a watercourse, lake or wetland, and any water flowing over or lying on land.

Sustainable Diversion Limit (SDL) The maximum amount of water that can be taken from the Murray-Darling Basin for consumptive use.

Travelling irrigators A large sprinkler system mounted on a moving platform and supplied with water through a heavy-duty hose system. Commonly used to irrigate pasture and lucerne but machines with elevated wheels may be used to irrigate taller field crops.

Unbundled right The separation of a bundled right into its individual elements. At its most basic level, unbundling separates water rights from a land property title, allowing the trade of water rights separately from land. Additional degrees of unbundling involve the separation of a water right into its individual elements. These might include, but are not limited to, water access entitlements, water allocations, water use rights, delivery share and works approvals.

Unregulated entitlement An entitlement to water whereby the holder cannot order the release or delivery of water. The exercise of the entitlement is subject to water being available in the watercourse.

Victorian Water Register A public register of all water-related entitlements in Victoria.

Water allocation The specific volume of water allocated to water access entitlements in a given water year or allocated as specified within a water resource plan.

Water entitlement A perpetual or ongoing entitlement to exclusive access to a share of water from a specified consumptive pool as defined in the relevant water plan.

EXECUTIVE SUMMARY

The Victorian Government has committed itself, in partnership with water corporations and catchment management authorities (CMAs), to work to achieve balanced outcomes from implementing the Murray-Darling Basin Plan in Victoria. As part of that commitment, it commissioned this report to assist it undertaking its own analysis of the socio-economic impacts of the Basin Plan in Victoria. This report aims to inform discussions with the Commonwealth Government and to help ensure that all future water recovery from Victoria is based on robust evidence that it can be done with neutral or positive social and economic impacts.

The report sets out a systematic, methodical and repeatable way to analyse the impacts of the Basin Plan in Victoria. It is not a comparison of irrigation before and after the Basin Plan. Rather it is a comparison of what happened after the Basin Plan was implemented with what could reasonably have been expected to have happened if the Basin Plan had not been implemented. Such comparisons between the “with” and “without” scenarios are standard practice in economics.¹

UNDERSTANDING THE SOUTHERN-CONNECTED BASIN AS A WHOLE

Understanding the socio-economic impacts of the Basin Plan in Victoria depends on an understanding of the various forms of water supply and demand in northern Victoria, southern NSW and the irrigation areas of South Australia. Collectively, these regions are referred to in this report as the southern-connected Basin. The physical connections between these regions enable water to be traded throughout the southern-connected Basin in ways that in effect, create a single integrated water market. Consequently, although water recovery under the Basin Plan has affected water supply in each state differently, the socio-economic impacts of water recovery depend on how water demand changes in response. This report is concerned with developing an understanding of those changes in supply and, more particularly, demand, under current and future water scenarios.

The different water allocation frameworks in each state mean that allocations against the five main types of water entitlements in the southern-connected Basin vary markedly, from each other, and from year to year (Figure 1). Allocations against NSW General Security entitlements have the most impact on market prices because they constitute the largest pool of entitlements, and the allocations against them are the most variable.

¹ Technically, the comparison is between the ‘observed’ and the ‘counterfactual’, and that more formal language is adopted in the body of the report.

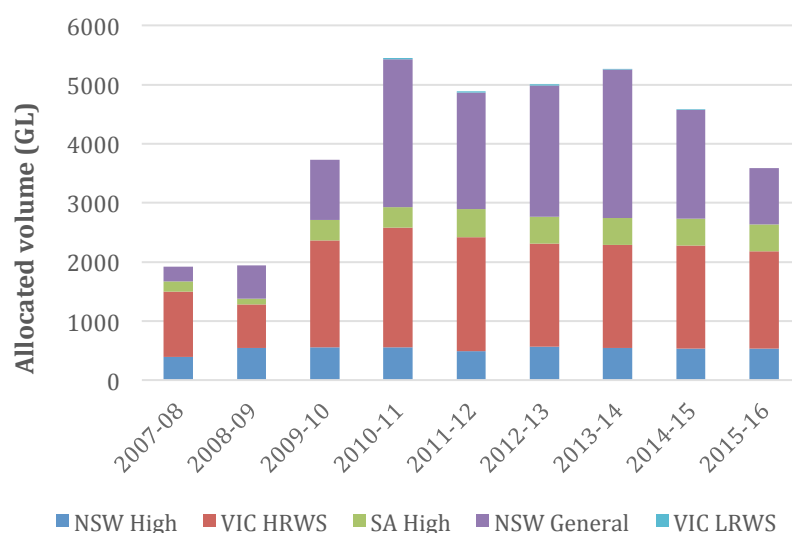


Figure 1: Water allocations against the five main entitlement types in the southern-connected Basin since water recovery commenced.

For the purposes of this report it is helpful to think about water in the southern-connected Basin being used for three main types of irrigated enterprise. These are:

- horticulture
- dairying and mixed farming
- rice-based and cotton-based annual cropping systems.

Irrigated horticulture in the southern-connected Basin is concentrated in the Mallee regions of NSW, South Australia and Victoria, around Griffith in NSW and around Shepparton in Victoria.

Irrigated dairying and mixed farming is concentrated in the Goulburn-Murray Irrigation District (GMID) of Victoria, with smaller levels of production in southern NSW and a low level of production in the Lower Lakes region of South Australia.

Rice-based and cotton-based annual cropping systems are concentrated in the Murrumbidgee and Murray regions of NSW.

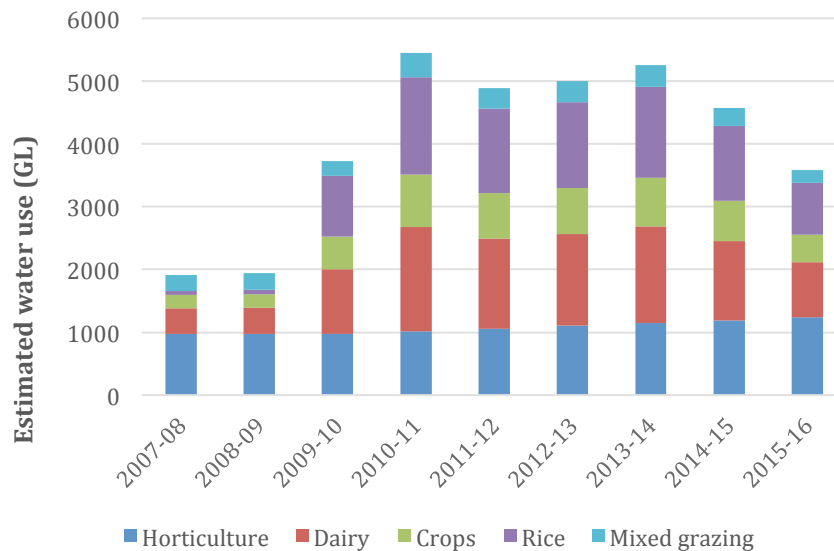


Figure 2: Estimated water use by different irrigated industries in the southern-connected Basin since water recovery commenced.

At the system-scale, the mix of irrigated enterprises that are non-interruptible (e.g. perennial horticulture), semi-interruptible (e.g. dairying) and interruptible (e.g. cropping) have traditionally helped irrigators to adjust to variable water supplies (Figure 2). Because the Basin Plan reduces the volumes of the different entitlements in different ways, it is also changing the proportions that each contributes to the whole. As irrigators adjust to these changes, they will change the mix of non-interruptible, semi-interruptible and interruptible irrigated enterprises, and they will reduce the total area of irrigation. It is the nature of those responses that determine the socio-economic impacts of the Basin Plan.

IMPACTS AT THE FARM SCALE

Water recovery started in 2007 in the midst of extreme drought. Since 2011/12 the Commonwealth's purchasing has slowed. It now concentrates on water recovery through on-farm and off-farm efficiency measures. Most of the Victorian water entitlements purchased by the Commonwealth were transferred into Commonwealth ownership in the three years from 2009/10 to 2011/12. In many cases contracts were exchanged in the year before the transfer took place.

As outlined in Chapter 4, there is no doubt that the money the Commonwealth paid irrigators for their entitlements, or for their on-farm efficiency measures, helped these irrigators to adjust to the drought. In many cases it helped people to exit farming with better financial resources than they would otherwise have had. As outlined in Chapter 5, during the same period, water recovery helped many irrigators cope with the collapse of the wine boom in similar ways. It also helped to prevent a significant disruption to the horticultural expansion when two major managed investment schemes became insolvent. The investors who salvaged those orchards often sold their entitlements to the Commonwealth and continued to purchase allocations in order to irrigate.

Record-breaking floods were recorded immediately after the buyback of entitlements stopped. The extraordinary levels of carryover built up during those *La Niña* years meant that the total combined volume of allocations and carryover against Victorian water shares were greater than the volume of use by irrigators in Victoria for four years after buyback was complete (Figure 13). This served to mask the impacts of the Basin Plan until early 2015/16.

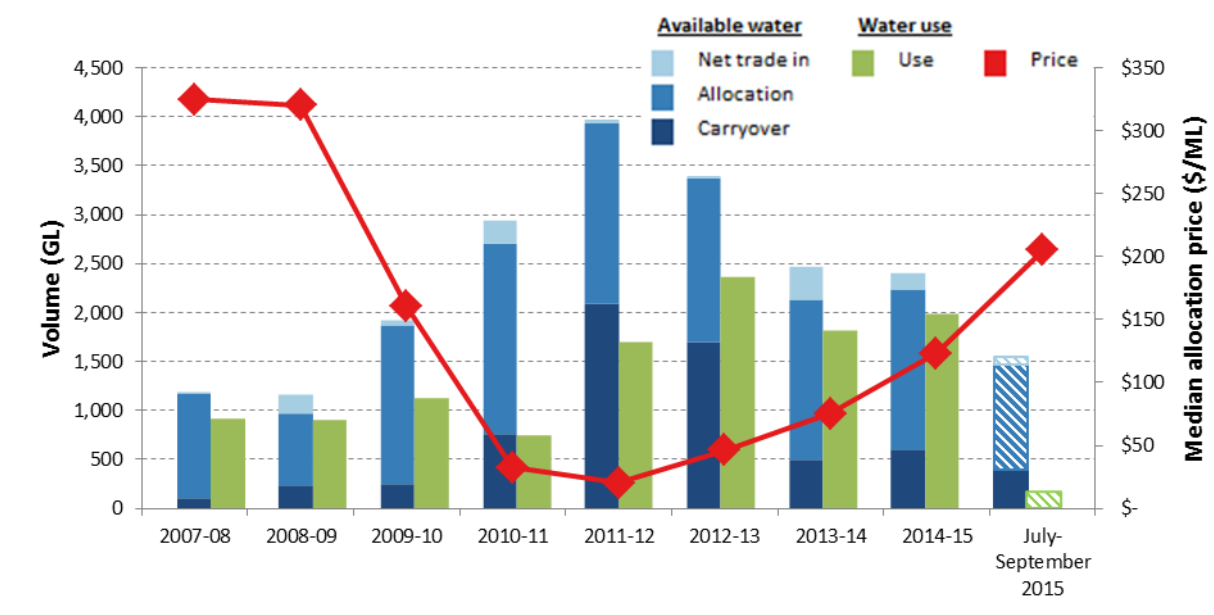


Figure 3: Private water availability, use and allocation price, Murray and Goulburn systems (DELWP, 2016a)

Note: The bars for 2015/16 are hatched to indicate that the season was not complete at the time the report (DELWP, 2016a) was being prepared. DELWP was unable to update this figure in time for this report. An updated version would provide insight into high levels of concern about allocation prices in 2015/16.

An analysis of water register data involving a sample of Victorian irrigators who sold entitlements to the Commonwealth showed that before the Commonwealth purchase, the irrigators in the sample mostly relied on their own allocations for their water use, although many also traded water and were net purchasers of water allocations. After the sale of entitlement to the Commonwealth, there were many changes to their approaches in sourcing water.

Because water entitlements are no longer linked to land, there are complexities involved in linking water share transfer data in the water register back to affected properties. There are further complexities involved in considering how water use has changed for the affected properties. In the time available to complete this report, DELWP was able to provide us with an analysis of a sample of 11% of the population of those irrigators who sold entitlement to the Commonwealth and continued to irrigate. DELWP compared the characteristics of this sample with those of the population, and as explained in Chapter 4, judged the sample was representative of the population.

As explained in Chapter 4, a key finding is that Victorian irrigators who sold water entitlements to the Commonwealth are now more reliant on allocation purchases than they would have been without the Basin Plan. As explained in Chapter 6, for dairy farmers in particular this increased their farming risk, and dairy farmers sold more entitlements to the Commonwealth than any other group of farmers.

After the buybacks stopped, the Commonwealth's Sustainable Rural Water Use and Infrastructure Program became the key mechanism to recover water. Most of its funds were directed to projects for improving the operation of off-farm delivery systems and helping irrigators improve on-farm water use efficiency. Those water savings are shared between the government for environmental use and irrigators for consumptive use.

Most water recovery through infrastructure savings has been in NSW regions (Figure 4). Because it does not differentiate between the impacts of on-farm and off-farm saving the different types of savings are not separately reported. In our analysis we consider them to have different impacts. Therefore, to the extent possible, we have tried to disaggregate the volumes recovered through the two approaches in Victoria.

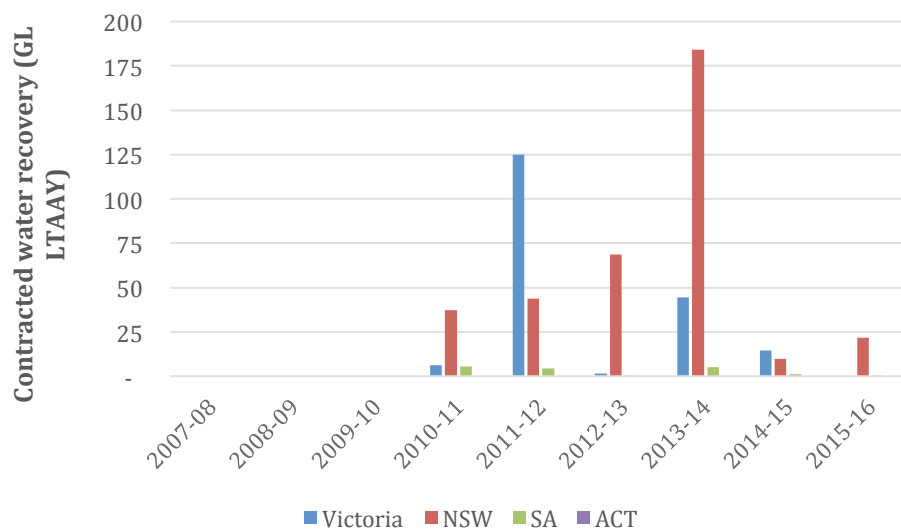


Figure 4: Infrastructure water recovery (ML LTAAY)

Source: Pers. comm., DAWR, 16th September 2016.

On-farm efficiency programs are intended to reduce diversions in ways that have neutral or positive economic outcomes, but the story is more complex than that.

On-farm projects aim to improve water use efficiency; maintaining production levels with reduced volumes of water. However, where the water savings are shared between the irrigators and the Commonwealth, the irrigator is, by definition, retaining more entitlement than would have been required to maintain production. In such cases the irrigator is free to expand production or sell surplus entitlement or the allocations against it.

Similarly, because the Commonwealth is willing to pay a premium above the market rate for the saved water, the irrigator is also free to take advantage of arbitrage to replace the water assigned to the Commonwealth. The extent to which this has happened is unclear, but Vignette 1 published by the MDBA (MDBA, 2016) (a fuller excerpt of which is reproduced in Appendix 3) suggests there may have been instances of arbitrage:

We're saving water but we're being more intense and more productive. Because we're using it more efficiently and being more profitable that drives us to want more water to do more things. It has that driving effect. We gave water back but we went straight back to the market and bought it again.

In these cases the net effect on the consumptive pool is the same as direct buyback by the Commonwealth.

The most important point, however, is if the savings come from dairy or rice farms, when allocation prices are so high that it is more economic for rice and dairy farmers to sell allocations rather than irrigate, the allocation volumes they put on the market will be lower than it would be if they had not undertaken the efficiency savings. As explored in more detail in Chapter 3, the volume of the savings given to the Commonwealth will reduce the volume of the consumptive pool that would otherwise have been available for horticulturalists to keep their crops alive in dry and extremely dry years.

For our analysis, we consider it valid to assume that on-farm water savings have similar characteristics to off-farm water savings in wet-to-average years. However, as we elaborate in Chapter 3, in dry and extreme dry years the on-farm efficiency savings gained from interruptible and semi-interruptible enterprises will serve to reduce the consumptive pool of allocations available to be used for non-interruptible enterprises. We note however that given the average to wet water availability conditions that have prevailed since these programs commenced, with the notable exception of 2015/16, the effect of on-farm efficiency measures in this regard have not yet been manifested.

IMPACTS FOR HORTICULTURAL INDUSTRIES

The structural adjustment issues associated with the 35% drop in wine grape plantings in the Victorian Mallee between 2006 and 2015 (Argus, 2015), and similar reductions in other parts of the Basin, were undoubtedly smoothed by the ability of wine grape growers to raise money by selling their water entitlements to the Commonwealth.

In effect, it is likely that buyback helped avoid a serious disruption to the development of horticultural industries in the Basin. Collectively, those orchards and vineyards employ thousands of people with most jobs occurring during the development phase.

As explained in Chapter 5, total horticultural water use is unaffected by the Basin Plan. However, because the Basin Plan reduced the size of the consumptive pool, Victorian horticultural demands as a proportion of full allocations against Victorian High Reliability Water Shares have risen from 32% without the Basin Plan to 40% with the Basin Plan. The Basin Plan has therefore constrained further investment and increased the risk of horticultural land being dried off in the next drought. As explained in Chapter 11, this risk would increase further in the other water recovery scenarios. Horticultural demands would rise to 46% in the 2750 GL and 51% in the 3200 GL water recovery scenarios.

The dry year water availability may also be considered a ceiling to horticultural investment. By reducing the consumptive pool of available water in years of extreme drought — when it is required to meet the fixed water requirements of horticultural biological assets (trees and vines) — the Basin Plan water recovery can be considered to have limited the expansion of horticultural investment. If further water recovery is pursued then this may put at risk the water requirements for current investment. The table below presents potential impacts on Victorian horticultural investment (it should be noted that this is an estimate of investment dollars, not production or value-added dollars).

Scenario	Potential impact on Victorian horticultural investment
2100 GL recovery scenario	<p>At current levels of water recovery, in a repeat of 2008-09 allocation levels there would be 16 GL more water available than it takes to meet the full irrigation requirements for horticulture. When the existing plantings mature however, there would be a shortfall (-110 GL).</p> <p>Without water recovery, there would still have been a small shortfall as existing planting mature of 8 GL of High Reliability Water Shares. Developers need to be aware of this risk, but based on the historical record they may judge that the risk is worth taking.</p> <p>At 12ML/ha the additional shortfall of 103GL could have developed another 8550ha. At \$19,000/ha this is \$162 million of total investment that has hypothetically already been forgone.²</p> <p>An alternative way of considering is that, when the existing plantings mature, the additional shortfall of -103GL puts 8850 ha of existing horticultural development at risk, which represents \$162 million of existing investment.</p>
2750 GL recovery scenario	<p>Under medium future water recovery, there would be an additional shortfall of -193GL in a repeat of 2008-09 allocation levels. This puts 16000ha of existing plantings at risk, which represents \$306 million of existing investment.</p>
3200 GL recovery scenario	<p>Under high future water recovery, there would be an additional shortfall of -241GL. This puts 20000ha of existing plantings, at risk, which represents \$381 million of existing investment.</p>

IMPACTS ON THE DAIRY INDUSTRY

As explained in Chapter 6, in the absence of the Basin Plan, water use by GMID and by GMW diverters would have been higher (Figure 5). Dairying is the mainstay of the GMID. As the consumptive pool is reduced under the various water recovery scenarios, and as the perennial demands of horticulturalists goes up, it is left to dairying, as the most exposed industry, to soak up more of the variability in

² This is at the conservative end of development costs provided by DELWP (Mildura).

available water supplies. Additionally, many dairy farmers sold entitlements during the buybacks, and they are now relying on allocation purchases to support their businesses.

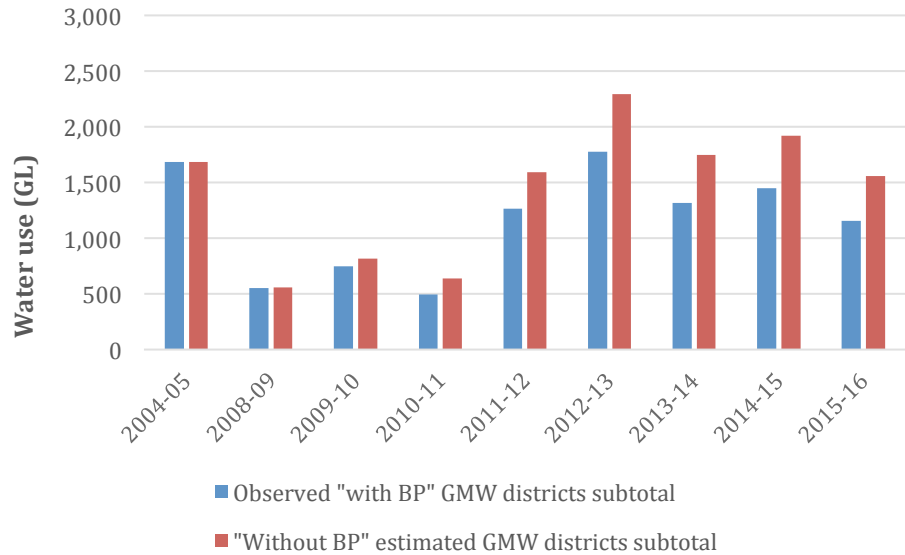


Figure 5: Water use in GMW irrigation districts with and without the Basin Plan

As explained in Chapter 6, the net result of all this is to push dairy farmers towards the more complex feeding systems they adopted as a loss minimisation strategy during the drought. Because those alternative feeding strategies are more complex than pasture grazing, they carry more risk. Dairy farmers’ indebtedness increased during the drought. This suggests that if dairy farmers are to adopt these strategies for the long term, they will need to increase their skills in managing these production systems.

Milk production would have been expected to have been greater *but for* the water recovery under the Basin Plan. Figure 6 presents milk production in the GMID as it was with the Basin Plan and as it might reasonably have been expected to be without the Basin Plan – assuming that the ratio of milk production to irrigation water use remained the same. The difference between the two would be less if it were assumed the additional water use was less efficient than the observed average.

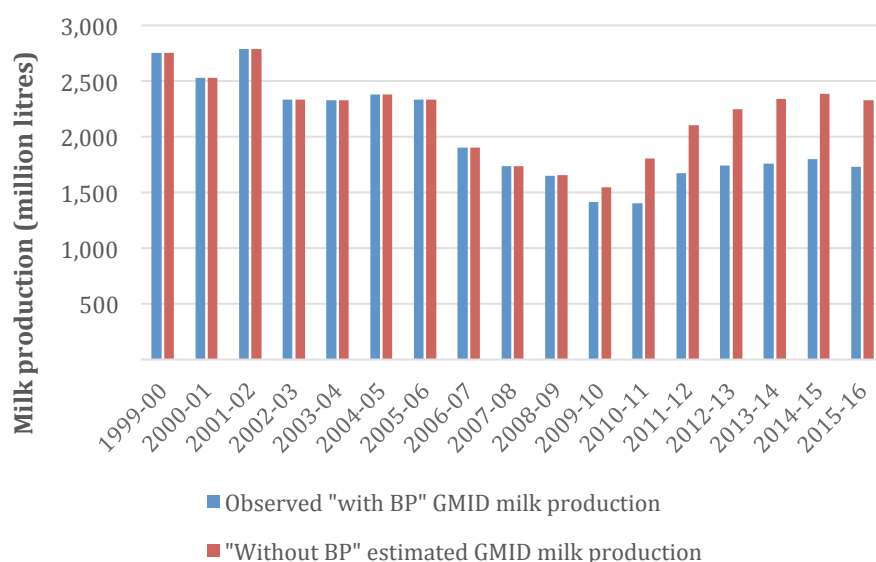


Figure 6: GMID milk production (with and without the Basin Plan)

RMCG (2016) estimated a similar reduction and equated this to a reduction in an annual farm-gate value of \$200 million per year. It is important to note however that output value is not just attributable to the additional water volumes; it is also attributable to the other inputs to production — and therefore is not a measure of the economic value added by the water. It is also important to note that despite high allocation levels and low allocation prices at the time of writing, milk production was being strongly influenced by low milk prices with dairy farmers reducing inputs of purchased feed and fertiliser in the short-term.

This reduced supply has reduced throughput in dairy processing. Although milk processing is not reported by factory, milk is generally processed in the region of production. For example, Murray-Goulburn Cooperative (MG) have milk processing sites in northern Victoria at Cobram (cheese, milk powders, infant formula) Kiewa (daily pasteurised milk, cream cheese, yoghurt, cream) and Rochester (cheese, milk powders), as well as elsewhere in Victoria (Koroit, Laverton, Leongatha and Maffra).

Commonwealth buybacks undoubtedly helped dairy farmers to adjust to the combined effects of the high cost of feed and the high cost of allocations during the drought. Many farmers took the opportunity to exit the industry with better financial resources than they would have done without the Basin Plan. Others managed to keep operating their businesses based on allocation purchases. Buyback also helped many dairy farmers reduce their debts.

More than half of all dairy farmers are now net purchasers of allocations, with 60% purchasing allocations in 2013/14. However, as discussed in Chapter 4, the limits to this strategy were revealed in 2015/16 once the extraordinary levels of carryover built up during the La Niña years were finally run down to lower level, and the return to dry conditions led to higher allocation prices. Many of the irrigators that pursued this strategy are still coming to terms with the risk to which this has exposed them.

On-farm improvements in irrigation layouts and irrigation management strategies over the past 30 years have helped dairy farmers adapt to the changes. Dairy farmers whose business models depend on allocation purchases are now confronting decisions about their willingness and ability to adopt the more complex feeding strategies associated with further improvements in irrigation technology.

Irrigated dairying has in the past relied on access to abundant, cheap water. Water has become more scarce as a result of horticultural expansion and the Basin Plan. Further sources of scarcity include climate change and continued horticultural expansion and the potential for further water to be recovered for the environment under the Basin Plan. For example, the Socioeconomic Analysis that accompanied the Regulatory Impact Statement for the Basin Plan (MDBA, 2011c) warned at page 78 that “for the Goulburn Broken Region GVIAP (gross value of irrigated agricultural production) will be reduced by 12.9 per cent (\$88.2 million) with the largest reductions experienced by dairy, meat cattle and hay”. The net result of these changes has been increased farming risk in Victoria’s irrigated dairy industry.

The levels of indebtedness outlined above, and the experience with the Campaspe Irrigation District, highlight that irrigated dairying is semi-interruptible only for so long. The limits to the strategy of substituting feed for water were revealed in the Campaspe Irrigation District in 2010. After four out five years with 0% water allocations, that district’s irrigators agreed to close down the irrigation district and sell all of their entitlements.

IMPACTS IN THE GMID

Dairying is the main form of farming in the GMID. Dairying can be outcompeted by irrigated industries that can pay more for water, and it can be outlasted by industries better adapted to variable water availability. Concerns about the future of dairy are a major contributor to doubts about the business model in the GMID. By contrast, there is growing confidence in the future of LMW’s irrigation districts – based on recent horticultural rejuvenation.

Since 2007, a total of 539 GL of entitlements has been traded out of the GMID as a result of horticultural expansion and the Basin Plan. As discussed in Chapter 8, this represents a 33% decrease in the volume of entitlement held in the GMID since 2001. The volume of the reduction is greater than the volume of all high reliability entitlements held in the Murray Valley and Loddon Valley Irrigation Districts in 2001. The key difference in this comparison is that rather than being concentrated in a small number of locations, the purchases have been scattered throughout the GMID (Figure 7). Because the changes in GMW customers’ water demands are spread throughout the network, opportunities to rationalise the network are much harder to identify and realise than they would have been had the transfers been concentrated in discrete areas.

Average deliveries in the GMID are likely to be around 1,200 GL in the future, 41% lower than long-term average modelled for Stage 1 of the Connections Project. In effect the Commonwealth’s buybacks and its on-farm infrastructure investments have worked at cross-purposes with its off-farm infrastructure projects.

Reduced deliveries are a major challenge to GMW because its extensive asset base requires routine annual maintenance, operations and renewal. Therefore, its costs are largely fixed. Consequently, the marginal cost of delivering water goes up as the volumes being delivered go down.

The effective costs of delivering water will increase significantly unless up to 40% of the delivery system infrastructure in place before the GMW Connections Project began can be rationalised (GMW 2009). The spatially random nature of Commonwealth water purchases has contributed to the difficulty of rationalising infrastructure.

The effect of lower deliveries is difficult to see on GMW's bottom line as the business is protected by largely fixed tariffs against their delivery shares. But more and more irrigators are paying for delivery share they do not use, and they are either unable or unwilling to pay to terminate them. The Victorian Government has committed to reviewing this issue.

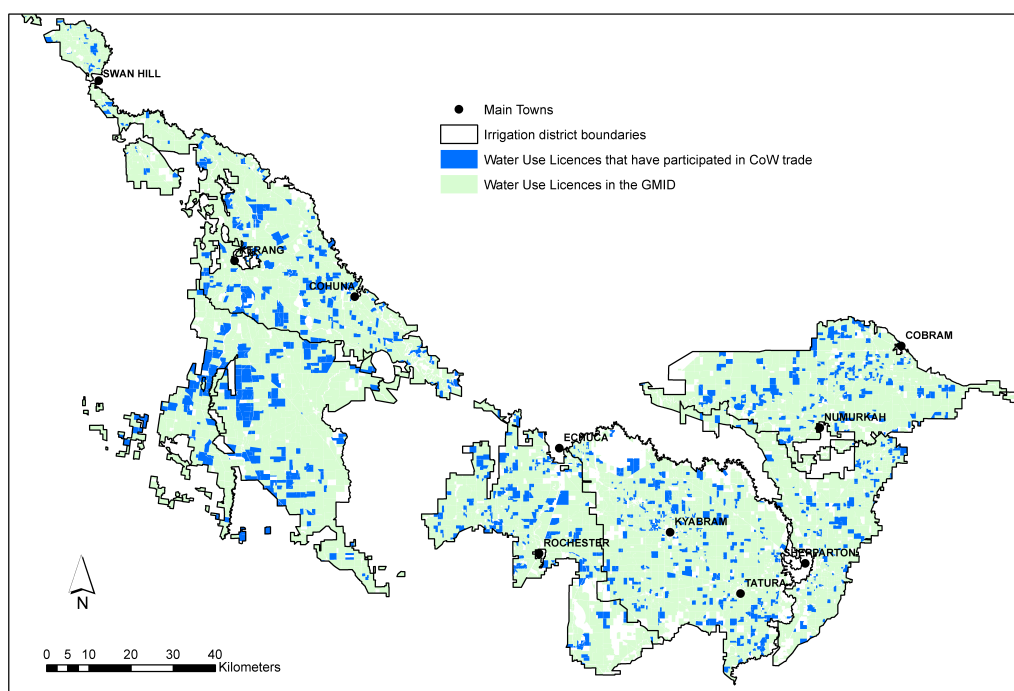


Figure 7 – Spatial distribution of water entitlements traded to the Commonwealth from farms in the GMID

IMPACTS IN NSW

Annual water use in southern NSW has declined by a volume similar to the extra allocations that would have been available in the absence of the buyback. This indicates that net trade from Victoria and South Australia has not changed.

The changes there have driven structural adjustment at the farm, industry and regional scales. Irrigators have shifted water away from rice towards other summer crops and winter crops. Corn and

cotton plantings have increased, and NSW irrigators are increasingly using forward markets to reduce season-to-season business variability.

Annual water use is evolving in southern NSW as irrigators consider how best to respond to the changed business environment. Irrigators and industries will seek to increase the returns per ML through improved management and through research and development. Recent developments in the rice industry are an example. Such structural adjustment may result in less water being traded into Victoria in the future especially if the marginal returns per ML approach those for dairying and horticulture.

In the short to medium term water is likely to trade into Victoria in low allocation years when allocation prices exceed \$200 per ML. In medium to high availability years there will be greater demand for allocation trade within NSW valleys as demonstrated in 2013/14, 2014/15 and 2016/17. The future demand for allocations in NSW will be determined by the relative profitability of the enterprises adopted by irrigators, irrespective of regional boundaries. As an example, the expansion of horticulture in the Murrumbidgee valley is likely to compete for water currently traded from the Murrumbidgee valley to the horticultural sector in northern Victoria, in years of low water availability.

IMPACTS IN SOUTH AUSTRALIA

South Australia's irrigated horticultural centres, especially those in the Mallee region have much in common with both the pumped districts and LMW diverters; there is much shared history. The low allocations in 2007/08 hit South Australian irrigators every bit as hard as it did Victoria's horticulturalists.

Based on the experience of 2007/08, the Basin Plan would seem to expose South Australia's horticulturalists to the same risks as those described above for Victoria. However, as noted in Chapter 2, South Australia has changed its water allocation framework, at least temporarily, to ensure that its irrigators receive 100% allocations until actual flows into South Australia fall 16% below entitlement flows. The effect of this change has not been evaluated for this report.

SOCIO-ECONOMIC IMPACTS

Evidence on social impacts is obtained primarily from the ABS Population Census. Although a census was conducted in 2016, the latest available census data is from the 2011 census. This means that much of the available social data is useful for understanding the context of potential social change, rather than providing evidence that the water recovery under the Basin Plan has resulted in particular types of change in particular localities. To provide additional socio-economic context for the regions of northern Victoria, summary charts are provided in Appendix 1. A common trend is the declining role of agricultural jobs in total employment, over the period to 1991 to 2011.

The 2015 Regional Wellbeing Survey collected the responses of 285 Victorian irrigators in north-west and north central Victoria on the *expected* impact of the Basin Plan. The results are presented in Appendix 1. A high proportion of responses considered that the Basin Plan would have a 'very negative' impact on the economy and communities of the MDB and the household/business/community that the respondent worked in.

ENVIRONMENTAL BENEFITS

It will take some time for the full benefits of the Basin Plan to become apparent because of lags in biological responses and because the Basin Plan, and associated water recovery, will not be implemented in full until 2024 (MDBA 2015a). Other complicating factors include the natural variability in system condition and the fact that the Basin Plan is only part, although a significant part, of a much broader integrated program of waterway and catchment management across the Basin.

At this stage the reporting of environmental outcomes is generally short-term and site or event specific. It is also almost as much about learning how river and wetland ecosystems will respond to environmental watering as reporting on responses.

CONCLUSIONS

The Victorian Government is committed to achieving balanced outcomes from the Basin Plan. On top of the environmental outcomes described in Chapter 12, the Commonwealth buyback of water entitlements provided timely assistance to many farmers with high levels of debt. It is also aware however, that most of the buyback was from Victoria, and more particularly the vast majority of high reliability entitlements secured through buyback were from Victoria.

This has left Victoria's irrigated dairy industry particularly exposed to increased reliance on allocation purchases. It has also left Victorian horticulturalists exposed to the risk of low allocations. In a repeat of 2008/09 allocations, more horticultural land would be exposed to the risk of being dried off.

The characteristics of water use in the southern-connected Basin have changed significantly as a result of the Basin Plan. The consumptive pool has decreased significantly and the mix of industries has changed. In particular, horticulture, with its relatively fixed water demands now accounts for a larger proportion of the consumptive pool. It is now at the point where in a repeat of 2008/09 allocation levels, horticultural use could account for all the available water. The proportion of the consumptive pool dedicated to horticulture will increase as horticulture continues to expand. It would increase further still under the 2750 GL and 3200 GL water recovery scenarios.

Because buyback was weighted towards high reliability entitlements, the remaining consumptive pool will yield more variable allocations at the Basin-scale. This has changed the risk profile for those irrigators who must compete with horticulturalists for allocations in dry years.

If water recovery had not occurred, water use in the GMID would have been 29-31% higher in the past three years (2013/14 to 2015/16). Accordingly, GMID milk production could be expected to have been about 30% higher than was observed. The foregone production would otherwise have had significant flow-on effects in towns and communities where farm inputs are sourced and where dairy manufacturing occurs. Water use by horticulturalists would have been largely the same with and without the Basin Plan.

Irrigators have been adapting, but the relative abundance of water since buyback was completed, with the notable exception of 2015/16, has enabled many irrigators to maintain water use though water

allocation purchases. Consequently many of the socio-economic impacts of the Basin Plan may not be observed until the next drought.

Further water recovery through government investment in on-farm efficiency savings may be positive for the farm enterprise being funded, however the effects on other water users and irrigation communities may be negative.

As explored in more detail in Chapter 3, on-farm water savings have similar characteristics to off-farm water savings in wet-to-average years. However, because most of the investments have occurred on farms that support interruptible and semi-interruptible enterprises, in dry and extreme dry years the on-farm projects serve to reduce the consumptive pool; those irrigators have less water to sell to non-interruptible horticulturalists in dry sequences. This will elevate allocation prices in dry years.

A key finding of this report is that Victorian irrigators who sold water entitlements to the Commonwealth are now more reliant on allocation purchases than they would have been without the Basin Plan. As explained in Chapter 6, this has increased their farming risk. The nature of this risk was masked for four years by the high level of carryover resulting from the extraordinarily high rainfall years of 2010/11 and 2011/12. The issue here is that, as discussed in Chapter 6, dairying is semi-interruptible for only so long. Compounding this, as explained in Chapter 8, as a result of the spatially random nature of the Commonwealth buyback, the effective costs of delivering water in the GMID, where most irrigated dairying occurs will increase significantly unless up to 40% of delivery system infrastructure in place before the GMW Connections Project began can be rationalised (GMW 2009).

1 INTRODUCTION

1.1 ABOUT THE BASIN PLAN

The Murray-Darling Basin Plan formally commenced in November 2012. The Basin Plan aims to achieve a healthy, working Murray-Darling Basin that includes communities with access to sufficient and reliable water supplies, productive and resilient water-dependent industries, and healthy and resilient ecosystems.

The Basin Plan sets limits on the amount of water that can be extracted from the Basin; it comes into effect in 2019. The Basin Plan's overall Sustainable Diversion Limit (SDL) aims to recover 2750 gigalitres (GL) of water for the environment. The recovered water will be used to help improve the environmental health of Basin rivers, wetlands and floodplains and the habitats of plants and animals that rely on the river system.

There is scope within the Basin Plan for the SDL to be increased to embrace a total recovery of only 2100 GL, provided offsetting measures, such as pumping water, or removing sills, can deliver water into floodplain wetlands (in ways that mimic natural cycles) without the need to flood those wetlands through high flows.

On the other hand, there is scope for the SDLs to be further reduced, through the recovery of up to 3200 GL, by including the recovery of an additional 450 GL through on-farm efficiency measures aimed at recovering water for the environment without reducing on-farm productivity. Importantly however, the additional 450 GL is contingent upon it being obtained through measures that have neutral or positive social and economic impacts.

Victoria's share of the 2750 GL target is 1075 GL, and it has already transferred 711 GL to the environment. The Victorian Government is committed to balancing its obligations under the Basin Plan with any associated impacts on Victorian industries and communities.

The Basin Plan also supports engagement with Indigenous communities in water resource planning and the consideration of Indigenous values and uses. Victoria will need to prepare water resource plans to manage Basin water resources in the long-term (DELWP, 2016b).

The Victorian Government has committed itself, in partnership with water corporations and catchment management authorities, to work to achieve balanced outcomes from implementing the Murray-Darling Basin Plan in Victoria by:

- continuing to prioritise projects to help meet its 1075 GL obligation under the Basin Plan with water savings and environmental offsets, rather than further reducing the consumptive pool
- publishing a yearly online update on Victoria's progress toward meeting Basin Plan water recovery targets
- working with the Commonwealth Government, other Basin jurisdictions and the Murray-Darling Basin Authority to ensure effective governance of the process to deliver environmental offsets

- undertaking its own socio-economic analysis into the impact of water recovery to inform discussions with the Federal Government and make sure that any further water recovery above 2750 GL from Victoria is based on robust evidence that it can be done with neutral or positive social and economic impacts
- participating in a coordinated interstate process to investigate the feasibility of addressing constraints to environmental water delivery in the southern Murray-Darling Basin, with strong community involvement (DELWP, 2016b).

1.2 PURPOSE OF THIS REPORT

This report was commissioned to assist the Victorian Government in undertaking its own socio-economic analysis into the impacts in Victoria of water recovery through the Basin Plan. It will inform discussions with the Commonwealth Government and help to make sure that all future water recovery from Victoria is based on robust evidence that it can be done with neutral or positive social and economic impacts.

1.3 STRUCTURE OF THIS REPORT

This report is essentially in four parts:

1. **Orientation:** The first part of the report provides the context for its development and the methodology used in preparing the report. It then explains why it is important to view water use in northern Victoria as part of a greater whole – the southern-connected Murray-Darling Basin. Changes in water use in any part of the southern-connected Basin can, through the mediation of one large water market, translate into changes in other parts of the system as a whole.
2. **Analysis:** The second part considers data on actual water use by irrigators since the Commonwealth began to recover water under the Basin Plan. Having determined what happened with the Plan, it then sets out the ‘counterfactual’, a logical construction of what could reasonably have been expected to happen without the Basin Plan. The MDBA’s preferred approach for analysing the expected outcomes of the Basin Plan is then used to compare expected with actual outcomes. The outcomes are considered at the farm scale, the industry scale and the system scale.
3. **Interpretation:** The analysis is carried further to consider the socio-economic outcomes of the Basin Plan in the context of human landscapes, the geographic centres of the major irrigated industries in the southern-connected Basin. Particular attention is paid to the Basin Plan’s implications for the future viability of the Goulburn-Murray Irrigation District. The environmental outcomes of the Basin Plan are also considered.
4. **Conclusion:** The report finishes with a series of conclusions about the socio-economic impacts of the Basin Plan in Victoria.

1.4 METHODOLOGY

The approach taken in assessing the impacts of the Basin Plan is intended to be systematic, methodical and repeatable. It is not a comparison of irrigation before and after the Basin Plan. Rather

it is a comparison of what happened after the Basin Plan was implemented with what could reasonably have been expected to happen if the Basin Plan had not been implemented. Such comparisons with the ‘counterfactual’ are standard practice in economics.

The complexity of the socio-economic systems in the southern-connected Basin mitigate against the use of a computable general equilibrium modelling approach to assessing the impacts because communities are subject to a range of localised and broad scale changes and not just the ‘shock’ imposed by the Basin Plan. Similarly, it is not possible to assess the impacts by simply referring to a range of socio-economic indicators, for one thing, as discussed in Chapter 10, that approach would depend on access to 2016 census data and ideally would involve 2021 census data also.

In recognition of those issues, we have instead constructed a systematic organising framework for our analysis, with a logic grounded in a deep understanding of the way the different irrigated industries have responded to variable water availability. Building from this we have considered the implications for different geographic centres, in the context of the vagaries in commodity prices and production levels.

There are of course limitations to our analysis. For example, we have not factored the human capacity to adapt to difficult circumstances, we do however make clear our assumptions about current trends in development and current rates of water use. Similarly, because this is not a modelling exercise we have assumed constant commodity prices – a future collapse in almond prices or jump in milk prices would result in outcomes different to those we describe. Conversely, a jump in almond prices and a further deterioration in milk prices would also result in different outcomes.

Our approach rests on a series of steps:

1. In Chapter 2 we establish the need to understand irrigation in northern Victoria in the context of irrigation in the southern-connected Murray-Darling Basin as a whole.

We show that by trade or by substitution, there is one large water market operating in the southern-connected Basin. We illustrate that between the three states in the southern Basin there are five water entitlement types used by irrigators and that the probability of receiving allocations against each of the entitlements varies considerably. We demonstrate that an understanding of the socio-economic impacts of the Basin plan rests on an understanding of the interactions between the variability of water supply and the relative constancy of demand for water by different irrigation industries.

The northern Basin is not considered in this analysis because the highly variable stream flows and relatively small storages there mean that the northern Basin embraces several small water markets that are not integrated and do not have a material bearing on water use in Victoria.

2. In Chapter 3 we analyse the data on actual water use in Victoria from when the Commonwealth began to recover water for the environment in 2007/08 until the end of 2015/16. We deliberately take a different approach to that used by RMCG (2016) in their recent analysis. We do this for two reasons. One is to help in triangulating their forensic

analysis of ABARES data. The other is to make use of more accurate data made available to us from the Victorian Water Register.

3. Having established the pattern of water use with the Basin Plan, we then set out, in Section 3.5, our logic for constructing the ‘counterfactual’ – what could reasonably have been expected to happen if the Basin Plan had not been implemented. We do this in explicit recognition of the underlying trend in Australia for population declines and job contractions in small towns (Chapter 10). We also explicitly account for the vagaries of commodity prices, climate variability and the underlying trends for structural adjustment in various irrigated industries (Chapters 4, 5, 6 and 7).
4. We analyse the different elements of socio-economic risk — vulnerability, exposure and impact — at the different scales of the region, the farm enterprise and the community, using the metrics outlined in Appendix 1 to inform that analysis.
5. We are transparent, careful and judicious in our efforts to establish causal links because we are aware that a range of other contributing factors may affect the same metric thereby complicating the link between water recovery and a given metric. Much of the detailed quantitative analysis to support our conclusions is provided in the Appendices.
6. In Chapter 4 we review the MDBA’s preferred approach to explaining the expected outcomes of the Basin Plan and over several chapters we compare the actual outcomes with the expected outcomes. We do this at a range of scales:
 - a. the farm scale
 - b. the industry scale
 - i. horticultural industries
 - ii. the dairy industry
 - iii. cropping industries in NSW – including their implications for Victoria
 - c. the regional scale – with a particular focus on the Goulburn-Murray Irrigation District
 - d. the system scale.
7. In Chapter 11 we then use the approach outlined in Step 6 to analyse the likely impacts of three different future water recovery scenarios. As explained previously, the different recovery volumes for these scenarios are:
 - a. 2100 GL if offsetting measures were to account for the full volume allowable
 - b. 2750 GL if no offsetting measures were to be taken into account
 - c. 3200 GL if no offsetting measures were taken into account and an additional 450 GL were recovered through on-farm efficiency measures having neutral or positive socio-economic impacts.

Finally, in Chapter 12, even though this is not a review of the environmental impacts of the Basin Plan, for the sake of putting the socio-economic impacts in context, we review the available information about the environmental outcomes and benefits of the Basin Plan.

2 AN OVERVIEW OF IRRIGATION IN THE SOUTHERN-CONNECTED MURRAY-DARLING BASIN

2.1 OVERVIEW

To understand the socio-economic impacts of the Basin Plan in Victoria, it is first necessary to understand the linkages between the supplies of water in each southern Basin state and the demands for water in each of those states. Water recovery under the Basin Plan affects the supply of water in each state differently, and the socio-economic impacts of those changes in available water depend on how water demands adjust in response.

This chapter explains how the different water allocation frameworks in each state affect total water supplies, the probability of those supplies being fully available in each year, and the types of irrigated enterprises that are common in different geographical centres. It then explains the interactions between the main irrigated industries.

2.2 UNDERSTANDING THE SOUTHERN-CONNECTED BASIN AS A SYSTEM

Joint management of the River Murray dates back to the River Murray Waters Agreement of 1914, in which the New South Wales (NSW), Victorian, South Australian and Commonwealth Governments agreed to share the waters, build dams and weirs, and operate the river in accordance with a set of rules. Today's arrangements for managing the River Murray are set out in the Murray–Darling Basin Agreement, to which the Basin states and the Commonwealth are all signatories. They each contribute funding to the joint management of the River Murray.

In operating the River Murray, the MDBA must take account of and accommodate inflows from a number of tributary systems, but its operations role under the Agreement does not extend into any of these tributaries. That responsibility lies with the relevant states, and operations on those rivers are undertaken by state water agencies.

The general principle for water sharing between the states is that NSW and Victoria each receive 50% of the flow upstream of Albury (including inflows to the Hume and Dartmouth storages and inflows from the Kiewa River). They also receive 50% of inflows to the Menindee Lakes (except when storage in the lakes falls below 480 GL, then all inflows revert to NSW until the storage returns to 640 GL).

The volume of water held by either state in a joint storage must not exceed half of the capacity of the reservoir in question, otherwise it is deemed to have been 'spilt' within the reservoir to the other state. In other words, spilt water is added to one state's storage account and removed from the 'spilling' state's account.

NSW and Victoria jointly provide South Australia with its entitlement, which varies from month to month as stipulated in the Murray–Darling Basin Agreement. Victoria and NSW provide water to South Australia through a combination of their share of water held in the joint storages and from inflows into the Murray from the tributaries assigned to each. In 2011, approval was given for South Australia to store its share of water resources in the joint storages for the purposes of meeting its critical human water needs and allowing its water users to carryover their allocations.

With regard to making water available to individual water users, each state has its own property rights regime for water, and there are some important differences in the water entitlement and allocation frameworks that underpin those property rights. For example, even though NSW and Victorian share the capacity of the joint storages equally, there are significant differences in the total volumes of entitlements issued to water users in either state from those storages.

The differences arise because NSW operates an annual water budget, while Victoria's water budget is calculated over a two-year period and South Australia receives a fixed volume in all but the driest of years. The key features of each state's allocation framework are outlined below.

NSW WATER ALLOCATION FRAMEWORK

At the start of each new water year on 1 July, NSW entitlement holders are provided with an opening allocation for each entitlement type, and there are minimal efforts to reserve water supplies for the following season. Opening allocations for Domestic and Stock and Town Water Supply are generally 100% unless conditions are very dry and storages are low. High Security allocations of near 100% are made at the start of all but the very dry years and Conveyance allocations are commensurate with total allocations against the other entitlements.

General Security entitlements are the last to receive allocations and are therefore the least secure NSW entitlement category. They can start the year with low or zero allocation and typically receive incremental improvement as the year unfolds commensurate with rainfall and runoff.

General security entitlements are the most susceptible to seasonal climatic variations. But as will be explained further below, they are suitable as a water supply source for the annual cropping systems that dominate irrigated agriculture in NSW. This is a case of chicken and egg; the development of different farming systems at the time of settlement influenced the development of the allocation framework and *vice versa*. The differences between the states are artefacts of settlement history and its consequence for farm size, and labour use.

VICTORIAN WATER ALLOCATION FRAMEWORK

Victoria considers its inflows and commitments over a two-year period to make sure reserves are established to secure at least partial allocations against high reliability water shares in the following year if conditions turn dry. Victoria's allocation policy has always been to secure next year's allocation against high-reliability water shares before making allocations against low-reliability water shares. As will be explained further below, this trade-off between reliability over the long term and maximum water availability in the short term suits the demands of the dairy and horticulture industries that dominate irrigated agriculture in northern Victoria. High-reliability water shares have supported the development of high-value irrigated agriculture in Victoria.³

³ <http://nvrn.net.au/seasonal-determinations/how-allocations-work> on 20 September 2016

SOUTH AUSTRALIAN WATER ALLOCATION FRAMEWORK

Under normal conditions, the River Murray in South Australia receives up to 1,850 GL of water per year (Entitlement Flow). Under these conditions, water access entitlement holders receive 100% of their water allocation. Under dry conditions, South Australia's Entitlement Flow is reduced. If South Australia receives less than 1,850 GL in a year, then the reduced volume is shared between entitlement holders.

For the 2016/17 water year, the South Australian Government has approved a change to the River Murray Water Allocation Framework to allow 100% allocations for entitlement holders when Entitlement Flow reaches 1,546 GL (DEWNR, 2016a).

IMPLICATIONS OF THE DIFFERENCES BETWEEN ALLOCATION FRAMEWORKS

The states' different water allocation frameworks result in a suite of different water entitlements, each of which has different reliability characteristics combined with a cap on the total volume that can be made available. This is easiest to understand if we first consider the Murray in isolation – where Victoria and NSW share the storages equally. Despite having equal storage space, for the reasons outlined above, the total volume of NSW entitlement held by irrigators before water recovery commenced (1,872 GL) was higher than the volume held by Victorian irrigators (1,459 GL) (Table 1).

Table 1: Maximum allocation volumes available for different entitlement types on the Murray as at June 2007⁴

Entitlement type	NSW (GL)	Victoria (GL)	South Australia (GL)
Low Reliability Water Shares		292	
General Security Access Licences	1,668		
Water Access Entitlements			565
High Reliability Water Shares		1,167	
High Security Access Licences	204		
Total	1,872	1,459	565

Having looked in isolation at the implications of having different allocation frameworks on the Murray, it is important to understand the implications for the southern-connected Basin as a whole. The first thing to note is that there are five main entitlement types, but the total volumes associated with each, after subtracting the entitlements recovered for the environment, vary by an order of magnitude from 465 GL for South Australian water access entitlements to 2,673 GL for NSW General Security entitlements (Table 2).

⁴ The sources for the data in are outlined in considerable detail beneath Table 28 in Appendix 2

Table 2: Maximum volumes remaining in the consumptive pool at 100% allocations against each entitlement type in the southern-connected Basin as at October 2016.⁵

Entitlement type	NSW (GL)	Victoria (GL)	South Australia (GL)	Total (GL)
Low Reliability Water Shares		731		731
General Security Access Licences	2,673			2,673
Water Access Entitlements			465	465
High Reliability Water Shares		1,749		1,749
High Security Access Licences	558			
Total	3,231	2,480	465	6,176

The second thing to note is that the different allocation frameworks in each state mean that the allocations against the different types of entitlements vary markedly from year to year (Figure 8). Because they constitute the largest pool of entitlements, allocations against NSW General Security entitlements have the most impact on the market price for allocations. Irrigators in each state therefore take an interest in the allocation levels in each of the major tributary systems, but they pay particular attention to allocations against NSW General Security entitlements.

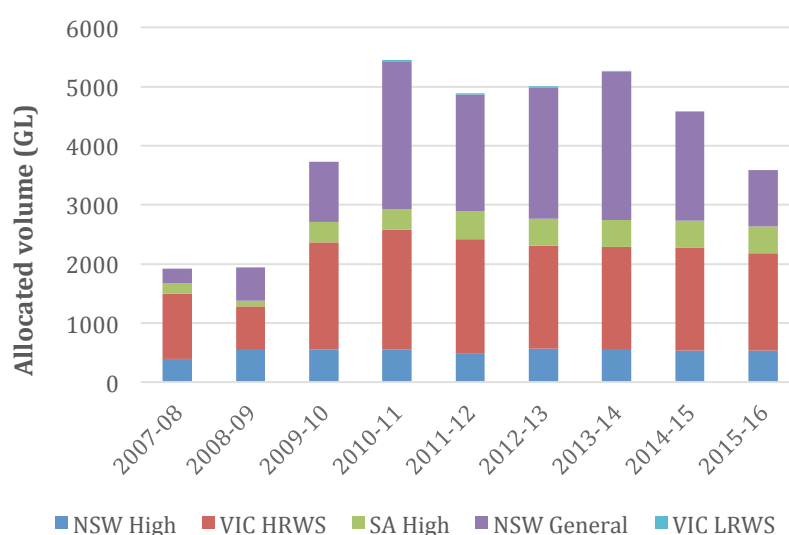


Figure 8: Seasonal allocations against the five main entitlement types in the southern-connected Basin since water recovery commenced

⁵ The sources for the data in Table 2 are outlined in considerable detail beneath Table 28 in Appendix 2

ONE LARGE WATER MARKET

Each state in the southern-connected basin started to develop its own water market in the 1980s. Over time, these were progressively integrated, based on the concept of a 'cap and trade' system, to the point where under the Commonwealth *Water Act 2007* the Australian Competition and Consumer Commission (ACCC) now enforces water market rules, provides advice to the Commonwealth Minister responsible for water on the development of water market rules and advises the MDBA on the development of water trading rules.

Caps on water extraction enable the scarcity value of water to be revealed. When water is plentiful there may be enough for all users, but when it is scarce, it is not possible to meet all users' demands. The water market enables water to be reallocated between users depending on their needs and circumstances. Consequently, water trading has become a vital business tool for many irrigators; it provides them with the flexibility to respond to variable water availability. The water market allows water to flow to where it can be used most productively. It also allows for major changes in how businesses manage their capital (e.g. whether they hold or sell entitlements).

Although there are varying degrees of connectivity between different parts of the southern-connected basin, there is now in effect one large water market covering the entire system. The heterogeneity of different irrigation enterprises throughout the system, combined with the varying degrees of reliability associated with different water entitlements, makes for a very active market.

SOME PHYSICAL CONSTRAINTS TO WATER TRADE

There are several locations in the river system, such as the Barmah Choke, where channel capacity is naturally restricted and flows need to be limited if all the water is to remain within the river's banks. Overbank flows occur naturally, typically in winter and spring, and they are critical to the ecological health of the riverine environment, including connected wetlands and forests, but unseasonal overbank flows can incur environmental, social and economic costs depending on their duration and the time of year they occur.

Channel capacity limitations at the Barmah Choke, the lower Goulburn, the lower Murrumbidgee and other locations are a major influence on the way the system is operated. They require an understanding of, and the ability to anticipate, downstream demands well ahead of time. To ensure timely access to water in the lower parts of the Basin, storage releases are sometimes necessary several months in advance to deliver water downstream to balancing-storages so that the rates of delivery later in the season can be maintained within channel capacity.

Water trading rules can help to manage system constraints. Over time, water trade can also cause changes to demand patterns to the point where river management rules may need to be reviewed to ensure they remain fit-for-purpose.

INTER-VALLEY TRANSFER RULES AND THEIR IMPLICATIONS

Water trade between the Murrumbidgee, Murray and Goulburn Valley systems is subject to “inter-valley transfer rules”. These trading rules were designed to protect against third-party impacts to other entitlement holders in each of the systems. In Victoria, these rules ensure that the resource set aside for the traded commitment can be preserved in storage without spilling. The guiding principle is that trading rules should be as liberal as possible while also protecting against third-party impacts.

The current Inter-Valley Transfer (IVT) rules are summarised below:

1. **Murrumbidgee to Murray:** There cannot be more than 100 GL of undelivered water in the IVT account at any given time. As such the IVT is closed when the account balance reaches 100 GL and it is reopened when it drops to 85GL. The account is live and is accessible on the web. There is no annual maximum volume that can be transferred. The end of season balance carries across to the following water season.
2. **NSW Murray to Victoria:** Allocation trade from NSW to Victoria is limited to a net annual volume of 200 GL or a volume that keeps the risk of spill in the Murray system below 50%, whichever is lower. If the risk of spill in the Victorian Murray system is above 50%, trade from NSW to Victoria is limited to the volume traded from Victoria to NSW since August 1. The 200 GL limit is reset each year and the risk of spill is reviewed regularly. There is no limit on the volume of water that can be traded annually from Victoria to NSW because such trade usually occurs in wet years and the NSW carryover rules are such that there is a low risk of third party impacts. NSW caps the sum of annual allocations plus carryover to 110% of held water entitlements
3. **Goulburn to Murray:** Water users in the Goulburn, Campaspe and Loddon systems can trade allocations to the Murray system, in Victoria, NSW and South Australia while the total volume owed to the Murray system is less than 200 GL. Trade in the other direction, back trade, can occur while the total volume owed to the Murray is greater than zero. Trade can continue to occur provided the live balance does not exceed 200 GL. Approximately 100 GL of entitlement was traded from the Goulburn to the Murray before the current tagged entitlement trade rules were introduced. This affects the capacity for trade from the Goulburn system on some occasions.

Table 3: Net trade into Victoria

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Observed water use (GL)	924	1,135	751	1,731	2,402	1,857	2,033	1,762
Net water allocation trade (into Victoria) (GL)	212	65	245	-8	-146	194	60	223

Source: DELWP, 2016a, pers. comm. DELWP.

Water allocation trade has been an important source of water for Victorian irrigators. Much of this water comes from the NSW Murrumbidgee and NSW Murray and is subject to the above trade constraints.

2.3 THE MAIN IRRIGATED INDUSTRIES AND THEIR GEOGRAPHIC CENTRES

For the purposes of this report, it is helpful to think about water in the southern-connected Basin being used for three main types of irrigated enterprise. These are:

- horticulture
- dairying and mixed farming
- rice-based and cotton-based annual cropping systems.

It is common for these different groups to be referred to as different irrigation industries. At one level this is a useful abstraction because it helps to think about the broad movements of water in what is effectively a single water market operating throughout the southern-connected Basin.

At another level however, it is unhelpful to think about each type of irrigated enterprise as a monolith; to do so is to risk ignoring the reality that there are thousands of different men and women involved in irrigation in the Basin, and they are farming at a range of scales, with widely different levels of profitability. Their financial successes and failures depend on a range of things including the weather, commodity prices, their indebtedness, their exposure to personal crises, their costs of doing business, as well as water availability and water prices. The variations between irrigators within industries are often much greater than the variations between industries.

For the purposes of this report, irrigation industries are discussed in the context of their patterns of water demand and how these might interact with the impacts of water supply under the Basin Plan. Since each of these industries is to some extent focused in different parts of the Basin, those interactions also influence the socio-economic impacts of the Basin Plan in different parts of the Basin.

Irrigated horticulture in the southern-connected Basin is concentrated in the Mallee regions of NSW, South Australia and Victoria, around Griffith in NSW and around Shepparton in Victoria. Perennial crops such as almonds, grapevines, citrus, pome fruits and stone fruits are *non-interruptible* in the sense that in the absence of irrigation, these crops may die and they will be expensive and time-consuming to replace. Annual vegetable crops are interruptible, but their high value of production means that vegetable growers will typically remain in the water market at very high prices. While they are concentrated in the Mallee, there are very important horticultural plantings in the Murrumbidgee and the Goulburn-Murray Irrigation District (GMID) of Victoria.

Irrigated dairying and mixed farming is concentrated in the GMID, with smaller levels of production in southern NSW and a low level of production in the Lower Lakes region of South Australia. Dairying is *semi-interruptible* in the sense that there are substitutes for water in the form of purchased feed. Moreover, parts of the herd can be ‘parked’ on dryland farms in other areas if necessary. However, dairy nutrition requires a balance between dry feed and pastures, and in the long run, the ‘perennial’ nature of herds, and the genetics on which they are based, will be expensive and time-consuming to

replace if they cannot be maintained. Mixed farming systems, which involve a mix of cropping and grazing for meat and fibre, now accounts for around 10% of the total value of production in the GMID (RMCG, 2016), is *interruptible*, but increasingly it helps to provide feed to the dairy industry.

Rice-based annual cropping systems are concentrated in the Murrumbidgee and Murray regions of NSW. These are *interruptible* in the sense that while income is foregone if they cannot be grown in a given year, they can be planted in another year in the hope of earning enough to offset those foregone revenues. In years of high water availability, rice accounts for more water use than any other industry.

Cotton-based annual cropping systems are now common in the Murrumbidgee region, where they now account for approximately 15% of total water use. At this stage they account for a small proportion of the total water use in the Murray region of NSW. Like rice-based systems, cotton-based systems are *interruptible*, but the higher value of their produce, coupled with the tendency for growers to have forward contracts for their production, means that they are likely to be still buying allocations at prices where rice farmers begin to sell.

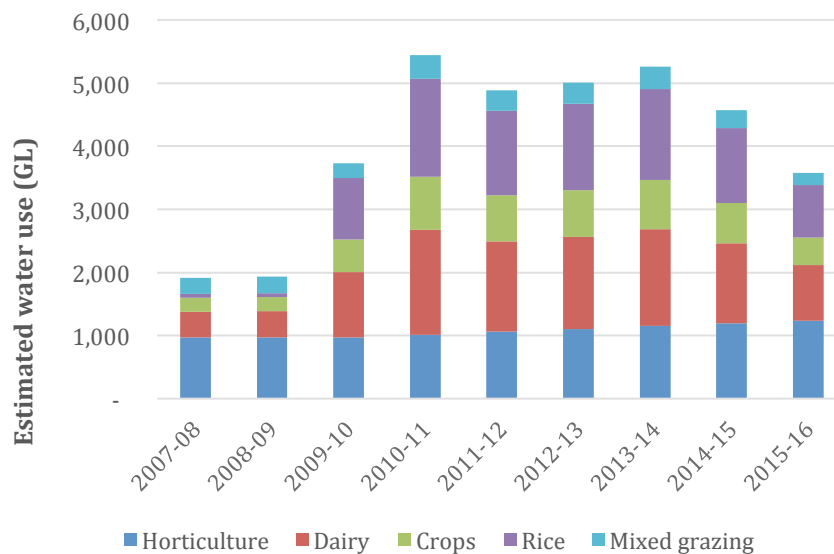


Figure 9: Estimated water use by different irrigated industries in the southern-connected Basin since water recovery commenced.

Source: Data from figure 8, and relative water use estimates from RMCG 2016.

2.4 SYSTEM DYNAMICS

The presence of these three main industries in the southern-connected Basin, and the variations within them, provides the heterogeneity necessary to drive the water market. When allocations are abundant and water prices are low, rice farmers will typically (subject to the relativities in commodity prices) buy allocations from other irrigators in order to expand their plantings. When allocations are scarce and prices are high irrigators with *non-interruptible* enterprises will (subject to commodity

prices) endeavour to protect their productive base by buying allocations and maintaining their production.

The scenarios outlined in the text box below, which were developed by RMCG, throw light on how different sorts of enterprises behave in the allocation market, and how the market is evolving.

Potential water availability scenarios developed by RMCG (personal communication, 2015)

Scenario	Allocation	Probability (years in 20)		Water available (GL)	Price	Year similar to scenario	Enterprise behaviour
		Long-term	Last 20 years				
Very wet	Some low-reliability	7	3	6,500	\$20	2011/12	Water carried over
Medium-wet	95% general security	4	5	6,100	\$45	2012/13	Rice farmers buy
Medium	55% general security	4	5	4,800	\$120	2014/15	Rice farmers sit
Medium-dry	20% general security	4	5	3,600	\$165	2009/10	Rice farmers sell
Drought	50% high-reliability	1	2	1,800	\$400	2007/08	Dairy farmers sell, horticulturalists compete

Note: These scenarios are based on water availability, not climatic conditions. The allocation level shown produces the water available. But a year chosen as typifying a scenario had its actual water allocated adjusted for water carried over into the year minus water carried over into the following year, with the resultant water available then matched with that in a scenario. Prices are actual weighted average prices in the Goulburn in the year chosen as typical of the scenario.

RMCG's scenarios are necessarily simplified. For example, each farmer's prognosis for the next season will be a factor in their decisions to buy or sell allocations, as will what they have already planted, the stage of the season, commodity prices, contracts in place with the purchasers of produce, farm systems and capabilities, and the availability of alternatives like hay, silage and cut fodder crops. These scenarios should therefore be treated as indicative only.

The scenarios nevertheless underline the significance to the market of what is happening in NSW. And they are useful in highlighting important trends.

2.5 SUMMING UP

Water supplies in the southern-connected Basin are highly variable. Each of the southern Basin states designed its water allocation framework to deal with that variability in ways that favoured the dominant irrigation industries in that state. As water markets developed in each state, and as those markets began to be integrated, irrigation in the southern-connected Basin increasingly began to operate as a single, large, dynamic system.

3 OBSERVED WATER USE IN VICTORIA SINCE WATER RECOVERY COMMENCED – COMPARED WITH A LOGICALLY CONSTRUCTED ‘COUNTERFACTUAL’

3.1 OVERVIEW

Other analyses of the impacts of the Basin Plan have tended to compare what happened before water recovery commenced with what happened after. However, such approaches only describe what happened; they do not explain that other things may also have changed during the same period that also affect the outcome. They are a description of the factual, rather than an analysis of the logically constructed counterfactual.

This chapter describes observed water use in Victoria since water recovery commenced, putting those observations in the context of the other factors influencing water use during that time. It then quantifies the volumes of water recovered through buyback, through on-farm infrastructure savings and through off-farm infrastructure savings, while also putting the timing of those recoveries in the context of what else was happening at the time. It finishes with a transparent, logical construction of the counterfactual to be used as the basis of comparison for the remainder of the report.

3.2 OBSERVED WATER USE IN VICTORIA SINCE WATER RECOVERY COMMENCED

Irrigation water availability and use in northern Victoria has been extraordinarily variable over the past decade, water recovery for the environment commenced in a period punctuated by extreme drought and recording-breaking floods. Figure 10 below presents annual water use by Victorian irrigators for 2004/05 and the period 2008/09 to 2015/16.

Water use for 2004/05 is included for comparison. 2004/05 represents the last year, before water recovery commenced, where both the Goulburn and Murray systems received the equivalent of 100% allocations to high reliability entitlements and 0% to low reliability entitlements.

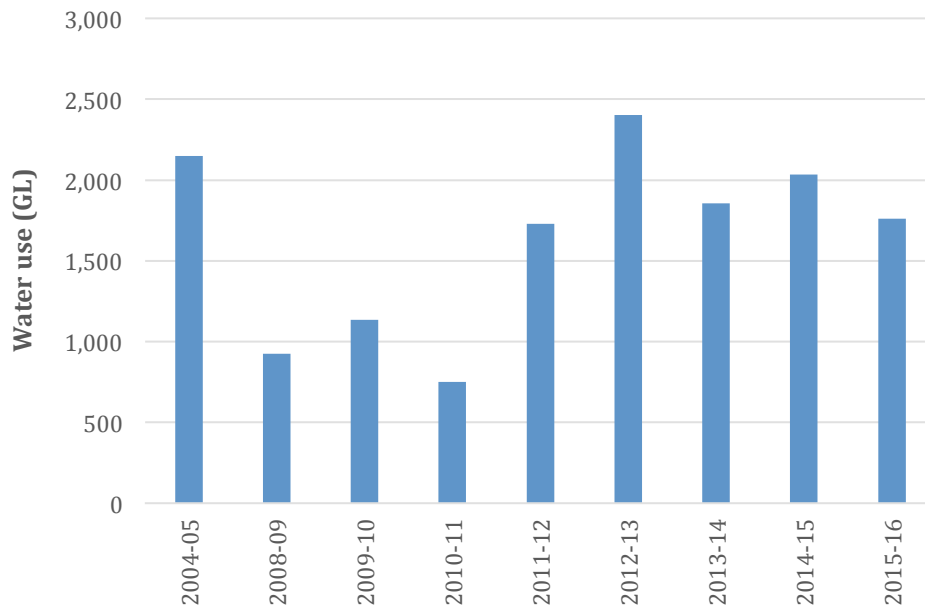


Figure 10: Water use by Victorian irrigators

Given the mix of different irrigation industries in Victoria, it is helpful to disaggregate this data to help understand the socio-economic impacts in different geographic centres. The Victorian Water Register, from which much of our data is drawn, can separate out water-usage data for the different “delivery systems” serviced by the two major rural water corporations in northern Victoria, Goulburn Murray Water (GMW) and Lower Murray Water (LMW).

Figure 11 below separates this annual water use between GMW’s irrigation districts, which are mostly dominated by dairying but do include important areas of horticultural plantings, GMW’s river diverters (irrigators who pump their own water directly from rivers without being part of an irrigation district), who irrigate a range of enterprises (including dairying and horticulture), LMW’s river diverters who overwhelmingly grow horticultural crops and LMW irrigation districts who are also mostly horticulturalists.

Figure 11 shows that irrigators in GMW districts account for the largest share of water use and that their water use is highly variable, especially compared to the next largest group being LMW diverters.

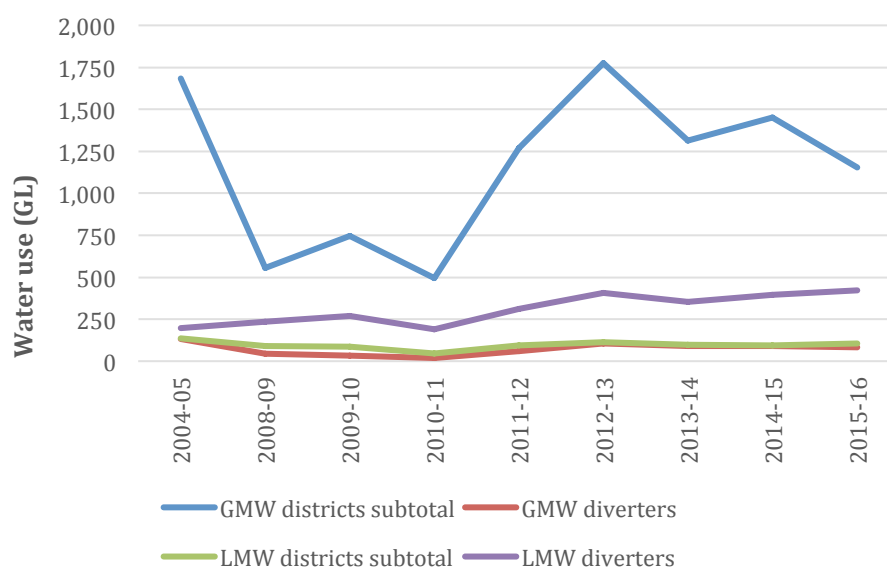


Figure 11: Water use by Victorian irrigation districts and diverters

Within the GMW districts (Figure 12), there is a similar pattern of variability in response to seasonal conditions and water availability. The notable exceptions are Nyah, Tresco and Woorinen, which are horticultural districts, and Campaspe, which was closed in 2010 after receiving 0% allocations in four years out of five.

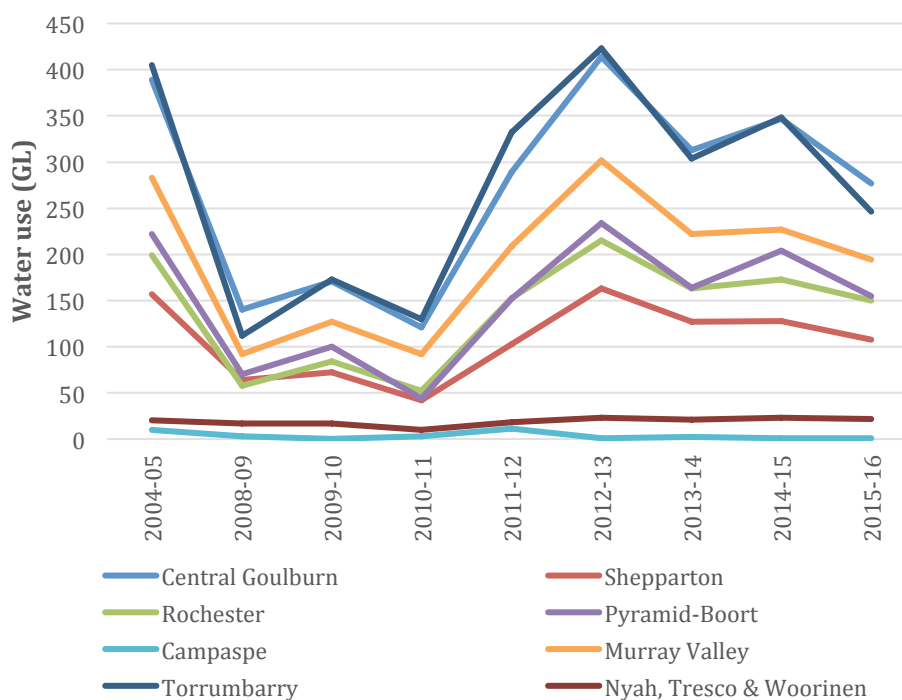


Figure 12: Water use within GMW districts

3.3 INFLUENCES ON WATER USE AT THE TIME WATER RECOVERY COMMENCED

Significant volumes of water had been recovered for the environment through the Snowy River and the Living Murray initiatives before the Basin Plan commenced. Water recovery for those initiatives continued after 30 June 2007 with 191 GL (long term average annual yield, LTAAY) in NSW and 30 GL (LTAAY) in Victoria being recovered since then.

In 2007, in the midst of extreme drought, Victoria's water security was a pressing issue and there were concerns that Melbourne would run out of water. The Victorian Government proposed several large water savings projects, including the modernisation of water irrigation infrastructure in Victoria's Goulburn-Murray Region, a \$1 billion project designed to generate water savings for Melbourne, irrigators and the environment.

On 1 July 2007, Victoria unbundled its water entitlements on regulated streams in northern Victoria. Water rights and diversion licences on those systems were 'unbundled' to become high reliability water shares, water-use licences and delivery shares. In return for 20% of the total modelled volume being returned to the environment, the previously ill-defined 'sales' water was converted to become entitlements known as low reliability water shares.

The Victorian Water Register went live at the same time. It improved the accounting arrangements for water usage, and it provided secure electronic titles for water shares, making it possible for them to be subject to mortgages.

The National Water Initiative of 2004 specified requirements for national metering standards and a nationally consistent framework for water metering and measurement. Consequently, The Victorian State Implementation Plan for Non-urban Water Metering was completed in 2010. It required all non-urban meters to perform within the maximum permissible limits of error of $\pm 5\%$.

The extreme drought was reflected in extraordinarily low allocation levels when water recovery commenced, and record-breaking floods were recorded immediately after the buyback of entitlements stopped. The extraordinary levels of carryover built up during the *La Nina* years meant that the total combined volume of allocations and carryover against Victorian water shares were greater than the volume of use by irrigators in Victoria for four years after buyback was complete (Figure 13). This served to mask the impacts of the Basin Plan water recovery until early 2015/16.

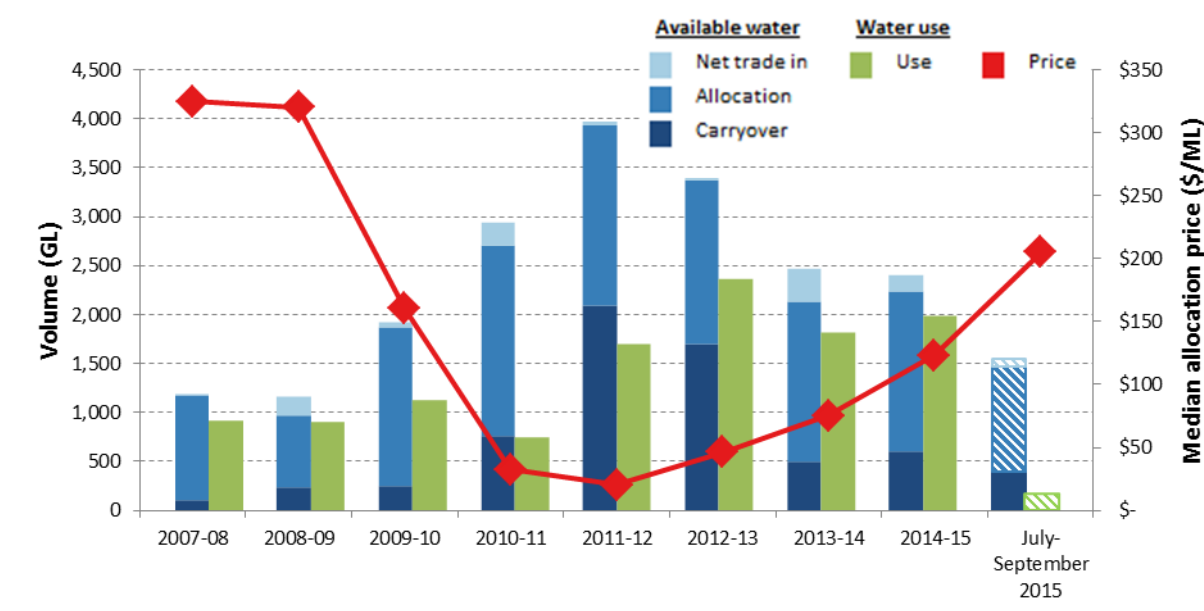


Figure 13: Private water availability, use and allocation price, Murray and Goulburn systems (DELWP, 2016a)

Note: The bars for 2015/16 are hatched to indicate that the season was not complete at the time the report (DELWP, 2016a) was being prepared. DELWP was unable to update this figure in time for this report. An updated version would provide insight into high levels of concern about allocation prices in 2015/16.

The collapse of the wine boom, and the collapse of two large managed investment companies (Timbercorp and Great Southern), which had been investing in Victoria's horticultural expansion, coincided with low allocation levels and the start of water recovery. Buyback helped with the necessary structural adjustment. Wine grape growers were able to exit the industry, and many large almond orchards were salvaged by buyers who subsequently sold the entitlements associated with them to the Commonwealth while sustaining the orchards through allocation purchases. Despite these disruptions, as is discussed in Chapter 5, horticultural plantings continued to expand before, during and after water recovery.

3.4 WATER RECOVERY UNDER THE BASIN PLAN

Water recovery under the Basin Plan commenced in 2007/08 with a small volume of buyback, which was the main vehicle for water recovery through until 2011/12 (Figure 14). After that infrastructure efficiency savings, which had commenced in 2010/11, became the main vehicle for recovery. Because many different types of entitlement were recovered, the total volumes of recovered water are expressed here using long-term annual average yield (LTAAY) in megalitres (ML) as the equilibrating unit of account.

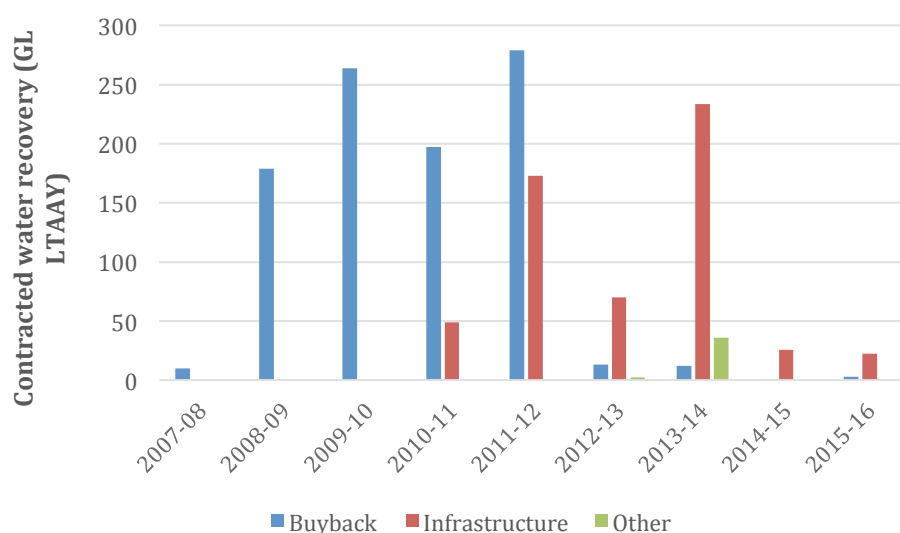


Figure 14: Contracted water recovery (ML LTAAY) across the southern MDB

Note: The timing of contracted water recovery may differ from the timing of when ownership of water entitlements are transferred to the Commonwealth. For example, although the majority of buyback was contracted in the four years 2008/09 to 2011/12, the majority of this was transferred to Commonwealth ownership during the three years 2009/10 to 2011/12. Source: Pers. comm., DAWR, 16th September 2016.

Appendix 2 includes a full table of water recovery progress by entitlement type (separating buyback and infrastructure projects). It is important to note that the Commonwealth records water recovery as taking place when the vendor contracts to transfer the water. By contrast, the Victorian Water Register records recovery as taking place when the transfer occurs, sometimes in the following year. Therefore the graphs in this chapter refer variously to ‘contracted water recovery’ when using Commonwealth data and ‘transfer of ownership’ when using Victorian data.

BUYBACK

Figure 15 shows that Victorian high reliability water shares account for the bulk of water recovered through buyback in the southern-connected Basin.

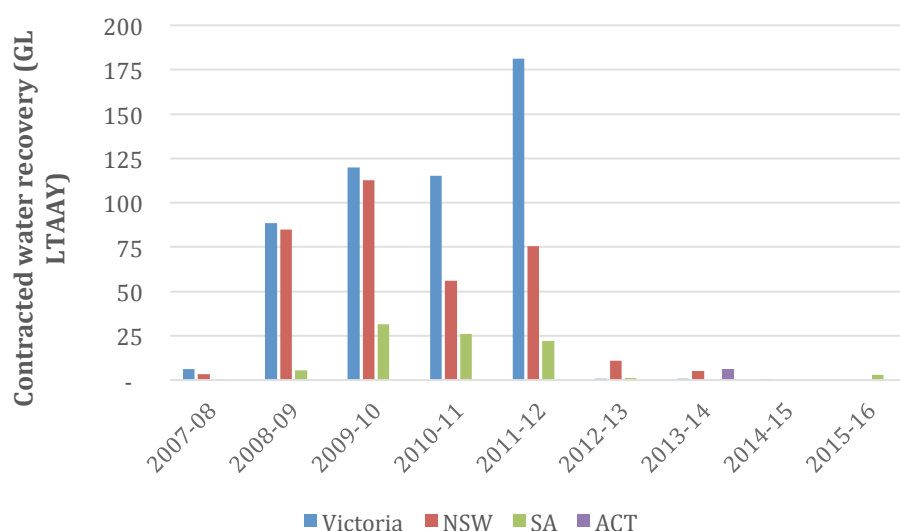


Figure 15: Contracted water recovery through buyback (ML LTAAY) in the southern MDB

Note: In addition, 22.5GL LTAAY was purchased from the Wimmera and Murray Irrigation Irrigator Led Group Proposals (<http://agriculture.gov.au/water/markets/commonwealth-water-mdb/progress-water-purchases>). It should be noted that the 'ACT' buyback volume was of NSW Murrumbidgee entitlement.

Source: Pers. comm., DAWR, 16th September 2016.

This difference in buyback volumes between states is more pronounced when only high reliability entitlements are considered. Figure 16 compares these on a LTAAY basis in order to recognise that NSW high security entitlements are more reliable than Victorian high reliability water shares and South Australian water access entitlements. Their LTAAY is therefore higher.



Figure 16: Contracted water recovery of high reliability entitlements (ML LTAAY)

Source: Pers. comm., DAWR, 16th September 2016.

The buyback of water entitlements occurred through tender mechanisms so these water purchases also represent a large amount of reimbursement to the entitlement holders. Across the entire MDB, buyback over the period to 2007/08 to 2013/14 has involved over 4500 trades totalling nearly \$2.3 billion.⁶

As discussed, the Victorian Water Register records the date that individual water shares are transferred to the Commonwealth (rather than the date the transfer is contracted as shown in Figure 16). The register data in Figure 17 shows that GMW’s customers with Goulburn water shares accounted for the largest volume of Victorian entitlements transferred to the Commonwealth. GMW’s customers with Murray entitlements were the next largest followed by LMW’s customers with Murray entitlements. Entitlements from tributaries other than the Goulburn accounted for very small proportion of the total entitlement volumes transferred to the Commonwealth. This means that that vast majority of buyback came from GMW customers.

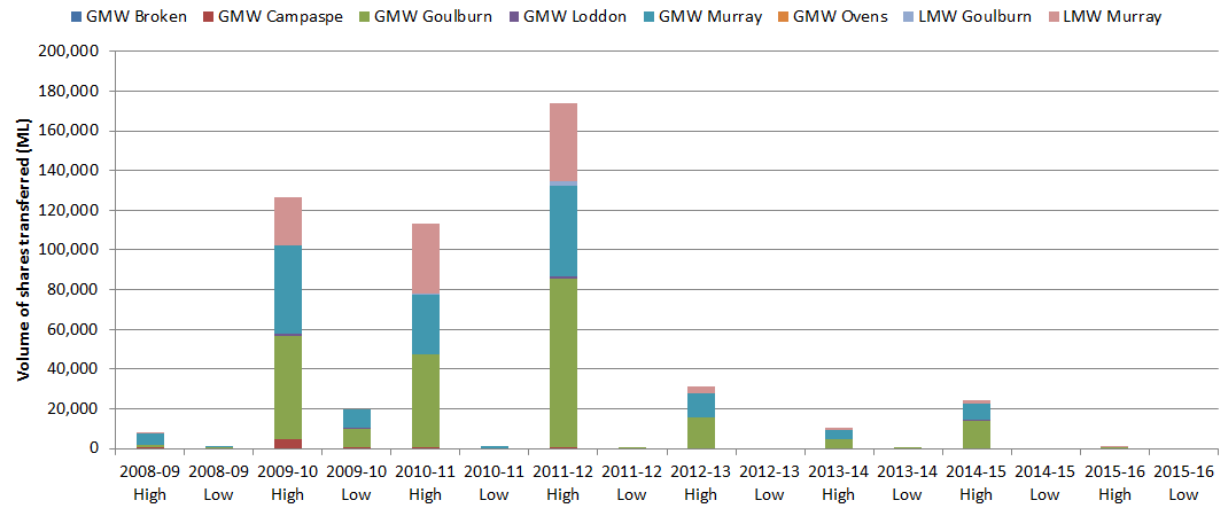


Figure 17: Transfer of ownership of high and low reliability Victorian water shares to the Commonwealth, broken down by water authority and water system

Source: pers comm., DELWP, 13 October 2016.

Put differently, Figure 18 shows that the vast majority of Victorian water shares transferred to the Commonwealth were formerly associated with land in GMW districts. The implications of this are explored in Chapter 8.

⁶ MDBA 2014, Basin Plan annual report 2013-14.

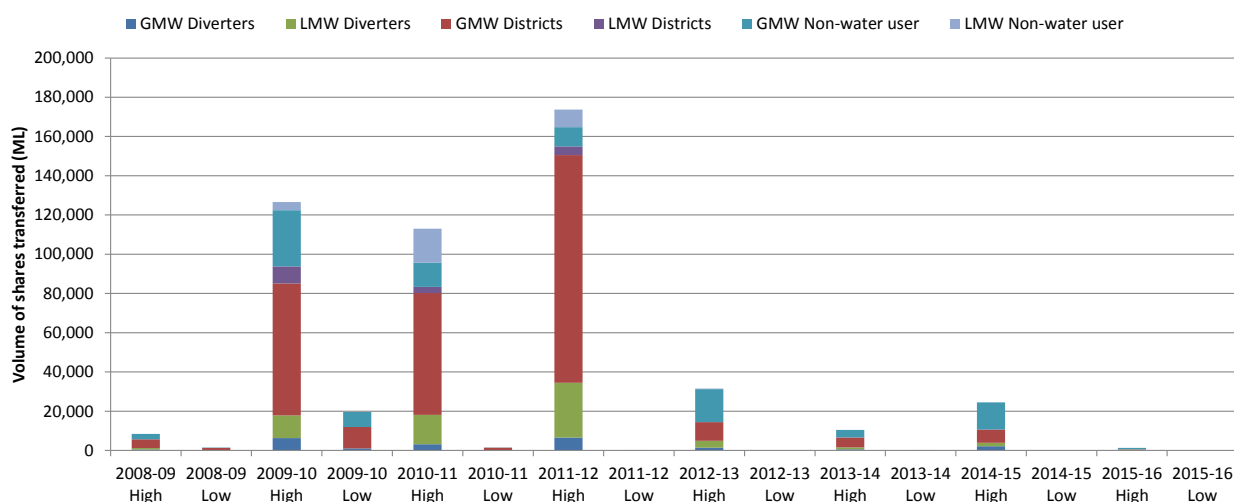


Figure 18: Transfer of ownership of high and low reliability Victorian water shares to the Commonwealth, broken down by grouped delivery system

Source: pers comm., DELWP, 13 October 2016.

ABARES farm survey data (ABARES, n.d.) also indicates that entitlement sales from dairy farmers were higher than those purchased from other types of farmers (Figure 19). This is consistent with Figure 20 which identifies the dairy industry as having the highest proportion of farmers selling entitlement. And as discussed in Chapter 6 of this report most dairy farmers in the southern-connected Basin are in GMW’s districts. It should be noted that the ABARES data is from a survey of a sample of farms and not the entire population; therefore ABARES results are not as comprehensive as the water register data. Although this measures all entitlement sales, rather than only those to the Commonwealth, it is reasonable to assume that this is representative of the industry source of buyback volumes.

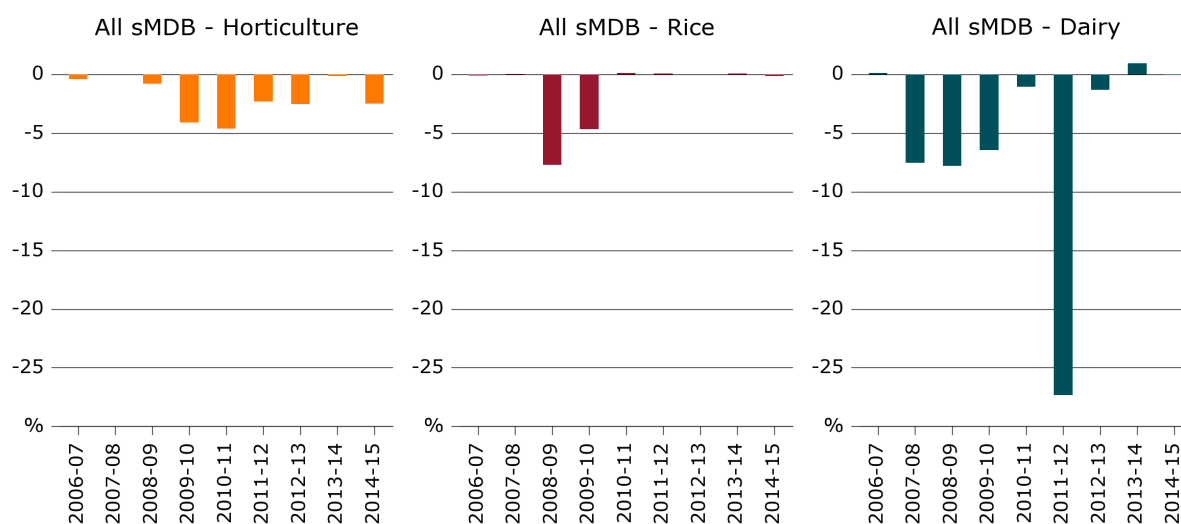


Figure 19: Average net water entitlement trade as percentage of entitlements held for farms in the southern MDB (2006/07 to 2014/15)

Source: (ABARES, n.d.)

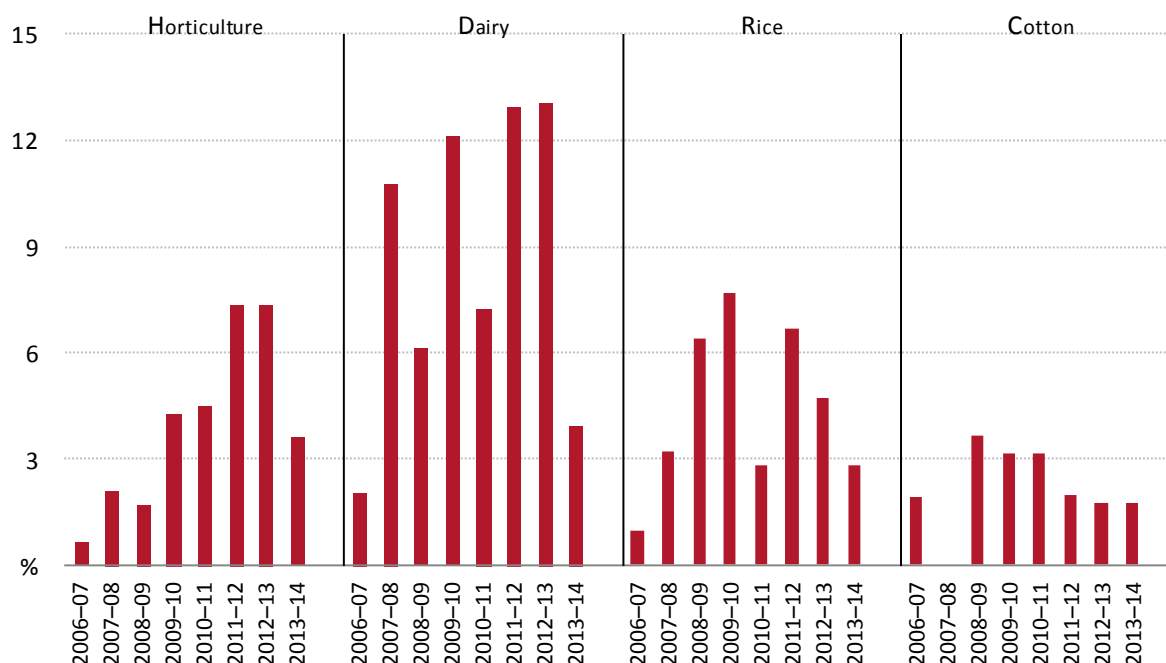


Figure 20: Proportion of farms selling permanent water entitlements, Murray–Darling Basin, 2006–07 to 2013–14

Note: Water trade data not available for 2014–15.

Source: ABARES 2015.13 from Murray–Darling Basin Irrigation Survey

It is important to note that the sale of entitlement from a particular region or industry does not necessarily mean that water use in that region or industry will reduce to the same degree. Water trading allows the sellers to buy entitlements and allocations in order to maintain their existing use in part or in full if they wish to do so, provided the marginal costs of so doing are less than the marginal benefits.

Overall however, the effect of buyback is to reduce the consumptive pool. This view is consistent with ABARES (2016, p. 20), which states “entitlements that are purchased by the government reduce the supply of allocations available for irrigation users (assuming allocations are used for environmental flows and not traded back to irrigators).

In total the cumulative buyback amounts to more than 956GL LTAAAY across the southern MDB (Figure 21). The vast majority of this was contracted by 2011/12. The vendors were free to use the proceeds of these sales to exit farming, reduce debt or adapt their farming systems either through increased water efficiency, or adopt more flexible production systems.

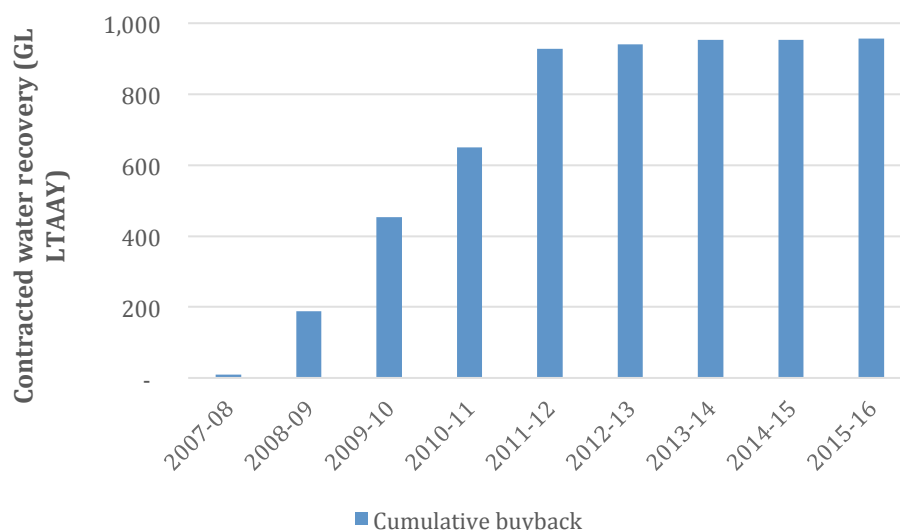


Figure 21: Cumulative buyback 2007/08 to 2015/16 (ML LTAAY) in the southern MDB

Source: Pers. comm., DAWR, 16th September 2016.

WATER RECOVERY THROUGH IRRIGATION INFRASTRUCTURE PROJECTS

Apart from buybacks, the Commonwealth's Sustainable Rural Water Use and Infrastructure Program, which was set up to be the key mechanism to 'bridge the gap' to the SDLs, also included irrigation infrastructure projects. The majority of its infrastructure funds are committed to projects for improving the operation of off-farm delivery systems, but funds are also invested in incentives for irrigators to improve their on-farm water use efficiency. The water savings generated from these projects are shared between the Commonwealth Government for environmental use, and irrigators for consumptive use.⁷

In the southern-connected Basin, the bulk of contract water recovery through infrastructure projects has been in NSW regions (Figure 22). Because it does not differentiate between the impacts of off-farm and on-farm infrastructure projects the Commonwealth does not separately report the volumes recovered through each type. As will be elaborated further below (as well as in Appendix 3), we consider these two types of projects to have different impacts, and have therefore sought to distinguish the volumes recovered through each approach.

⁷ <http://agriculture.gov.au/water/mdb/programmes/basin-wide/srwiup> accessed on 13 October 2016

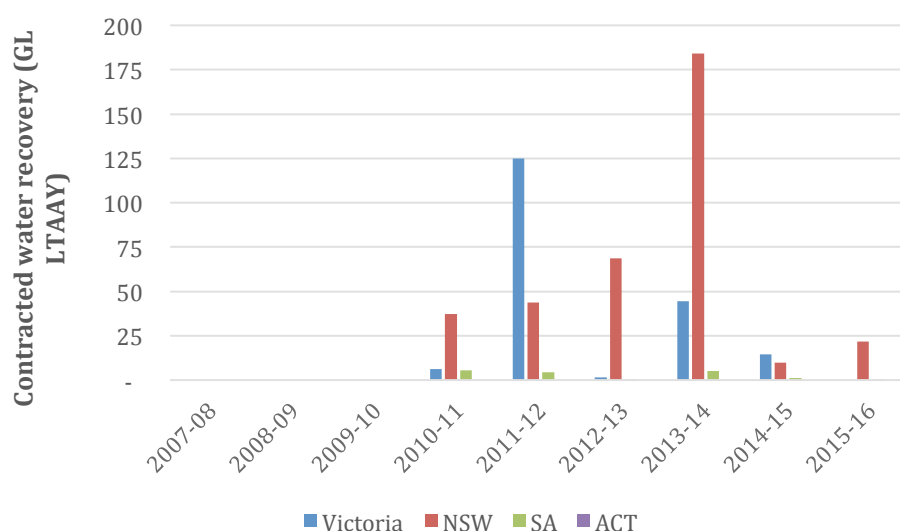


Figure 22: Infrastructure water recovery (ML LTAAY) in the southern MDB

Note: The timing of contracted water recovery may differ from the timing of when ownership of water entitlements is transferred to the Commonwealth.

Source: Pers. comm., DAWR, 16th September 2016.

Off-farm infrastructure projects

Where NSW projects recover conveyance entitlements, we assume that they are off-farm infrastructure projects.

Access to Victorian Water Register data enables the tracking of Victorian off-farm water recovery. The Victorian water accounting framework is such that losses are covered in the 'wholesale' water accounts, and all savings must be converted into water shares in the 'retail' water accounts before they can be transferred to the Commonwealth.

For South Australia, a Draft Water Allocation Plan for the River Murray Prescribed Watercourse has been released for public consultation. This proposed plan adopts consumptive pools instead of the current entitlement classes.

Table 4 shows the estimated off farm infrastructure savings recovered from each state in terms of LTAAY.

Table 4: LTAAY (GL) recovered from off-farm infrastructure savings in each state

NSW (GL)	Victoria (GL)	South Australia (GL)	Total (GL)
^	75*	^	^

Notes: ^ Information separating off-farm and on-farm infrastructure savings was not identified.

* Estimate only as water savings in some programs are yet to be confirmed. Almost all savings in Victoria have been HRWS

On-farm infrastructure projects

In general, on-farm projects seek to enhance water efficiency so that production levels can be maintained with reduced volumes of irrigation water. Water savings are shared between individual irrigators and the Commonwealth. The irrigator retains more entitlement than would have been required to maintain production. In such cases the irrigator is free to expand production or sell the surplus entitlement or sell the allocations against it.

There is no doubt that these projects have provided a range of benefits to participating irrigators. This is borne out by the participant profiles published on Goulburn Broken CMA's website.⁸ These benefits are discussed in more detail in Chapter 4. The issue considered in this section of the report is their long-term impacts on the consumptive pool.

The first thing to note about on-farm projects is that the Commonwealth is willing to pay a premium above the market rate per ML for on-farm savings. This provides a potential incentive for participants to engage in arbitrage to replace the water given to the Commonwealth in order to increase production on the more efficient irrigation layout. DELWP and the Goulburn Broken CMA have taken steps to minimise this potential, nonetheless Vignette 1 in MDBA (2016a) (a fuller excerpt of which is reproduced in Appendix 3) suggests there may have been instances of arbitrage.

We're saving water but we're being more intense and more productive. Because we're using it more efficiently and being more profitable that drives us to want more water to do more things. It has that driving effect. We gave water back but we went straight back to the market and bought it again.

If a participant were to take advantage of arbitrage to replace the water recovered for the environment, the net effect on the consumptive pool would be the same as direct buyback by the Commonwealth.

More importantly however, if water efficiency is improved on-farm but the seasonal conditions are so dry that the farm in question would not be irrigated and instead the irrigator were to sell allocations, then the volume of allocations put on to the market would be lower than it would otherwise be. The volume of the savings given to the Commonwealth would therefore reduce the volume of the consumptive pool in dry and extremely dry years.

For our analysis, we consider it valid to assume that on-farm water savings have similar characteristics to off-farm water savings in wet-to-average years. In dry and extreme dry years the on-farm projects reduce the consumptive pool. Given the average to wet water availability conditions that have prevailed since these programs commenced, with the notable exception of 2015/16, on-farm efficiency measures may not, in effect, have significantly reduced the consumptive pool.

⁸ https://www.gbcma.vic.gov.au/sustainable_irrigation/farm_water/participant-profiles Accessed on 15 January 2017

ABARES (2016, p. 20) makes the following observation:

... Investments in on or off-farm infrastructure reduce losses (to evaporation, seepage and so on). Under the Murray–Darling Basin Plan programmes, at least 50 per cent of these water savings are returned to the Commonwealth, with the remainder returned to entitlement holders. As such, the net effect of infrastructure projects should be to increase the volume of water available for use and/or to improve farm water use efficiency (by an amount greater than any environmental water recovery)—both of which would lead to lower water prices.

However, infrastructure projects can also help farmers achieve improvements in productivity. General improvements in irrigation farm productivity and profitability may result in increased demand for water. Thus, the precise effect of infrastructure projects on the water allocation price is difficult to measure, although the overall effect on the allocation price is likely to be downward because of the water savings achieved.

Similarly, Aither (2016b), in considering anecdotal evidence about these issues, makes an important first-principles observation:

There are anecdotal accounts that some irrigators have reduced their demand for allocations as a result of on-farm efficiency programs, whereas others have increased their demand. This is consistent with economic theory, which suggests that the ability to deliver water more efficiently to the crop has two opposing incentive effects, one to reduce water use and the other to increase water use, and that the relative strength of these effects will depend on the circumstances of individual irrigators. At this stage, there is insufficient empirical evidence to determine the overall impact on demand for allocations across the market. However, it is plausible that the price impacts of future on-farm efficiency programs could be as large as, or larger than, equivalent Commonwealth environmental water purchases. This is an area for further research.

In considering the overall impact of water recovery to date on the consumptive pool (both for Victoria and for the southern-connected Basin as a whole), the focus of our analysis is on the impact of irrigators foregoing the use of the allocations against the entitlements recovered for the environment. In dry years, that includes the allocations against entitlements gained in return for on-farm efficiency measures as well as entitlements obtained through buyback. Unfortunately, however there is no published data about how much water has been recovered through on-farm efficiency measures.

We would welcome the MDBA doing further work in testing our assumptions and in considering ABARES' and Aither's observations in this regard. For our part we endeavoured to analyse water register data for those irrigators who participated in on-farm efficiency savings to compare their water use before and after their participation, but this proved to complex to achieve in the time available to us.

It is important to note here that for the purposes of this report we assume that the Commonwealth will continue its policy of excluding the Commonwealth Environmental Water Holder (CEWH) from actively participating in the water market, apart from buyback. For that reason we consistently treat water recovery as a reduction in the consumptive pool. If the CEWH were to trade water, the recovery would be more accurately described as an increase in demand.

3.5 THE COUNTERFACTUAL – WATER USE IN THE ABSENCE OF THE BASIN PLAN

The approach to estimating what water use would have been *but for* the Basin Plan water recovery considers three components:

- observed water use in each year
- allocations to buyback volumes — it is assumed that the annual allocations made to entitlements purchased by Government under the buyback would otherwise have been allocated to and used by irrigators
- an estimated change to net trade — Because observed water use includes volumes traded in, it needs to be recognised that some of this trade in would not have occurred absent the reductions in allocations associated with the lower level of entitlements held after buyback. Victoria has been a net importer of water allocation in most years during the water recovery and part of the reason for this net import may be using trade as a means to adjust to the changes in the consumptive pool. This is consistent with the net trade pattern observed prior to water recovery where Victoria would be a net importer in response to reduced water availability (NWC, 2009). Net trade was adjusted by the proportion of the environmental buyback allocation volumes compared to observed water use.

The sum of these three components is the estimated counterfactual water use. (Other counterfactual socio-economic issues are considered in Chapter 10.) Carryover use (i.e. risk management) may have also been different as a result of the water recovery program, although this has not been quantified.

Table 5 sets out the elements of this calculation, and a comparison with observed northern Victorian irrigation water use is in Figure 23 below.

Table 5: Observed and counterfactual water use

	2004/05	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Observed water use (GL)	2,150	924	1,135	751	1,731	2,402	1,857	2,033	1,762
Allocation to buyback (GL)	0	2	80	219	340	516	517	518	492
Change to net trade (GL)	0.0	-0.5	-4.6	-71.5	1.6	31.4	-54.0	-15.3	-62.2
Counter-factual water use (GL)	2,150	926	1,210	899	2,073	2,950	2,320	2,535	2,192
Difference between counter-factual and observed (GL)	0	-2	-75	-148	-342	-548	-463	-502	-430

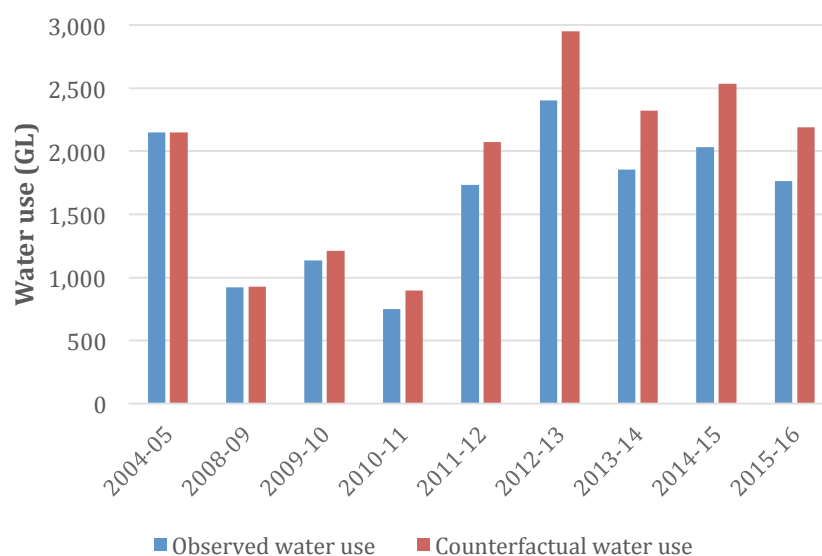


Figure 23: Observed and counterfactual water use (Victoria)

Due to the relatively fixed water demands of horticulture (discussed further in section 5.5), it is assumed that LMW’s diverters or districts would not have used this additional water. The larger volumetric change in water use are likely to have been in GMW districts (where dairy and cropping can use additional volumes). The chart below shows the expected change to water use in GMW districts. It should also be noted that the reduced net trade into Victoria is likely to have been applied to rice crops in the Riverina.

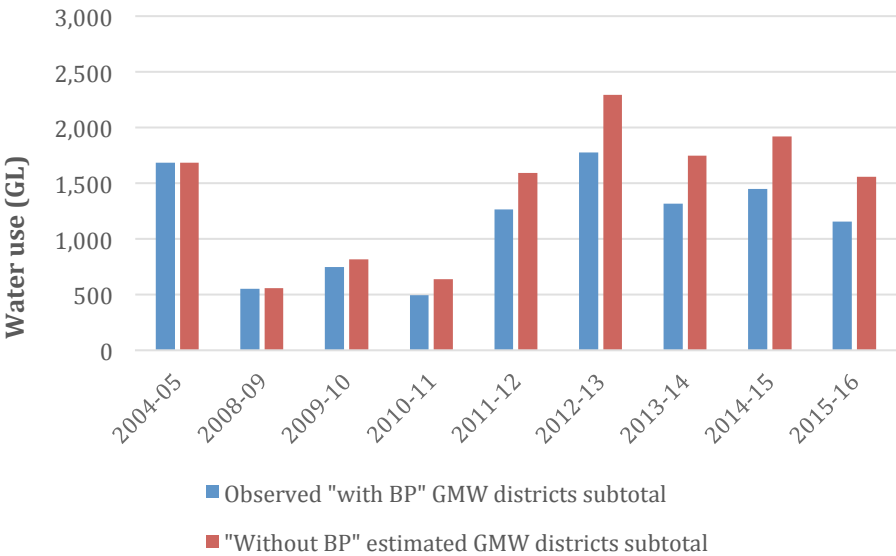


Figure 24: Observed and counterfactual water use (GMW districts)

Given the variability observed in GMW diverters, the counterfactual water use is also expected to be higher.

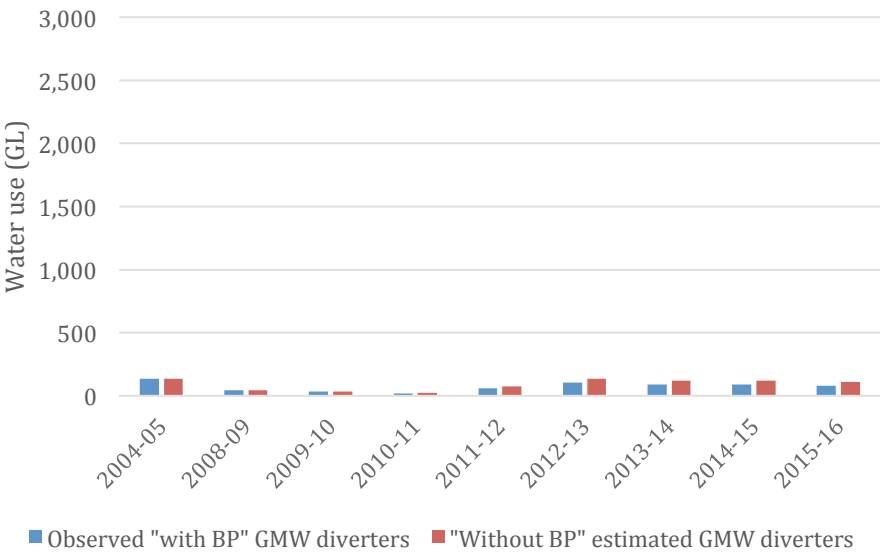


Figure 25: Observed and counterfactual water use (GMW diverters)

3.6 SUMMING UP

Irrigation water use in northern Victoria varied markedly over the last ten years. Buyback commenced at the height of the drought and finished at a time when water allocations combined with carryover volumes could sustain use in excess of entitlement volumes for four years in a row.

Off-farm infrastructure savings do not reduce the consumptive pool. By contrast, while on-farm water savings have similar characteristics to off-farm water savings in wet-to-average years. In dry and extreme dry years the on-farm projects reduce the consumptive pool. Given the average to wet conditions that have prevailed since these programs commenced, with the notable exception of 2015/16, on-farm efficiency measures may not, in effect, have significantly reduced the consumptive pool. As will be described several times in later chapter that one dry year is important to understand in terms of the socio-economic impacts of the Basin Plan.

In the absence of the Basin Plan, water use by horticulturalists, including LMW diverters and LMW district irrigators would have been the same as what has been observed since the Plan commenced. Water use in the GMID and by GMW diverters would have been higher.

4 THE IMPACTS OF THE BASIN PLAN AT THE FARM SCALE

4.1 OVERVIEW

Much of the discussion about water recovery revolves around the impacts at the farm scale. It is at this scale that vendors receive payments in return for transferring their entitlements to the Commonwealth. And it is at this scale that irrigators invest in on-farm infrastructure savings in return for transferring part of the savings to the Commonwealth.

This chapter begins with an overview of the MDBA's preferred approach for evaluating the socio-economic impacts of water recovery at this scale, before discussing the benefits at the farm scale. It then provides empirical evidence of the observed, after the fact, water market behaviour of Victorian irrigators who participated in the buyback to determine the extent to which the buybacks have "assisted [them] to transition to the Sustainable Diversion Limits". This data from the Victorian Water Register is then compared with data from the ABARES Farm Surveys (ABARES, 2015).

An analysis of the assumptions implicit in the vendors' acceptance of the prices at which buyback occurred is then followed by an examination of the trends in reported water use per hectare for different industries.

4.2 THE MDBA'S PREFERRED APPROACH TO SOCIO-ECONOMIC EVALUATION

The Basin Plan evaluation framework (MDBA 2014c) outlines how the MDBA will work with partner governments and the community to evaluate the implementation of the Basin Plan. Figure 26 is an excerpt from the MDBA socio-economic evaluation regarding elements of 'productive and resilient industries and communities' (MDBA, 2014c p. 4). Figure 27 shows its sample evaluation questions (MDBA, 2014c, p. 7).

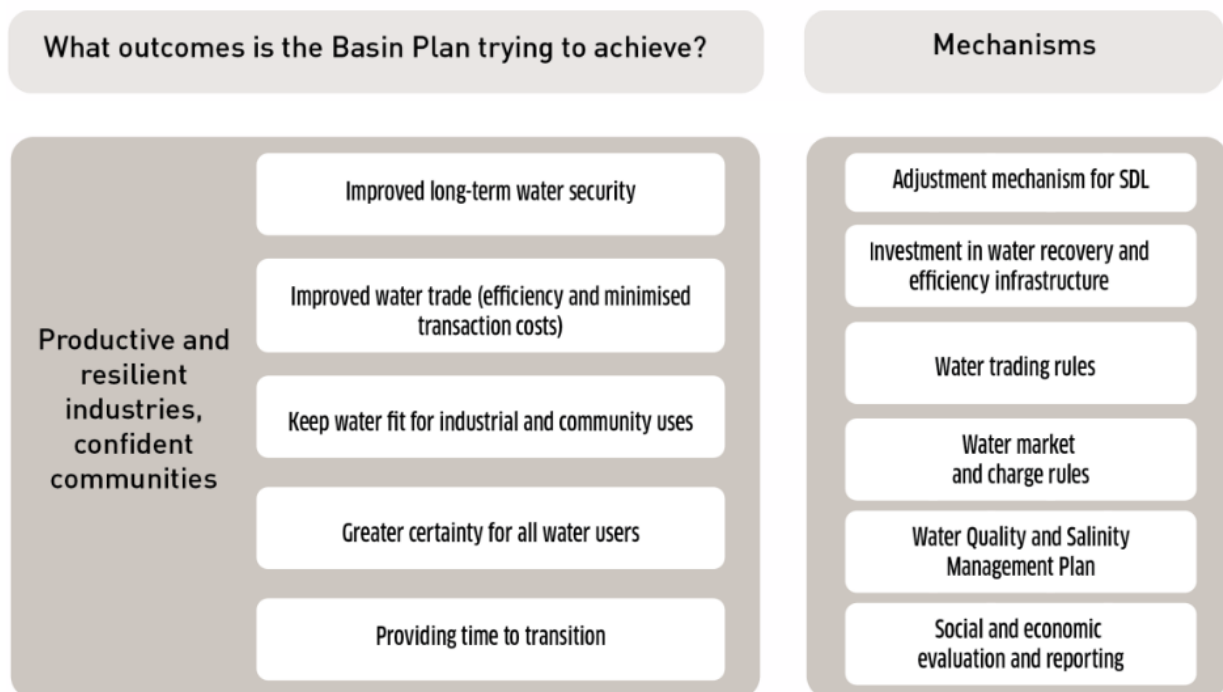


Figure 26: The MDBA's expected outcomes from the Basin Plan

Source: MDBA 2014c.

Outcome	Sample evaluation questions
Productive and resilient industries, confident communities	What have been the social and economic benefits and costs to water-dependent industries, from the implementation of the Basin Plan?
	What have been the social and economic benefits and costs to Basin communities, and the nation more broadly, from the implementation of the Basin Plan?
	Were there any unexpected or unintended social or economic consequences arising from the Basin Plan?
	To what extent have infrastructure investments and buybacks assisted communities and industry to transition to the Sustainable Diversion Limits?
	Has the Basin Plan provided greater certainty for industries and communities?
	What are the major factors that have enabled or constrained the capacity of industries and communities to respond to the Basin Plan and to achieve intended Basin Plan outcomes?
	What have been the social and economic benefits (including ecosystem service benefits) associated with improved environmental outcomes?
	How have the different components of the Basin Plan interacted as a package to help water-dependent industries and communities to adapt to reduced water for consumption?

Figure 27: The MDBA’s sample socio-economic evaluation questions

Source: MDBA 2014c.

These questions are linked together by a chain of logic expected from Basin Plan water reform mechanisms that were specifically designed to achieve social and economic outcomes. The MDBA’s preferred approach to the analysis of the socio-economic impacts of the Basin Plan is to compare what *has happened* with what *would have happened* if the Plan did not exist, taking into account the influences of factors other than the Basin Plan. This is the approach adopted for this report.

4.3 BENEFITS OF WATER RECOVERY AT THE FARM SCALE

As is elaborated in more detail in Chapters 5, 6 and 7, there have been undoubted benefits at the farm scale for irrigators who participated in the buyback. The money invested in the buyback aided structural adjustment in response to the drought and in response to the collapse in the wine industry. And without it there would now be more dairy farmers grappling with low milk prices. It is also

possible that buyback helped to forestall a serious disruption to horticultural expansion by LMW diverters.

As evidenced by the Participant Profiles on Goulburn Broken CMA's website (which were referenced above in Section 3.4), the investment in on-farm efficiency measures has also helped many irrigators save time and money in their farming operations. Some quotes from those profiles are reproduced below.

Graeme Nurse of Stanhope described the following benefits:

The work needed to be done and it would have taken me 10 to 12 years to do otherwise. There's no doubt we're more efficient – we're using less water and saving time and labour. The work has definitely at least doubled the value of the property – it's so much easier to run.

Vin Warnock of Goomalibee experienced the following benefits:

After years of drought and poor milk prices it's been a bit tight (financially). Things are turning around, but they're turning around very slowly. This funding has allowed me to carry out work now that I probably couldn't have afforded to do at this time otherwise.

Bill Gread of Katunga (among others) sees the benefits extending beyond the farm gate as well:

I reckon this Goulburn-Murray region is a golden region – a real Garden of Eden – but because of the drought, we were watching it wither before our eyes. This modernisation work and extra funding for on-farm work is completely reinvigorating the region, it's given us all a new lease on life.

Bill Gread's observations suggest that there are synergistic benefits, at the farm-scale, from the Commonwealth's investment in both on-farm and off-farm efficiencies. As will be discussed in more detail however in Chapter 8, the off-farm investment has tended to work at cross-purposes with the buyback.

4.4 OBSERVED EX-POST BEHAVIOUR OF VICTORIANS WHO PARTICIPATED IN THE BUYBACK

To support the production of this report, DELWP staff analysed the water holding and water use records for a sample (11% of the total population) of those irrigators who sold water entitlement to the Commonwealth, but continued to irrigate.

Because water use varies from year to year, their pre-sale water availability and water use was compared with their water availability and use in the 2015/16 year – which was judged to be the first year of use not masked by the extraordinarily high volumes of carryover made available in the La Nina years (DELWP, 2016a). This separated the sample into three groups depending on the year they sold to the Commonwealth: 2008/09, 2009/10 or 2010/11.

The sample was stratified according to the size of their original holdings and this was compared to a similar stratification of the total population. The 2008/09 sample represented the population well, the later years had a slight overrepresentation of small volume sales.

Before sale to the Commonwealth, the irrigators in the sample were reliant on the allocations that accrued to their entitlement. Many also traded water and were net purchasers of water allocations (66-69% for 2008/09 and 2009/10 sellers, and 29% for 2010/11 sellers). After the sale of entitlement to the Commonwealth, many changes to water sourcing decisions occurred:

- Many irrigators had sold all of their original entitlement (only 61-74% of the sample of irrigators from each year of selling still received allocations to their pre-buyback entitlement)
- Many had purchased new entitlements (37-49% of the sample of irrigators from each year of selling received allocations to new entitlements purchased)
- The proportion of net purchasers of water allocations increased:
 - from 69% to 77% for 2008/09 sellers of entitlement under buyback
 - from 66% to 78% for 2009/10 sellers of entitlement under buyback
 - from 29% to 63% for 2010/11 sellers of entitlement under buyback
- The reliance on water allocation purchases increased:
 - from 11% of water available to 52% across the sample of 2008/09 sellers
 - from 12% of water available to 39% across the sample of 2009/10 sellers
 - from -3% of water available to 26% across the sample of 2010/11 sellers

The key results are summarised in the following charts.

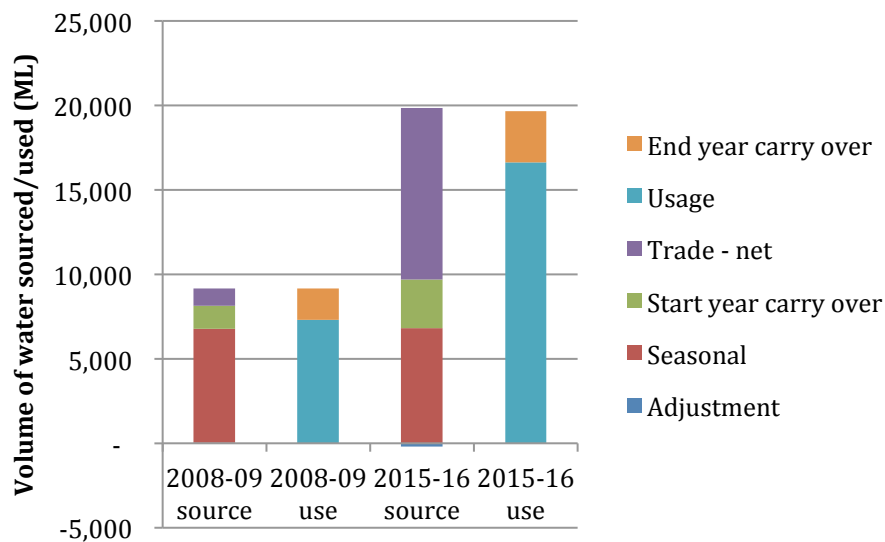


Figure 28: Volumetric water sourcing and use before and after selling entitlements to the Commonwealth (for sample of sellers who participated in 2009/10 buyback)

Source: pers. comm. DELWP 2016.

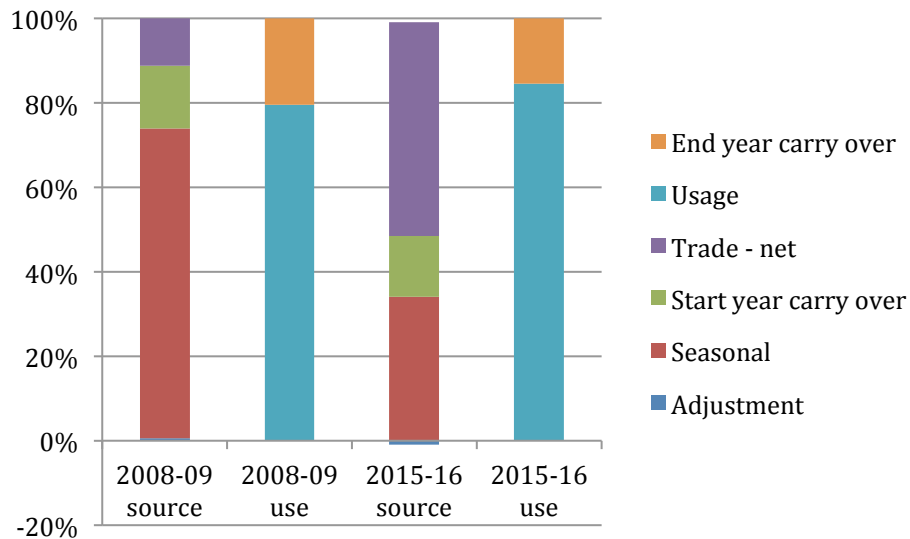


Figure 29: Percentage water sourcing and use before and after selling entitlements to the Commonwealth (for sample of sellers who participated in 2009/10 buyback)

Source: pers. comm. DELWP 2016.

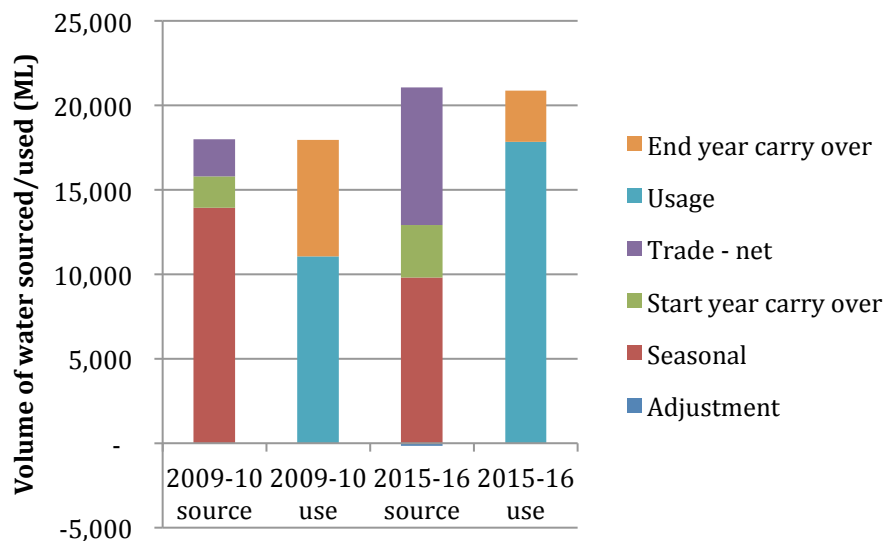


Figure 30: Volumetric water sourcing and use before and after selling entitlements to the Commonwealth (for sample of sellers who participated in 2010/11 buyback)

Source: pers. comm. DELWP 2016.

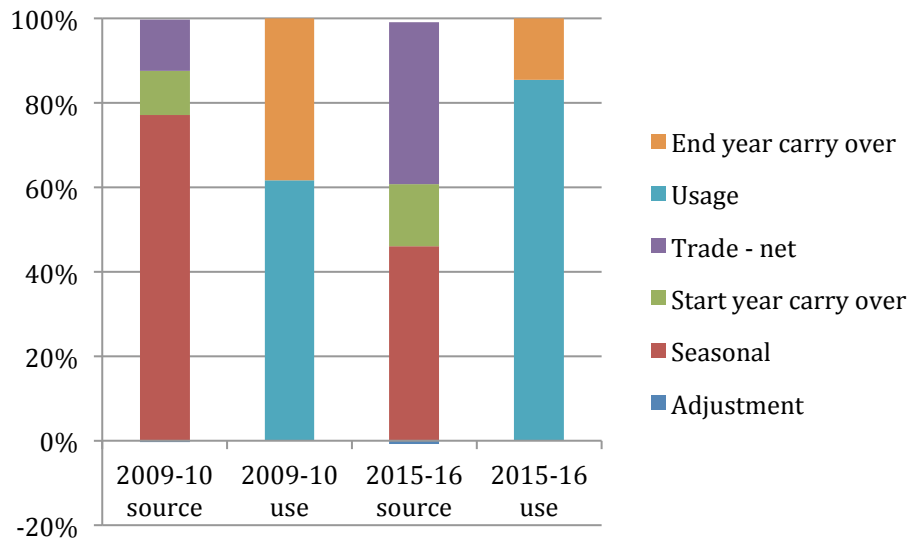


Figure 31: Percentage water sourcing and use before and after selling entitlements to the Commonwealth (for sample of sellers who participated in 2010/11 buyback)

Source: pers. comm. DELWP 2016.

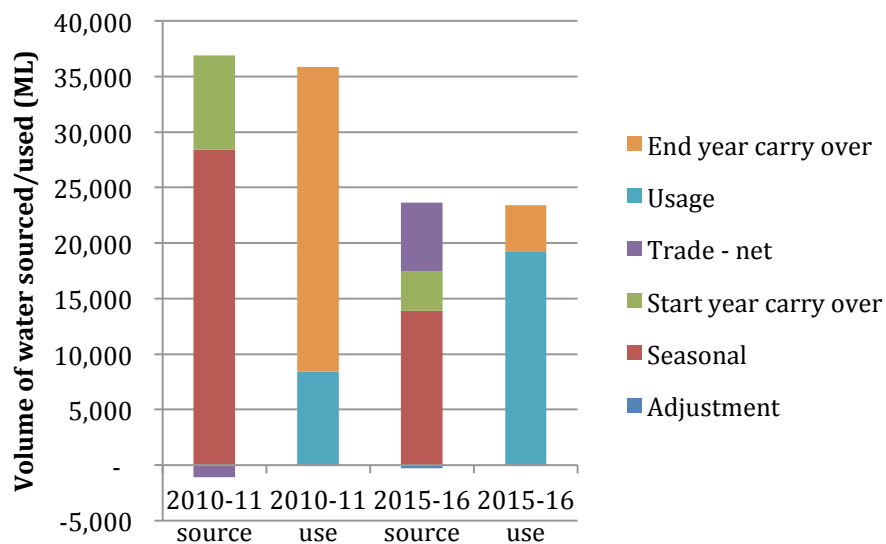


Figure 32: Volumetric water sourcing and use before and after selling entitlements to the Commonwealth (for sample of sellers who participated in 2011/12 buyback)

Source: pers. comm. DELWP 2016.

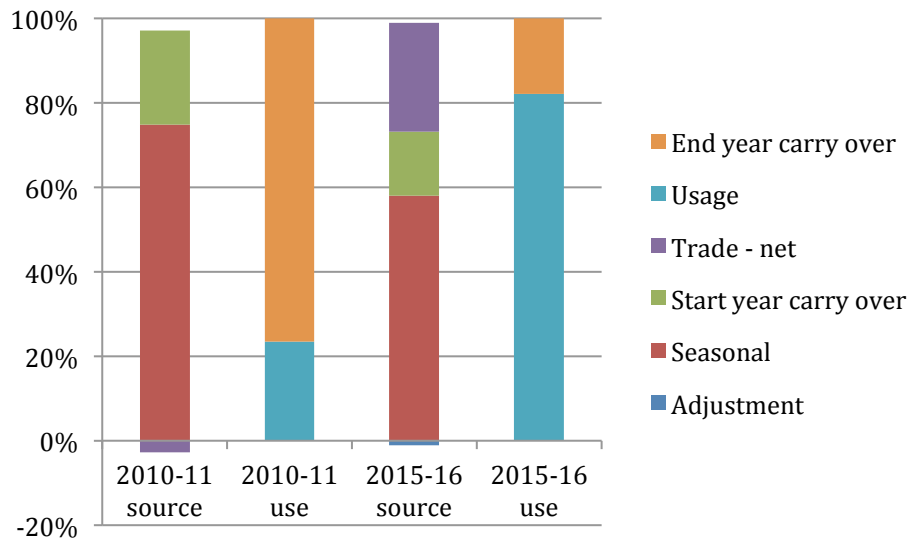


Figure 33: Percentage water sourcing and use before and after selling entitlements to the Commonwealth (for sample of sellers who participated in 2011/12 buyback)

Source: pers. comm. DELWP 2016.

4.5 CORROBORATING EVIDENCE FROM ABARES FARM SURVEYS

Results from ABARES Farm Surveys corroborate the above analysis with respect to dairy farms. ABARES (2015) found:

In 2012–13 and 2013–14 the proportion of dairy farmers trading water increased significantly as a result of permanent water access entitlement sales and a change in business and risk management strategies. Many farmers had sold water access entitlements and, subject to price, opted to purchase temporary water as required

... Some dairy farmers at the workshop indicated this was because of changes in business strategy to source water from temporary markets rather than holding permanent entitlements

... Some dairy farms now have no or few permanent water entitlements and completely rely on the temporary water market.

In the years after the bulk of buyback had occurred, the majority of dairy farms surveyed by ABARES were net buyers in the allocation market. In 2012/13 and 2013/14, around 60% of farms were net buyers.



Figure 34 Percentage of dairy farms by allocation water trading activity, Murray–Darling Basin, 2006–07 to 2013–14

Note: Net buyers/sellers are farms that bought/sold more water than they sold/bought. Survey estimates for water trading are not available for 2014–15.

Source: ABARES 2015.

This is in contrast to horticultural farms in the MDB, many of which were net buyers of water allocations during the drought, but have not been observed to be as active in water allocation purchases in the years since the bulk of buyback occurred. ABARES (2016) presents the proportions of horticultural farms that were net seller of citrus and pome and stone fruits, however does not report similar information on other types of horticultural farms that were net sellers of grapes or nuts.

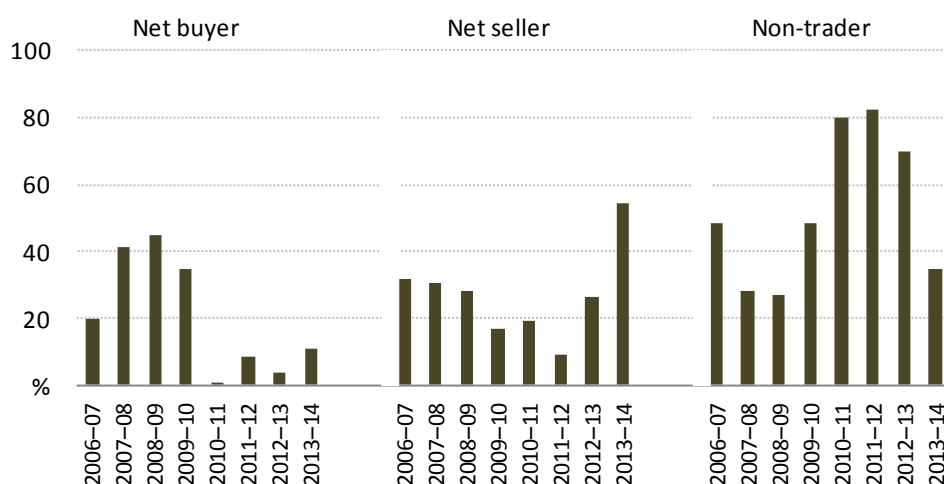


Figure 35 Percentage of citrus farms by allocation water trade group, Murray–Darling Basin, 2006–07 to 2013–14

Note: Net buyers/sellers are farms that bought/sold more water than they sold/bought.
Source: ABARES 2016

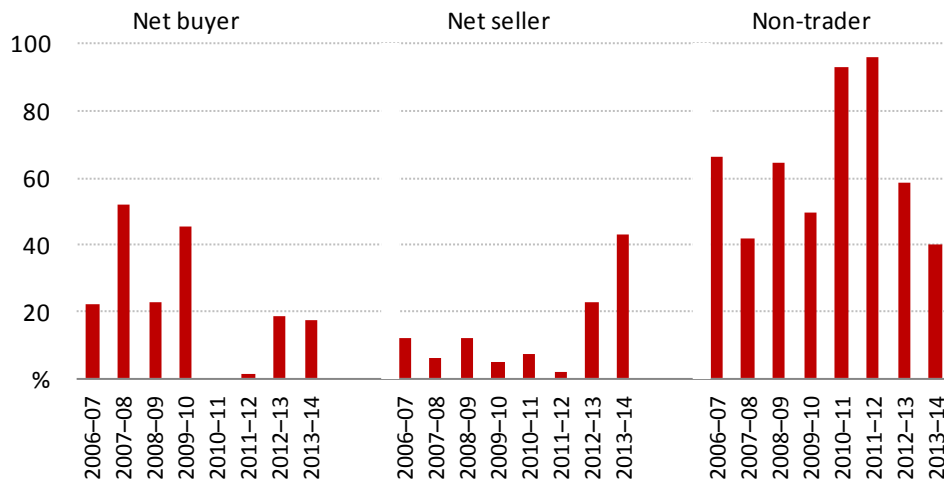


Figure 36 Percentage of pome and stone fruit farms by allocation water trade group, Murray–Darling Basin, 2006–07 to 2013–14

Note: Net buyers/sellers are farms that bought/sold more water than they sold/bought.
Source: ABARES 2016

4.6 AN ANALYSIS OF THE ASSUMPTIONS IMPLICIT IN THE VENDORS' ACCEPTANCE OF THE PRICES AT WHICH BUYBACK OCCURRED

The decision to sell water entitlements and rely instead on water allocation purchases introduces the farm enterprise to water price risk — which will benefit the business if water allocation can be purchased cheaply but will reduce profitability if water must be secured at high allocation prices. A simple comparison can be made between:

- The interest saved by selling entitlement and retiring farm debt.
 - For example, if the Victorian HRWS was sold for \$2400 per ML during the buyback and the interest rate on the business loan is 6%, then the interest saving is \$144 per ML sold.⁹
- The water allocation price.
 - From the water allocation prices presented in the figure below, the strategy to generate interest savings of \$144 per ML could have been profitable in every year after buyback until 2015/16. In 2015/16, prices were generally in excess of \$200 per ML (Figure 37).

⁹ It is important to note that this analysis is conservative; irrigators with high levels of indebtedness would be paying much higher interest rates than 6%.

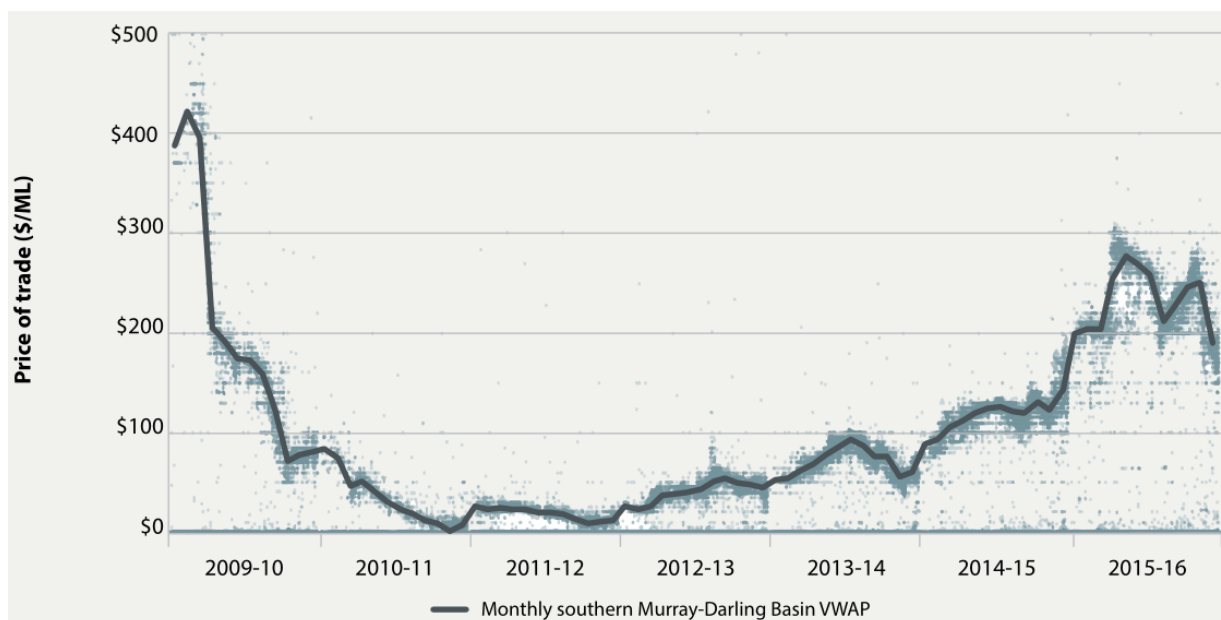


Figure 37: Water allocation prices in the southern-connected Basin

Source: Aither 2016c.

The relative benefits and costs would be different for those that participated in the 2013/14 buyback tender where the average price for Goulburn HRWS was \$1600 per ML (DAWR, 2016a). At a business loan interest rate of 6%, this would imply a cut off price of \$96 per ML. It is important to remember that interruptible and semi-interruptible production systems do have significant scope to vary their water use, and this will be influenced by the prevailing price of water allocations.

Given that many farm enterprises have chosen to pursue the strategy of selling water entitlements and increasing reliance on water allocation purchases, and that the water recovery has reduced the consumptive pool of water available for use, the water market price will be higher than it otherwise would be. A discussion of the price effects of water recovery on water allocation markets is presented in Appendix 4. A key finding is that allocation prices are expected to be higher, for given seasonal conditions, as a result of buyback. Those irrigators that have chosen to increase their reliance on water allocation markets will be worse off than if the water allocation price remained unaffected. For example, a dairy farmer who made the decision to sell water entitlements and rely on water allocation purchases might still expect to use the same volume of water in an average year with medium allocations. However the water price impacts of water recovery (and associated changes in industry water demand) are estimated to have led to a \$17-47/ML increase¹⁰ in the price of water allocations under these conditions. This corresponds to increased water costs of 0.9-2.5 cents per litre of milk produced¹¹, as compared to the average milk price in northern Victoria of 46 cents per litre¹².

¹⁰ Aither (2016b) and RMCG (2016) water price modelling presented in the Appendix.

¹¹ Based on an average conversion rate of 1,872 litres of milk per ML of irrigation water applied, used by RMCG (2016).

¹² DEPI (2014), used by RMCG (2016).

What is unclear from this type of analysis is whether the sale of entitlement to the Commonwealth and continued water use relying on water allocations was a default strategy, or an adaptation strategy and informed risk decision, or somewhere in-between.

- Buyback occurred when many farmers had accumulated high levels of debt during the drought. The sale of entitlement provided a mechanism to retire some of this debt and continue business.
- Given that large numbers of farmers were all seeking to increase reliance on water allocation purchases, it was foreseeable that competition for water allocations would increase prices. The same level of irrigated water demand could not be supported under a reduced consumptive pool.
- As discussed in the later dairy section, adaptation opportunities exist that may allow water users to be more flexible and therefore benefit from water allocation purchases in abundant years when the price of allocations is lower while reducing reliance on allocation purchases under drier years when prices are higher.

ABARES (2015) also provides insights on farms that did not continue water use, which are not picked up in the water register analysis. ABARES identified that some irrigators sold entitlements and ceased irrigating or farming altogether, while others continued irrigated farming by purchasing seasonal water allocations or entitlements.

4.7 TRENDS IN WATER USE PER HECTARE FOR DIFFERENT INDUSTRIES

ABARES (2015) reported on the on-farm water use efficiency of dairy farms in the MDB. This included a comparison of different types of irrigation technologies including flood irrigation using border-check irrigations systems and ‘travelling irrigators’ such as centre pivot and lateral move systems. They found water use per hectare had increased in recent years:

Water use and application rates declined from 2006–07 to 2008–09 as irrigators modified their irrigation practices to accommodate reduced water allocations. An improvement in water availability in 2009–10 resulted in increased water use on farms and higher application rates per hectare as many dairy farms returned to using pre-drought irrigation management practices. (p. 14)

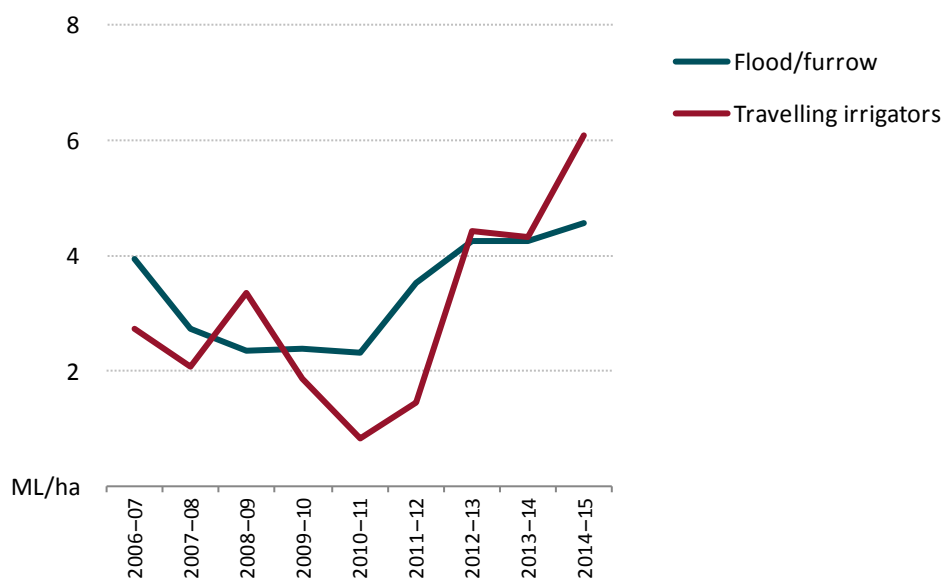


Figure 38 Water application rates by technology, dairy farms, Murray–Darling Basin, 2006–07 to 2014–15

Note: 2014–15 data are provisional estimates. Water application rates are average per farm.

Source: ABARES 2015

ABARES (2016) reports similar information for horticultural farms in the MDB. Water use per hectare remained broadly steady or increased since the end of the drought.

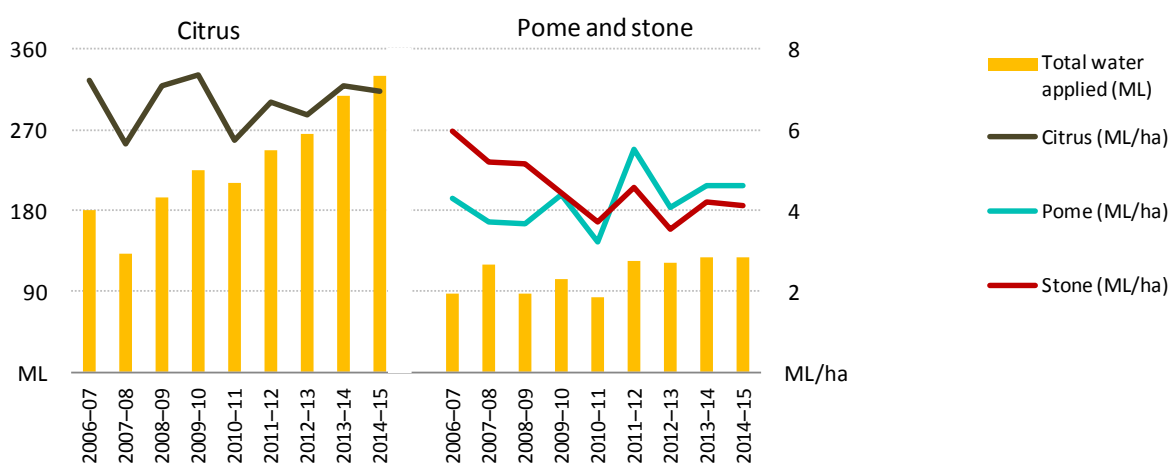


Figure 39 Water applied by farm type, Murray–Darling Basin, 2006–07 to 2014–15

Note: Data for 2014–15 are provisional estimates. Water application rates are average per farm.

Source: ABARES 2016

4.8 SUMMING UP

Those farmers who participated in the buyback or in the Commonwealth's investments in on-farm efficiency benefited from that participation.

The key finding in this chapter is however, that Victorian irrigators who sold water entitlements to the Commonwealth but remained in farming, are now more reliant on allocation purchases than they would have been without the Basin Plan. As will be argued in more detail in Chapter 6, for dairy farmers this has increased their reliance on more complex feeding systems. And as has already been demonstrated in Chapter 3, dairy farmers sold more entitlements to the Commonwealth than any other group of farmers. A potential mitigating factor is that these farmers may be in a position to manage the risks associated with these more complex feeding systems where buyback funds were used to retire debt.

Trends in water use per hectare are difficult to interpret because of the pressing needs to improve efficiencies in a range of measures during the drought. The ABARES (2015) data show that water use per hectare trended down during the drought, but it trended up again immediately afterwards. Outside of individual case studies, it will take time before the overall impacts of the Basin Plan on-farm water use efficiency can be fully evaluated.

Although water use efficiency went up for dairy farmers during the drought, as will be shown in Chapter 6, their indebtedness rose during the same period. This is a reminder that the concept of water use efficiency is more complex than the universal good that it is often portrayed to be; it should not be considered in isolation of risk.

5 THE IMPACTS OF THE BASIN PLAN ON HORTICULTURAL INDUSTRIES

5.1 OVERVIEW

As outlined in Chapter 3 the total water use on horticultural crops is the same for the counterfactual as it is with the Basin Plan. This chapter explains that horticultural plantings are continuing to expand in the southern-connected Basin. Most of that expansion to date has occurred in the Mallee regions of NSW, South Australia and Victoria, but expansion is starting to occur in the Murrumbidgee, and the current rejuvenation of horticulture in the GMID can ultimately be expected to result in an expansion there as well.

This chapter explains that even without further expansion the maturation of existing plantings will result in an increase in horticultural demands for water. It also explains that while total horticultural water use is unaffected by the Basin Plan, because the consumptive pool has been reduced, horticulture now accounts for a greater proportion of the total water available for irrigation. The Basin Plan has therefore increased the risk of horticultural land being dried off in the next drought. This chapter finishes by exploring the implications of the Basin Plan for horticulturalists in different parts of the Basin.

5.2 TRENDS IN HORTICULTURAL EXPANSION

Horticultural plantings in the Mallee regions of NSW, South Australia and Victoria have continued to expand since the Basin Plan commenced, continuing the trend that started with the introduction of entitlement trade in Victoria in 1994. According to the Mallee CMA's data, the total area irrigable for horticulture in the Victorian Mallee increased from 39,700 to 73,000 ha between 1997 and 2015. In 2015, 70% of this area was devoted to perennial crops, 13% supported seasonal crops including vegetables and 17% was vacant (Argus, 2016).

In contrast, the area of horticultural plantings in the GMID has remained relatively constant since the Basin Plan commenced. In the GMID the value of horticultural production has nonetheless increased as plantings for the declining canning industry have been replaced by pome and stone fruit plantings for the fresh market. This is reflected in the 2013/14 decline in tree plantings for the Goulburn Broken region followed by a return to previous levels in 2014/15. This rejuvenation of horticulture in the GMID is likely to lead to expansion in the future.

As discussed in Chapter 7, horticultural plantings in the Murrumbidgee have remained relatively constant. However, nut crops are currently expanding in the Murrumbidgee.

As discussed in Chapter 2, the irrigation demand for perennial horticultural crops is essentially *non-interruptible* and, depending on relative commodity prices, in times of low water availability horticulturalists are likely to remain as buyers when the price of water hits the point where dairy farmers start to substitute feed for water.

Nonetheless, as happened during the last drought, when allocations are low and allocation prices are high, marginally profitable and unprofitable horticultural crops will be dried-off, and the crops that can be mothballed will be. This is why the percentage of vacant irrigable land in the Mallee went from

3% in 1997 (about the rate necessary for continual renewal of orchards and vineyards) to 20% in 2009 and back to 17% in 2015. The unprofitability of many wine grape varieties at that time was reflected in a 35% reduction in total wine grape plantings (Argus, 2016). As that land is being gradually replanted, wine grapes are being replaced by crops such as almonds and table grapes, which use more water per hectare.

As horticulture continues to expand and use a larger proportion of the diminished consumptive pool, the scale of horticultural land to be dried-off in the next drought will increase, and as outlined in Chapter 11 it would increase even more in the higher water recovery scenarios. The variability in total water availability in the southern-connected Basin as a whole makes it extremely unlikely that *non-interruptible* crops could sustainably account for the majority of water use. The sustainable limits to *non-interruptible* plantings, which will depend on the commodity prices prevailing at the time, will be revealed in times of low allocations and high allocation prices. Given that horticultural investment is subject to waves of optimism and pessimism, it is likely that total plantings will oscillate around those limits. New entrants are likely to assume that they will be the ones best placed to cope with high allocation prices; and, depending on their financial resources and their farming systems, they may be right.

It is important to note that a significant proportion (8%) of the irrigable land in the Victorian Mallee is supporting high value vegetable crops including carrots (accounting for half), potatoes, cucurbits, asparagus and others (Argus, 2016). Although these crops are *interruptible*, their high value, and their contract-based production systems, makes it unlikely that they will be dried-off during all but the most severe water shortages.

It is also important to note that many of the perennial horticultural plantings in the Victorian Mallee are yet to mature. Therefore their demand for water is likely to continue to increase over the next few years. And redevelopment on the vacant land has hastened in the current financial year, since Argus (2016) completed her assessments of crop areas (pers. com., LMW).

Based on the reported areas of horticultural plantings in the Victorian Mallee (Argus, 2016) and the reported areas in the Lower Murray-Darling (Sunrise, 2015), we were able to calculate the mature irrigation requirements for existing plantings (Appendix 5).

Discussions with Lower Murray Water and the Mallee CMA allowed us to forecast additional demand based on currently approved developments that have not yet been planted, proposed developments currently subject to approval, and potential developments currently being subject to due diligence and the expectations, based on current trends, of how much of the dried off land is likely to be redeveloped. Taking account of the varying levels of certainty surrounding these figures, our initial estimates, as outline in Appendix 5, suggest that irrigation demands for crops in the Victorian Mallee are likely to increase by something between 50 and 200 GL per annum in the medium term.

5.3 IRRIGATED HORTICULTURE IN THE COUNTERFACTUAL

As outlined in Chapter 3, we assume that horticultural water use in Victoria would be the same without the Basin Plan as it is with the Basin Plan. We assume that this would also be true for horticulture in NSW and South Australia.

5.4 OVERALL IMPLICATIONS OF THE BASIN PLAN FOR HORTICULTURE

The structural adjustment issues associated with the 35% drop in wine grape plantings in the Victorian Mallee, and similar reductions in other parts of the Basin, were undoubtedly smoothed by the ability of wine grape growers to raise money by selling their water entitlements to the Commonwealth. Similarly, it is possible that by further limiting the total volume of high reliability water shares that can be used to support perennial horticulture development below the Barmah Choke, the Basin Plan may have helped maintain the risk of congestion in the Choke at existing levels, when in the absence of the Basin Plan it may otherwise have increased.

However, because it significantly reduced the consumptive pool available for irrigation, the Basin Plan has increased the risk of horticultural land being dried-off during the next drought (although horticultural enterprises may outbid other water users, the risk is that there would be not water available beyond that required to meet horticultural demands). As outlined in Chapter 3, total water use for horticulture is the same with the Basin Plan as it would have been for the counterfactual. This means that horticultural demands now account for a higher proportion of the total consumptive pool.

To put this in stark relief:

1. Before the Basin Plan horticultural demands accounted for 32% of the consumptive pool of high reliability entitlements.
2. Under the 2100 GL water recovery scenario (which is equivalent to the current situation) it now accounts for 40% of high reliability entitlements.

Put differently, if allocations in a future drought were to drop to 32% one fifth of current horticultural plantings may need to be dried off assuming that no water was used for dairying or rice production. As discussed in Chapter 11, the risk of horticultural land being dried off during periods of low allocations increases further for the 2750 and 3200 GL water recovery scenarios.

5.5 IMPLICATIONS FOR LMW DIVERTERS

Horticultural development by LMW diverters was initially supported by entitlement purchase, but the total volume of entitlement linked to land for greenfield developments peaked at 323 GL at 30 June 2009 – just before the Commonwealth began purchasing water for the environment. Their entitlement holdings declined to 216 GL at 30 June 2015. In the same period their use rose from 236 to 397 GL (DELWP, 2016a).

A former director of a managed investment scheme, who was interviewed for this report, suggested that the collapse of Timbercorp in April 2009 so affected the investment climate that his firm judged that the only way to secure their business continuity, in the period after the collapse, was to raise capital by selling the majority of their water entitlement holdings to the Commonwealth. They were successful in that strategy.

Similarly, he suggested that some of the firms who purchased individual Timbercorp and Great Southern orchards did so for not much more than the value of the associated water entitlements. In some cases those entitlements were then sold, in part at least, to the Commonwealth to help finance

the purchase. Alternatively, the water entitlements were sold to superannuation companies with lease-back arrangements that benefitted the ongoing management of the orchard.

In effect, it is likely that buyback helped avoid a serious disruption to the development of horticultural industries in the Basin. Collectively, those orchards and vineyards employ thousands of people with most jobs occurring during the development phase.

While the irrigable area LMW diverters continued to expand during the drought, the older parts of those developments, such as the Nangiloc-Colignan region and the areas fringing the pumped districts were affected in ways similar to the pumped irrigation districts. Land there was dried-off during the drought. The area of vacant land in Nangiloc-Colignan remained at 16% in 2015 (Argus, 2016). Though, as with the pumped districts, personal communication with LMW and DELWP regional staff suggests that redevelopment has accelerated this financial year.

5.6 IMPLICATIONS FOR THE PUMPED DISTRICTS

Commonwealth purchase of water entitlements undoubtedly helped wine grape growers to adjust to the combined effects of the collapse of the wine boom and the high cost of purchasing allocations during the drought. Many growers took the opportunity to exit the industry in a better financial situation than they would have been without the Basin Plan.

Other irrigators, including one interviewed for this report took the opportunity to diversify their portfolios of water entitlements after having sold to the Commonwealth. This irrigator purchased some NSW high security entitlements because their opening seasonal allocations were close to 100% while Victorian HRWS allocations started the season at low levels and typically built during the course of the year – making it more difficult to plan a water budget. Other irrigators purchased Victorian low reliability water shares for the advantages they provided in terms of carryover.

Other drought response measures such as the Small Block Irrigators Exit Grant also played a role in the adjustment process. The average proportion of vacant land in the pumped districts went from 4% in 2003 to a peak of 29% in 2012, with Merbein peaking at 39% in 2015.

5.7 IMPLICATIONS FOR THE GRAVITY DISTRICTS

Horticulture in the GMID has changed rapidly and radically over the last 15 years. It has a history of fluctuations in the dominance of different types of tree crops depending on the relative dominance of processed versus fresh production and on differences in the preference for particular commodities. Historically fresh fruit production in the GMID was for the domestic market, but increasingly it is being grown for export. Revenue from fruit growing in the Goulburn Valley has increased over time although production volumes have reduced (RMCG, 2013).

Like the other horticultural areas the Goulburn Valley has been largely unaffected by the Basin Plan to date. But since it is dependent on allocations from Victorian High Reliability Water Shares, it will be affected by the system-scale change of the reduction in the consumptive pool. RMCG (2016) estimate total horticultural demand at 97 GL. We were unable to generate a demand figure based on detailed

assessments of actual plantings in the GMID, but we accept RMCg's figure as being broadly consistent with the likely demands of the reported planted area.

5.8 IMPLICATIONS FOR SOUTH AUSTRALIAN HORTICULTURE

South Australia's irrigated horticultural centres, especially those in the Mallee region have much in common with both the pumped districts and LMW diverters; there is much shared history. The low allocations in 2007/08 hit South Australian irrigators very hard, largely because it was the first time in living memory that they had not received 100% allocations. This was true of Victorian horticulturalists on the Murray as well, but the difference was that irrigators there had seen Goulburn allocations drop to very low levels in 2002/03, and the twice-monthly seasonal allocation announcement procedures were familiar to them. The potential for low allocations was telegraphed to them well in advance.

South Australia had to develop its seasonal allocation announcement procedures during the course of that season and there were some teething problems. For example, on 30 October 2007 the South Australian Government announced that allocations were unlikely to increase above 16%, but on 14 November it unexpectedly announced a 6% increase and on 4 December a further 10% increase. This doubled the amount of water available to SA irrigators and as shown in Figure 40 reduced the market demand and caused allocation prices in Victoria to fall (Watson and Cummins, 2008).

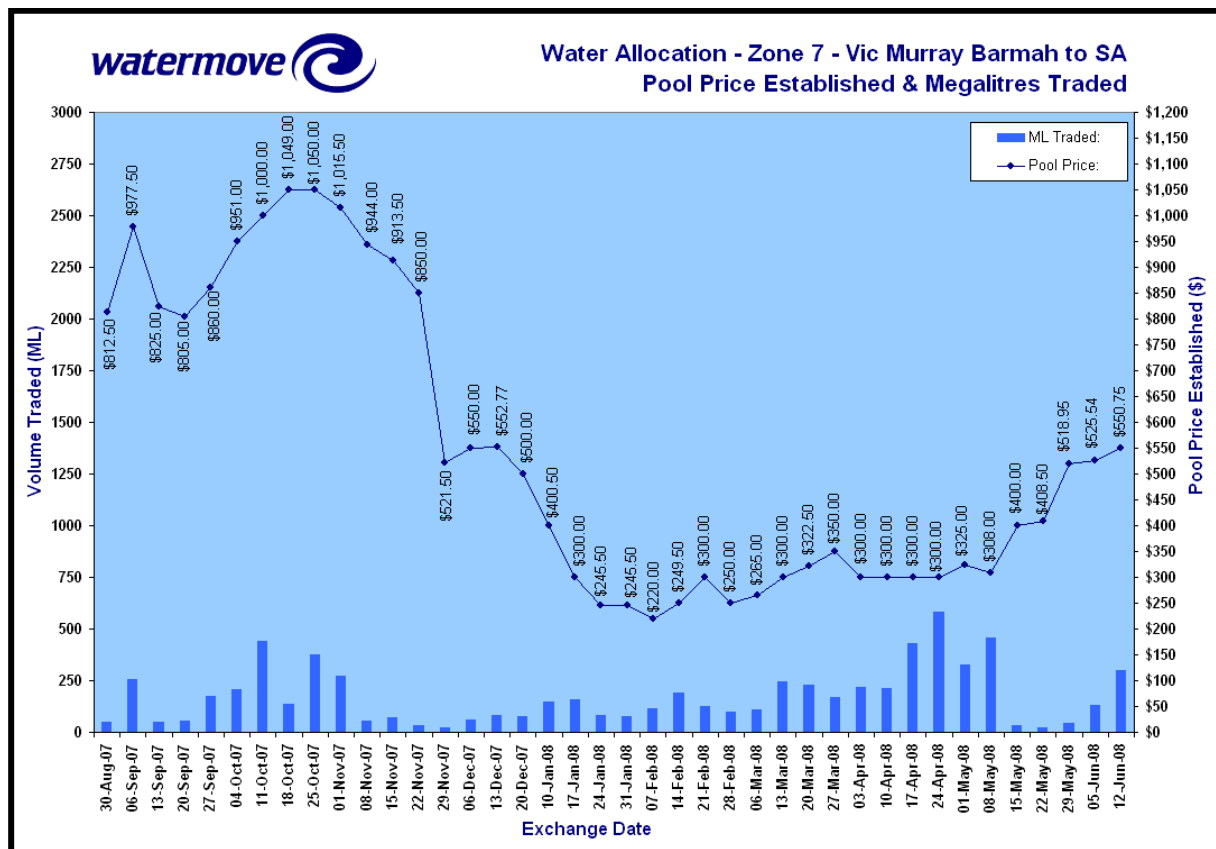


Figure 40 Murray allocation trade 2007/08 prices and volumes

South Australia's seasonal allocation announcement procedures are now much more mature, and horticulturalists throughout the southern-connected basin are now much more experienced water

market participants. Few horticulturalists now try to secure their entire annual needs at the start of the season. They are much more willing to wait and see how the market responds to the potential for allocations to rise during the course of the season.

Figure 40 shows that horticulturalists in South Australia have traditionally been exposed to the same market forces as those in Victoria. Ostensibly, they will therefore be exposed to the same system-scale impacts of the Basin Plan. However, as described in Chapter 2, South Australia has changed its water allocation framework, at least temporarily, to ensure that its irrigators receive 100% allocations until actual flows into South Australia fall 16% below entitlement flows. The effects of this change have not been evaluated for this report, therefore it is not clear what effect the change will have in terms of allocation prices or flows into the Lower Lakes.

5.9 IMPLICATIONS FOR NSW HORTICULTURE

Most existing horticulture in NSW is supported by allocations against high security entitlements. The NSW water allocation framework is such that anyone irrigating with NSW high security entitlements can be very confident that they will receive 95% allocations in all but the most extreme circumstances. Consequently, the changes to the consumptive pool resulting from the Basin Plan will have no negative impacts on them.

5.10 SUMMING UP

The recovery of water for the environments through Commonwealth buyback aided structural adjustment for the wine industry and it helped to avoid a disruption to the continued expansion of horticulture that would otherwise have followed the collapse of the large managed investment schemes.

Horticultural plantings in the southern-connected Basin are continuing to increase. Total horticultural water use has to date been unaffected by the Basin Plan. However, before the Basin Plan was introduced most horticulturalists held sufficient entitlement to meet their long-term average annual irrigation requirements. Many horticulturalists sold water to the Commonwealth during the buyback, but continued to irrigate by relying on allocation purchases. They are now more exposed to the risk of low allocations, but as illustrated in Chapter 3, until 2015/16 the full nature of that risk was masked by the extraordinarily high levels of carryover built up just as the buyback was finishing.

Because water recovery under the Basin Plan has reduced the size of the consumptive pool, horticultural demands as a proportion of that pool at full allocation are now at 40%, which is higher than the counterfactual level of 32%. The Basin Plan has therefore increased the risk of horticultural land being dried off in the next drought. As will be explained in Chapter 11, this risk would increase further in the other water recovery scenarios.

The characteristics of NSW High Security entitlements mean that NSW horticulturalists are largely shielded from these risks. By contrast Victorian and South Australian horticulturalists are exposed to a similar degree.

6 THE IMPACTS OF THE BASIN PLAN ON THE DAIRY INDUSTRY

6.1 OVERVIEW

As explained in Chapter 2, irrigated dairying is a semi-interruptible enterprise in that to some extent purchased feed can be used as a substitute for grazing. In this way, total or partial mixed rations can substitute for irrigation water.

This chapter shows that these alternative feeding strategies are more complex than pasture grazing; they have a different and more complex risk profile, they are more capital-intensive, and they require more active management of risks. Irrigated dairy farmers in the GMID used them as loss minimisation strategies during the drought, but their indebtedness increased. It also shows that when compared with the counterfactual outlined in Chapter 3, the reduction in the consumptive pool under the Basin Plan has resulted in a reduction in the GMID's milk production. The increasing water demand associated with continued expansion of horticulture is also further reducing milk production. However, it is also important to note that despite high allocation levels and low allocation prices at the time of writing, milk production was being strongly affected by low milk prices with dairy farmers reducing inputs of purchased feed and fertiliser in the short-term.

As also explained in Chapter 2, in simple terms, the volume of NSW allocations that can be traded into Victoria to support the horticultural and dairy industries is limited under current trade management settings. Irrigated dairying therefore is underpinned by allocations against Victorian high reliability entitlements. This chapter explains that horticultural demands for these allocations are relatively fixed, that, in effect, leaves dairying to soak up the variability in allocation levels. With further reductions to the consumptive pool and further horticultural expansion the variability in the dairy industry's share of available allocations will increase relative to average availability.

The chapter concludes with a discussion of the implications of these changes with regard to the future viability and growth of irrigated dairying.

6.2 A BRIEF DISCUSSION OF THE COMPLEXITY INVOLVED IN SUBSTITUTING FEED FOR WATER

Irrigated dairy farming is more complex than irrigated cropping because on top of the complexity of growing and sourcing feed, the technical efficiency of cattle feeding systems also varies. For example, the responses in production from feeding concentrate supplements varies widely depending on operator knowledge and skills, the amount and characteristics of pasture being offered and consumed, the amount and composition of the supplement being fed and genetics, stage of lactation and production level of cows in the herd (Doyle, Gibb and Ho, 2009).

Each dairy farm business is unique. Farmers each have different goals, business skills and knowledge, technical skills and knowledge, and attitudes to risk. Farm resources in terms of land (area and capability), water (rainfall and entitlements), infrastructure, labour (skills and knowledge) and herd characteristics vary. Dairy farm businesses also operate in an economic environment where milk prices vary depending on the company supplied, as well as from year to year and within each year.

The climate across the southern-connected basin varies and there are marked variations in seasonal weather patterns in different areas. This complexity means that the efficiency (productivity) of any one dairy farm is likely to differ to that of any other farm using a similar system. Flexibility in the production system is therefore essential. This means that tactical (within year or season) decisions are as important as strategic (longer term) decisions to dairy farm business performance (Doyle, Gibb and Ho, 2009).

The Victorian dairy industry has always needed to deal with seasonal variability but with increased intensity of farming, together with volatility in milk prices, allocation prices and other input costs, there is an increasing emphasis on the need for adaptive strategies. The last decade of extreme weather in many areas of Victoria has highlighted just how variable the seasons can be. Feed is the largest cost for a dairy farm and the growing conditions are a major variable. This makes selecting the most appropriate mix of forages and adaptive feeding strategies very important for dairy farms (Mickan, 2015).

Five different dairy feeding systems are common in Australia. They can be summarised as follows:

1. Grazed pasture and other forages with up to one tonne per year of grain and concentrate feeding in bail
2. Grazed pasture and other forages with more than one tonne per year of grain and concentrate feeding in bail
3. Grazed pasture for most or all of year, with partial-mixed-rations consumed on a feed pad with or without grain and concentrate feeding in bail
4. Hybrid system – grazed pasture for less than nine months per year, with partial-mixed-rations consumed on a feed pad with or without grain and concentrate feeding in bail and total-mixed-rations for more than three months per year
5. Total-mixed-rations system – no grazing because cows are housed and fed total-mixed-rations

Moving from the first system to the fifth requires progressively more focus on the balance of dietary fibre, rumen health, feed quality, feed palatability and nutritional balance. It therefore involves taking on increasing levels of risk and making a commitment to acquire more skills.

Despite their differences each of the five main feeding strategies aims to:

- Optimise total daily feed intake (with the optimum intake changing in line with milk prices)
- Maintain high feed quality
- Maintain good rumen function
- Minimise feed gaps throughout the year
- Minimise feed wastage

6.3 A SHORT HISTORY OF IRRIGATOR EXPERIENCE WITH DIFFERENT FEEDING SYSTEMS

Before the Millennium Drought (the dry period that extended from late 1996 until mid 2010 in Southern Australia), northern Victoria's dairy industry had, for an extended period, experienced weather conditions in line with long-term climate averages. Regional milk production in 2000/01 was 2,751 million litres, with an estimated farm gate value of \$780 million (Murray Dairy, 2001). Nearly all

(96%) of the milk was used for manufactured products. The region contained approximately 2,640 farms with a total regional herd size of 508,613 cows (Dairy Australia, 2016). Average farm debt was \$105,000 (2009/10 dollars) for dairy farms across Victoria, and this was comparable with estimated figures for northern Victoria (Harris, 2011).

A survey of irrigation farms in the GMID in 1988 showed that 68.5% of their irrigation water came from water rights (now high reliability water shares) with 17.1% from sales water (similar to today's low reliability water shares) and the remaining 15% from other sources such as groundwater (SIRLWSMP, 1989). This distribution was little changed at the commencement of the Millennium Drought. The industry was continuing to improve its use of water, and by the mid 1990s over 60% of the irrigated area in the Goulburn Broken catchment was laser graded, and 1,250 re-use systems had been installed (GB CMA, 1997). Landholders invested an estimated \$126m in these initiatives with government co-investment adding \$60.7m (GB CMA, 1996).

At that time, the three less capital intensive, less complex feeding systems outlined above were dominant (Little et al, 2009). Those less complex feed systems are based on homegrown pasture. Dairy farmers endowed with high volumes of water entitlement per hectare, for example those in the eastern GMID, grew perennial pastures to optimise stocking rates and hence returns per hectare. Farmers endowed with lower volumes of water entitlements per hectare, for example those in the western GMID, where water was more limiting than land, generally relied more on annual pastures and often grew fodder crops away from the milking area, as a risk management strategy (Dairy Australia, 2009).

Feeding strategies at that time were focused on improving pasture growth through better nutrient management and improving pasture conversion efficiency through better grazing management. Although feed concentrates and grains began to be used in the drought of 1982/83, they were still being used at relatively low levels at the start of the Millennium Drought, when they averaged 0.6 tonnes per head (Harris, 2011).

During the Millennium Drought, the dairy industry's water substitution strategies included purchasing fodder, changing pasture type (from perennial to annual) and agisting non-milking cows or grazing them on non-irrigated pastures. It is important to note that for many farmers this meant a move away from the three least capital intensive, least complex feed-base systems, which as outlined above had previously been most common in northern Victoria. Moving into the other two more capital intensive, more complex systems was a rational choice in order to minimise losses and maintain productive potential for when the drought broke, but it proved costly for most dairy farmers. Dairy Australia (2009), writing at that time, said that "a number of dairy farms in the region have generated competitive rates of return". They were in the minority however; ABARES (2015) data shows that overall dairy farmers' indebtedness increased in this period. In fact, dairy farm cash incomes generally fared worse than horticultural or broadacre farms during the drought (Figure 41).

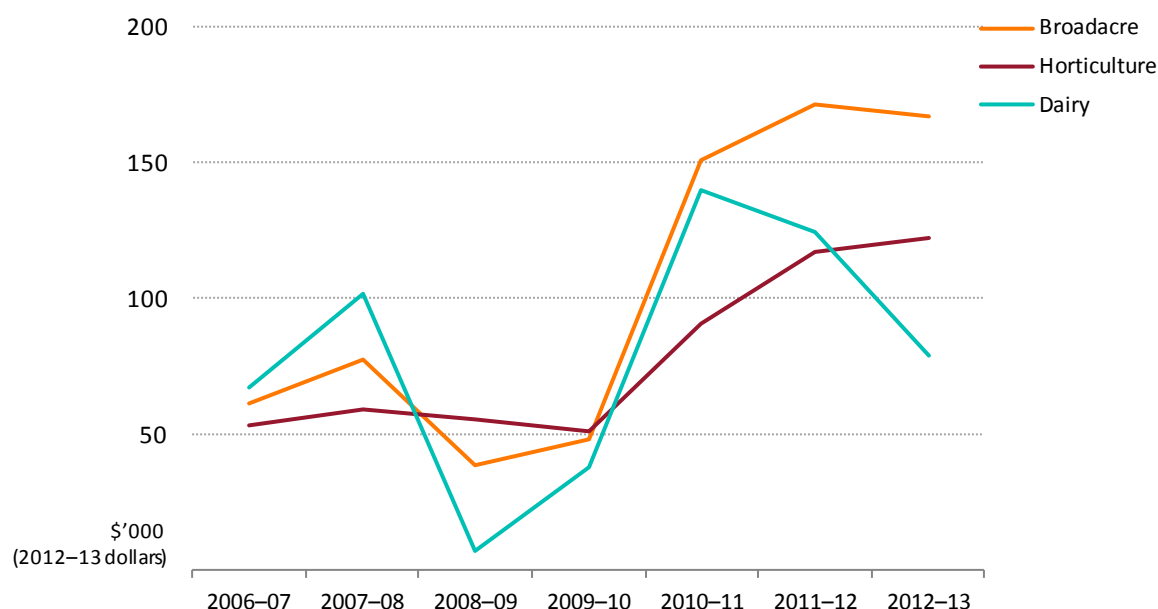


Figure 41: Farm cash income, by industry, 2006–07 to 2012–13

Note: Farm cash incomes are average per farm.

Source: ABARES 2014.10 from ABARES survey of irrigation farms in the Murray–Darling Basin.

6.4 THE IRRIGATED DAIRY INDUSTRY IN THE COUNTERFACTUAL

Milk production is expected to have been greater *but for* the water recovery for the Basin Plan which reduced the consumptive pool of water. Figure 42 presents observed and counterfactual milk production for the GMID. The counterfactual is based on milk production maintaining the same milk/irrigation water relationship as observed, across the additional water volume of the counterfactual scenario. The difference between observed and counterfactual milk production would be less if it were assumed the additional water use was less efficient than the observed average.

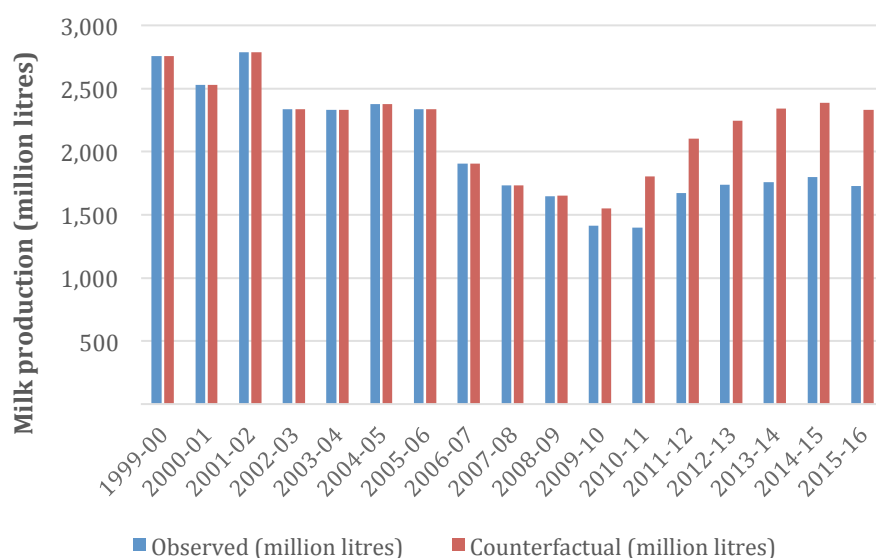


Figure 42 GMID milk production (observed and counterfactual)

RMCG (2016) estimated foregone milk production of a similar magnitude and equated this to a reduction in the annual farm-gate value of dairy production of \$200 million per year. It is important to note that this value of output is not only attributable to the additional water volumes but also to the other inputs to production — it is not a measure of the economic value-add from the water.

This reduced supply has reduced throughput in dairy processing. Although milk processing is not reported by factory, milk manufacturers operate farm to factory milk pick-up and milk is generally processed in the region of production. For example, Murray-Goulburn Cooperative (MG) have milk processing sites in northern Victoria at Cobram (cheese, milk powders, infant formula) Kiewa (daily pasteurised milk, cream cheese, yoghurt, cream) and Rochester (cheese, milk powders), as well as elsewhere in Victoria (Koroit, Laverton, Leongatha and Maffra).

MG milk intake has fluctuated in line with variations in GMID milk production (Figure 43). It would be expected that additional milk volumes under the counterfactual would be processed within the region at sites such as MG's.

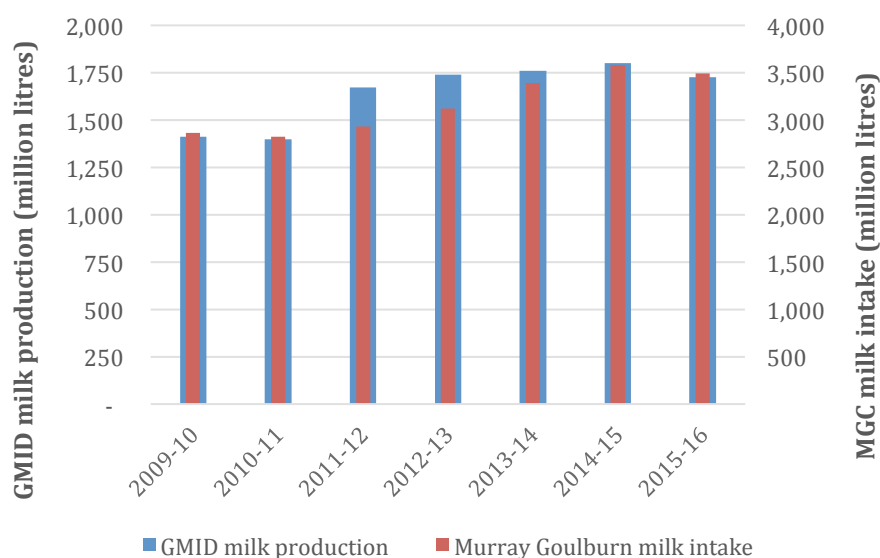


Figure 43 GMID milk production and MG milk intake

Source: Devondale Murray Goulburn 2016.

6.5 THE IRRIGATED DAIRY INDUSTRY TODAY

In 2015/16, regional milk production in northern Victoria had settled at close to 2,000 million litres, down by 28% from pre-drought figures (Dairy Australia, 2016). The region had seen a 50% drop in farm numbers to 1,140 properties (Goulburn Broken CMA, unpublished) supporting a total regional herd of 306,832 cows (Dairy Australia, 2016). The number of rotary dairies has increased; they had the capacity to handle around 50% of total milk capacity (Goulburn Broken CMA, unpublished). Average Victorian dairy farm debt had increased to \$806,000 in 2014/15 from \$105,000 in 2009/10, and this was comparable with estimated figures for northern Victoria (ABARES, 2015).

Total 2015/16 water use by the dairy industry in the GMID was 740 GL – a drop of 30% from 2001/02 (Goulburn Broken CMA, unpublished). During the same period, there was a 44% drop in the ownership of high reliability water shares by dairy farmers from 819 GL to 465 GL. A survey of irrigation farms in the GMID in 2016 supported these figures with 28% of dairy farmers owning less than 200 ML of high reliability water shares and more than half of surveyed dairy farmers (55.3%) saying they had to rely heavily on the allocation market to meet their water needs (Goulburn Broken CMA, unpublished). A 44% drop in water use matched a 38% drop in production from 2001/02 to 2015/16.

Significant investment in on-farm and regional irrigation infrastructure has occurred with 68.9% of respondents to a Land Use Survey having undertaken irrigation upgrades over the last 5 years (Goulburn Broken CMA, unpublished). By 2014/15 the industry had lasered 85% of the irrigated area used for farming, installed 3,440 re-use systems and installed over 8,700 ha of automatic irrigation (GB CMA, 2014/15).

During the 2000s, in response to low water allocations, high allocation prices, and the vagaries of feed input costs and milk prices, interest in more diverse feed-base systems, incorporating annual crops,

annual pastures and lucerne increased. Dairy farmers who had sold entitlements and had begun to rely on allocation purchases maintained that interest in the 2010s. During this time the use of different supplementary feeds has increased. This adds to the complexity of the system and to the challenge of maintaining profit margins – given the vagaries of feed input costs and milk prices (Lower Murray Darling, 2009). Relative to the situation where a dairy farmer, with 100% allocations against held water entitlements, has sufficient water to meet the feed requirements of an individual herd, the more complex feed-base systems involve more risk.

As the drought came to an end, dairy farmers debt had increased. The Victorian Dairy Industry Farm Monitor Project found that over 70% of participants in northern Victoria reported a negative return on equity during 2009/10 (DPI 2010). In addition, the relatively high milk prices during the early 2000s supported farmers to adapt their farming practices to cope with the drought and the predicted on-going increase in variability of extreme climatic conditions. In the process many not only increased their debt exposure but also, in some cases, their embedded cost of production (Dairy Moving Forward, 2009). The most recent assessment of MDB dairy farm performance (ABARES 2015) found that average farm debt had increased significantly (Figure 44). However, increases in average farm debt over time were modest relative to dairy farmers’ capacity to service debt by generating income. Average debt relative to total farm cash receipts remained relatively steady over the period 2006/07 to 2013/14. It is very unlikely that things have improved since, given milk prices at the time of writing.

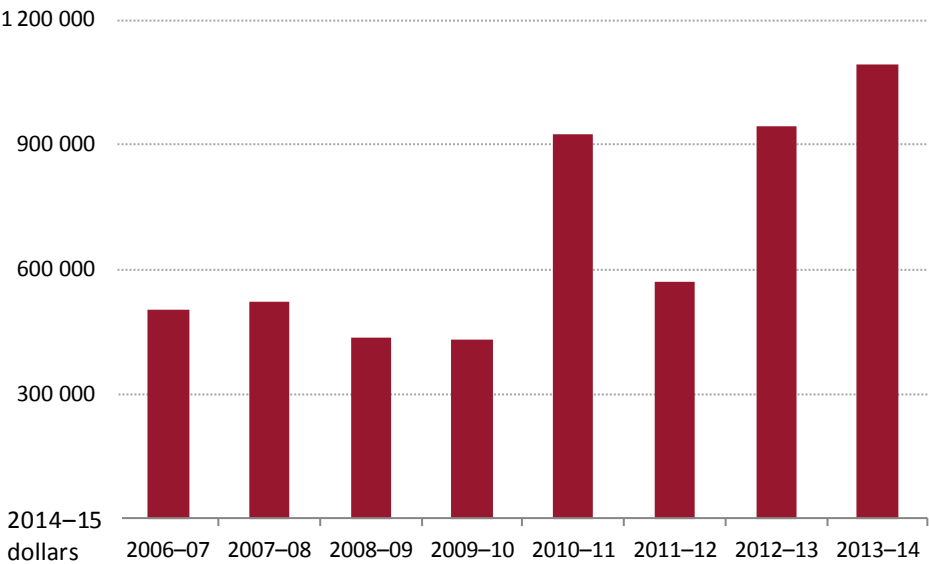


Figure 44 Farm business debt, dairy farms, Murray–Darling Basin

Note: Survey estimates for business debt are not available for 2014–15. Farm business debts are average per farm.
Source: ABARES 2015.12

There has also been a significant divergence in the performance of individual farms, and this spread has widened from the drought years to 2012/13 (Figure 45).

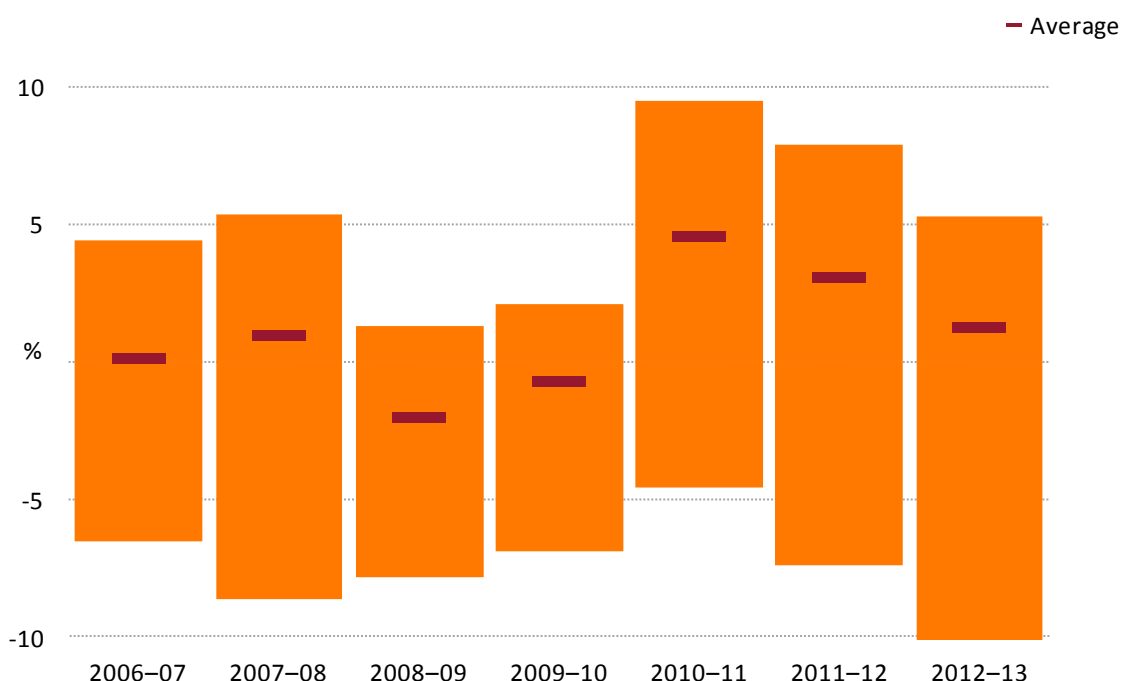


Figure 45 Distribution of dairy farms, by rate of return, Murray and Goulburn–Broken regions

Note: 75% of farms lie within the upper and lower bounds shown. The average shown is for the entire population of farms. Estimates for the Murray and Goulburn–Broken regions.

Source: ABARES 2014.10 from ABARES survey of irrigation farms in the Murray–Darling Basin.

6.6 THE DAIRY INDUSTRY’S OPTIONS IN RESPONDING TO LOW WATER AVAILABILITY

Irrigated dairying has in the past relied on access to abundant, cheap water. Water has become scarcer as a result of horticultural expansion to date and the Basin Plan. Further sources of scarcity include climate change and continued horticultural expansion and the potential for further water to be recovered for the environment under the Basin Plan. For example, the Socio-economic Analysis that accompanied the Regulatory Impact Statement for the Basin Plan (MDBA, 2011c) warned, at page 78, that “for the Goulburn Broken Region GVIAP (gross value of irrigated agricultural production) will be reduced by 12.9 per cent (\$88.2 million) with the largest reductions experienced by dairy, meat cattle and hay”. The net result of these changes has been increased farming risk in Victoria’s irrigated dairy industry.

The levels of indebtedness outlined above, and the experience with the Campaspe Irrigation District discussed below, highlight that irrigated dairying is semi-interruptible only for so long. The dairy industry is therefore currently considering its options for the future. The water market, enables dairy farmers to pursue a range of strategies.

Tietenberg and Lewis (2009) identify four key strategies for any business to mitigate the scarcity of a key input; these are substitution, increased efficiency, alternative supplies or exit. During the drought, when water was very scarce, dairy farmers in northern Victoria employed all four of these strategies with the particular mix used by individual farmers being driven by their individual circumstances, their farm set-up and their expectations regarding future water supplies (ABARES, 2010).

Substitution for irrigated dairying involves replacing water with another more abundant resource. As already discussed, for individual farms, substitution can be complicated. This is because changing one input such as water is likely to have implications for other components of the farming system. For example, managing the implications for animal health associated with the adoption of more complex feeding systems may also require additional investments in infrastructure and management skills (Productivity Commission, 2005).

The limits to the strategy of substitution were revealed in the Campaspe Irrigation District, when in 2010 after four out of five years with 0% water allocations, that district's irrigators agreed to close down the irrigation district and sell all of their entitlements.

Efficiency can be achieved by minimising the amount of water required to produce milk, recycling drainage water or identifying methods of using lower quality water sources (Tietenberg and Lewis, 2009).

Dairy farmers increased their efficiency during the drought, and before, by laser-levelling, installing drainage re-use systems and installing automated irrigation systems. Consequently, irrigation application rates for pasture for dairying were reduced by 17% from 4.2 ML/ha to 3.5 ML/ha between 2000/01 and 2005/06 (Dairy Australia, 2009). In the eastern GMID, shallow groundwater pumps helped to make use of saline water in shallow groundwater systems built up by accumulated leaching fractions and water that had seeped from supply channels into shallow groundwater systems. Notably, both of these sources of shallow groundwater will decrease as a result of the Commonwealth's investment in both on-farm and off-farm infrastructure savings.

Seeking alternative supplies: dairy farmers during the drought pumped more water from deep-lead groundwater systems (up to the permissible consumptive volume). They also purchased additional allocations from the water market (ABARE, 2010). In 2006/07 an estimated 31% of dairy farms participated in allocation trade (Dairy Australia, 2009).

Exiting is the last of the four scarcity mitigation strategies to be used. It is used when the other three have already been exhausted or when their costs exceed the benefits (Field, 2001). Dairy farmers during the drought pursued a range of partial exiting options that included: selling assets (such as cows or water entitlements), 'mothballing' the dairy business until conditions improved, pursuing off-farm income, and changing the focus of the business (e.g. from dairy to grain). In the absence of viable options for a partial exit, many dairy farmers sold their farms or ceased to farm.

Dairy farmers increasingly pursued exit strategies as the drought continued. Between 2006 and 2010 there was a 47.5% drop in land area used for dairy across the GMID (Goulburn Broken CMA, unpublished). Many farmers sold off cows with a 47% reduction in the herd size in the GMID between 2006 and 2010. This is compared to the more modest 12% reduction in herd sizes between 2001 and 2006 elsewhere in Australia (Dairy Australia 2016).

The Commonwealth's entry into the water market in 2007 coincided with the majority of dairy farmers having already pursued their affordable options in terms of their substitution, efficiency, alternative supply and exit strategies. This led to a 75% increase in farmers selling their high reliability

shares between 2007/08 and 2008/09 in the southern-connected Basin (NWC, 2009). Similar rates continued until the end of the drought (NWC, 2009).

The Commonwealth purchase of water entitlements undoubtedly helped dairy farmers to adjust to the combined effects of the high cost of feed and the high cost of allocations during the drought. Many farmers took the opportunity to exit the industry with better financial resources than they would have done without the Basin Plan. Others managed to keep operating their businesses after pursuing partial exit strategies when, in the absence of the Commonwealth purchases, they may otherwise have been forced to cease farming altogether. At the very least, buyback helped many dairy farmers to reduce their debts (ABARES 2014.10).

Many dairy farmers who sold entitlements ultimately stayed on in dairy farming using a business model that relied upon future purchases of allocations rather than a replacement of their entitlements. Some dairy farms now rely completely on water allocation purchases to meet their full irrigation requirements. These farmers are purchasing water as part of routine farm business activities using various trading strategies (ABARES 2014.10).

This is a widely used strategy with more than half of all dairy farmers being net purchasers of allocations in recent years (Figure 46), with 60% doing so in 2013/14. However, as discussed in Chapter 4, in 2015/16 declining water availability due to the return of dry conditions and the run down of the extraordinary levels of carryover built up in the La Niña years led to higher allocation prices. Many of the irrigators that pursued this strategy are still coming to terms with the risk that this has exposed them to.

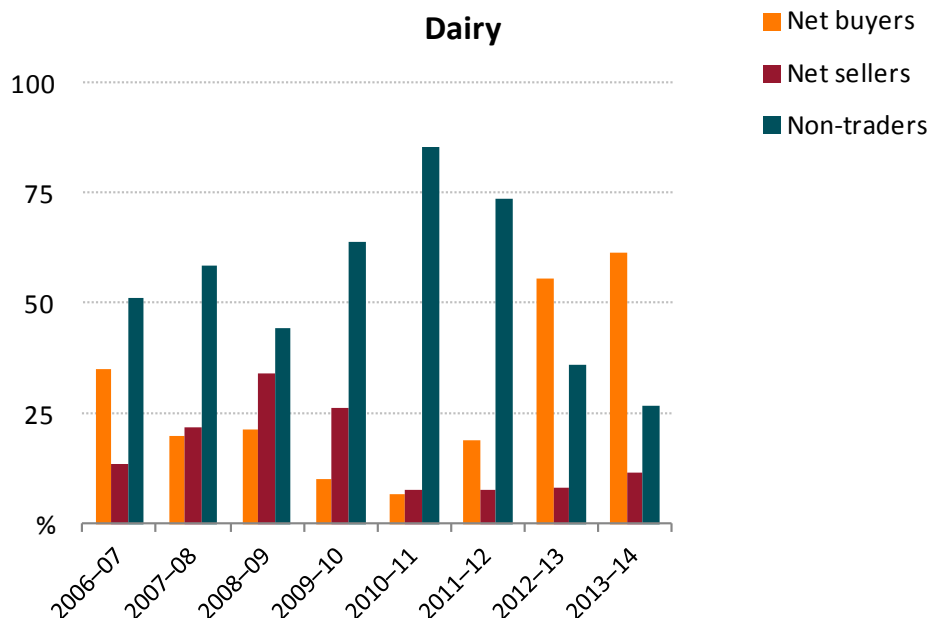


Figure 46: Proportion of dairy farms trading temporary water allocations

Note: Net buyers/sellers are farms that bought/sold more water than they sold/bought.

Source: ABARES 2015.13 from Murray–Darling Basin Irrigation Survey

6.7 IMPLICATIONS FOR FUTURE VIABILITY AND GROWTH

Over the past decade, dairy farmers in the GMID have responded to major challenges. Despite climate variability, the lowest ever recorded inflows, drastically reduced irrigation water allocations, and increased farm debt, some dairy farmers in the region have generated competitive rates of return.

Seven years ago, Dairy Australia (2009) advised the Productivity Commission that with regards to the Lower Murray-Darling Basin a “primary risk faced by the dairy industry remains water availability”. Referencing the Northern Region Sustainable Water Strategy (DSE, 2009), they advised that the “best estimate for average water availability for dairy farming in the Goulburn-Murray Irrigation District is 767 GL in 10 years time. This level of water availability can underpin a sizeable dairy industry but necessitates continued improvement in water use efficiency. Experience shows there will be variation around this average water availability and having the capacity to manage this variation is critical to the dairy industry’s future in the region.”

The dairy industry has continued with many of the *substitution* options used to respond to low water availability during the Millennium Drought. A large number of dairy farms have moved to systems that rely more on annual pastures, rather than perennial pastures and on “cut and carry” fodder crops grown away from the milking area. Land Use Mapping figures indicate that a large number of dairy farms have adopted this strategy; the area of land associated with dairying (127,000ha) is now larger than the area of the properties with dairies (103,000 ha). It is not yet clear whether this option has been fully adopted for those farms where this is a viable alternative. The skills necessary to manage the increased complexity of a diverse feeding system to consistently provide the energy and nutritional requirements of a dairy herd will limit the ability of some farmers to adopt this option (Dairy Australia, 2009 and Murray Dairy, 2001).

Doyle, Gibb and Ho, (2009) summarised the results of their review of relevant information on potential productivity gains from on - farm irrigation technology in the following terms:

“Adoption of alternative irrigation technologies to border-check (flood) irrigation has the potential to improve forage production, to save irrigation water and labour and, hence, to increase farm profit. At farm scale, these benefits will only be achieved under high levels of management, where the technologies are used on appropriate soil types and where operators can utilise any additional (or different) forage in efficient feeding systems. It is inevitable that there will be time delays in optimising the management of new irrigation systems and that not all farmers will obtain the necessary benefits to offset capital costs. On this basis we conclude that while profit may increase on some farms adopting different irrigation technologies, the impact at regional scale will be negligible in the short to medium term (1 to 10 years). Significant risk is involved in investment in additional capital in businesses that have an uncertain future.”

The open question now is whether we are approaching the 10-year time scale they referred to, and, if so, whether the remaining dairy farmers in the GMID, operating at larger scales, have the requisite high levels of management to take advantage of those technologies?

There are also limits to the efficiencies to be achieved by increasing economies of scale – given the high variable costs associated with each additional cow in the herd (e.g. variable costs are about 60% of total costs for dairy farms in the three regions of Victoria)¹³. Finally, the other key options such as improving herd genetics to improve feed conversion to milk have also already been widely adopted and are now facing limits due to issues with reduced fertility and the precision of feeding strategies needed to match the energy requirements of cows (Dairy Australia, 2009b).

The water market enables individual dairy farmers to obtain *new supplies* of water, but in dry years, competition from horticulturalists will drive allocation prices up to the point where other strategies must be explored. In a recent survey designed to support a land use mapping project for Goulburn Broken CMA, 78% of dairy farmers indicated that they could not pay more than \$200/ML (Goulburn Broken CMA, unpublished). Alternative groundwater supplies have now largely been exploited, following the widespread installation of groundwater pumps since the late 1980s to control salinity. Pumping has now stabilised at the volume that can sustainably be pumped and used on dairy farms.

Given that many of the *substitution*, *efficiency* and *alternative supply* options have already been widely adopted across the industry, it is likely that some dairy farmers will need to adopt exit options from their current farming systems. These could include increasing their holdings of high reliability water shares. The appropriate holding would depend on the individual circumstances on the farm but indications are that the current on-farm mix is not appropriate for many dairy farms. In the recent survey referred to above, 60% of dairy farmers indicated that although allocation trade is currently a part of their long-term business plan, their reliance on allocation trade is negatively affecting their ability to plan, their ability to implement a water budget and their ease of operation. For other dairy farmers less reliant on allocation purchases, the water market gives them flexibility.

Ostensibly another option would be to increase the income from other sources than dairying. Dairy farming is labour intensive, operates seven days a week with very few managed part time and this naturally limits the opportunities for off-farm income.¹⁴

A common exit option used in the later years of the Millennium Drought was to reduce the size of the herd. Although all farms annually sell poor performing cows with the aim of improving productivity, beyond that selling cows will have a direct impact on income and is unlikely to be implemented outside an extended drought.

6.8 SUPPORTING EVIDENCE COMING OUT OF THE LAND USE MAPPING SURVEY

The relationships studied in Goulburn Broken CMA's recent land use mapping survey as outlined in Table 6 below generally support the arguments outlined above (Goulburn Broken CMA, unpublished). It is important to note however, that relationship does not mean causation. It is also important to note that the survey was conducted in 20015/16 when NSW allocations were low and the high levels of carryover accumulated during the La Niña years, which had been masking the effects of the Basin

¹³ Dairy Industry Farm Monitor Project, Annual Report 2009-10, p.64-79 (note that these figures are based on 71 farms participating in the project)

¹⁴ N Barr, R Wilkinson and K Karunaratne, The changing social landscape of rural Victoria, Department of Primary Industries, Victoria, April 2005, p.78

Plan, had dropped back to lower levels. As recorded by DELWP (2016a) there was widespread uneasiness about the water market in that year. Media outlets reported assertions about speculators “corrupting” the market, and calls for such participants to be excluded. In fact, the price rise was principally a sign of water again becoming in short supply and in strong demand (DELWP, 2016a).

Table 6: Relationships tested through the survey for Goulburn Broken CMA’s Land Use Mapping Project (Goulburn Broken CMA, unpublished)

Relationships	Test	Test value	Statistical significance
<i>There is an association between ‘those who trade water as a large part of farm water use’ and ‘those who pay higher amount for the water’</i>	<i>Chi-square test</i>	18.396	<i>Significant at 0.00 probability level</i>
<i>There is an association between ‘those who have implemented on-farm irrigation upgrades’ and ‘those who have long term plan to use allocation trade’</i>	<i>Chi-square test</i>	8.204	<i>Significant at 0.004 probability level</i>
<i>There is an association between ‘those who have implemented on-farm irrigation upgrades’ and ‘those who are reliant on allocation trade’</i>	<i>Chi-square test</i>	6.597	<i>Significant at 0.04 probability level</i>
<i>For dairy, there is an association between ‘growing perennial pasture’ and ‘having sufficient amount of water entitlement’</i>	<i>Chi-square test</i>	5.914	<i>Significant at 0.05 probability level</i>
<i>For dairy, there is a correlation between ‘herd size’ and ‘amount of High Reliability Water Share ownership’</i>	<i>Correlations</i>	<i>r value = 0.70</i>	<i>Significant at 0.01 probability level</i>
<i>For dairy, there is a correlation between ‘the size of the property’ and ‘herd size’</i>	<i>Correlations</i>	<i>r value = 0.80</i>	<i>Significant at 0.01 probability level</i>
<i>There is no correlation between ‘size of irrigated land owned’ and ‘amount of High Reliability Water Share owned’</i>	<i>Correlations</i>	<i>R = 0.226</i>	<i>Correlation value low</i>
<i>There is no association between ‘growing perennial pasture’ and ‘allocation trade form a large part of farm water use’</i>	<i>Chi-square test</i>	2.78	<i>Not significant at 0.10 level</i>
<i>There is no association between ‘years of farming’ and ‘ownership of High Reliability of Water Share’</i>	<i>Chi-square test</i>	-0.022	<i>Correlation value low</i>
<i>The mean years of farming differ between those who agree with the statement ‘I have the amount of water entitlements to irrigate my property that I require’</i>	<i>t-test</i>	3.247	<i>Significant at 0.01 probability level</i>
<i>The mean years of farming differ between those who responded to the statement that they have ‘long-term plan to use allocation trade to manage through the irrigation season’</i>	<i>t-test</i>	8.123	<i>Significant at 0.001 probability level</i>
<i>There is no difference in the mean years of farming who responded to the statement that ‘the entitlement you have is enough to cover your production needs’</i>	<i>t-test</i>	0.381	<i>Not significant at 0.10 level</i>

6.9 SUMMING UP

Milk production in the GMID has fallen in response to both horticultural expansion and the Basin Plan. The counterfactual suggests that the Basin Plan has reduced annual average milk production by the order of 30%. The milk price slump at the time of writing is putting further downward pressure on milk production.

On-farm improvements in irrigation layouts and irrigation management strategies over the past 30 years have helped dairy farmers adapt to the changes. However many dairy farmers will have now exhausted most of their affordable options for coping with water scarcity in terms of their substitution, efficiency, alternative supply and exit strategies.

A key finding is that Victorian irrigators who sold water entitlements to the Commonwealth are now more reliant on allocation purchases than they would have been without the Basin Plan. For dairy farmers in particular this increased their farming risk; dairy farmers sold more entitlements to the Commonwealth than any other group of farmers. The nature of this risk was masked for four years by the high level of carryover resulting from the extraordinarily high rainfall years of 2010/11 and 2011/12.

Dairy farmers whose business models depend on allocation purchases are now confronting decisions about their willingness and ability to adopt the more complex feeding strategies associated with further improvements in irrigation technology.

7 IMPACTS IN NSW – AND THEIR IMPLICATIONS FOR VICTORIA

7.1 OVERVIEW

As explained in Chapter 2 understanding the socio-economic impacts of the Basin Plan in Victoria requires an understanding of the links between water supplies and demands in each state in the southern-connected Basin. South Australian influences were discussed in some detail in Chapter 5 because horticulture is the mainstay of irrigation there. NSW horticulture was also considered in that chapter. The focus for this chapter is therefore on the interruptible annual crops predominant in NSW.

It is important to note here however, that the level of detail involved in our analysis of the situation in NSW, and for that matter South Australia, is necessarily lower than that we were able to achieve for Victoria. Our access to data from the Victorian Water Register enhanced our ability to provide insights into the situation in Victoria.

The Murrumbidgee valley, the NSW Murray valley and the Lower Darling make up the NSW component of the southern-connected Basin. The region holds approximately 6300 GL of water entitlement and annual on farm usage, which varies significantly from year to year, is in the order of 2,600 GL on average.

This chapter gives separate summaries of the current situations in the Murrumbidgee and the NSW Murray, before considering possible future trends in these industries. It then discusses the implications for Victoria arising out of those possible future changes. It concludes with a discussion of the structural adjustment pressures in NSW.

7.2 THE MURRUMBIDGEE

Irrigators in the Murrumbidgee include private diverters, groundwater users and district irrigators in the Murrumbidgee and Coleambally Irrigation Areas. Most water is used in the two irrigation areas.

Table 7: Commonwealth recovery of water entitlements from the Murrumbidgee

Class of entitlement	ML issued (Murrumbidgee Water Sharing Plan 2016)	Recovery (ML) related to Infrastructure investments	Direct purchases (ML)	Other purchases (ML)	Total (ML)	Recovery as proportion of the total of that entitlement (%)	LTAAY (ML)
Conveyance	375,968	33,340		2,569	35,909	10	34,155
General Security	1,891,815	72,528	198,223		270,751	14	173,281
Groundwater		5,048			5,048		5,048
High Security	417,613	12,203	4,515		16,718	4	15,882
Supplementary (Low Bidgee)	747,000	172,974				23	172,974
Supplementary	198,780	7,057	20,814		27,871	14	3,902
Unregulated		164			164		110

Table 7 shows the Commonwealth directly purchased approximately 9% of General Security entitlements on the Murrumbidgee with a further 5% being obtained through on-farm infrastructure improvements. By contrast, the Commonwealth purchased only around 1% of High Security Entitlements with a further 3% being obtained through on-farm infrastructure improvements. Volumes of LTAAY similar to those recovered from high and general security entitlements were generated through the purchase of supplementary entitlements and the reduction in conveyance loss entitlements brought about through off-farm infrastructure improvements. A large proportion of the General and High Security water entitlements were secured by the Government prior to 2012/13.

Each of the organisations responsible for supplying water within those areas, Coleambally Irrigation Cooperative Ltd (CICL) and Murrumbidgee Irrigation Ltd, publish usage data in their Annual Compliance Reports. Table 8 and Table 9 provide a summary of water use data in those areas before and after the commencement of the Murray Darling Basin Plan.

Table 8: Water use in Coleambally before and after the Basin Plan (CICL Annual Compliance Report 2015 pg 20)

Year	2005/06	2012/13	2013/14	2014/15	2015/16*	Change 2005/06- 2012/13	Change 05/06 – 2014/15
Annual Allocation HS:GS (%)	95 :54	100:73	95:63	95:53	95:37		
Annual Use (GL)	417	571	398	405		+154	-12
- total							
- Surface water	349	496	312	301		+147	-48
- Ground water	68	75	86	104		+7	+36
Crop Water Use (% of deliveries)							
- Rice	63	53	44	44	35	-1	-19
- Corn	7	8	8	13	14	+1	+6
- Soybean	3	4	2	2	3	+1	-1
- Cotton	0	3	7	7	21	+3	+7
- Wheat	8	7	10	18	15	-1	+11
- Pasture	9	4	3	4	7	-5	-5
- Canola	1	1	1	1	2	0	0

* At the time of writing

Table 8 shows that compared with 2005/06 surface water use in Coleambally has declined following Government purchases by approximately 10% in those years (2013/14 and 2014/15) with similar allocation levels. Those water users with access to suitable quality groundwater have, however substituted groundwater for surface water.

The data also indicates a significant shift in crop water use with rice and pasture water use declining by 19% and 5% respectively. Water use has increased for corn (6%), cotton (7%) and winter crops (11%). This reflects a shift to enterprises that offer a higher return per ML.

Table 9: Water use in the MIA before and after the Basin Plan (MIL Annual Compliance Report 2015 pg 30)

Year	2005/06	2012/13	2013/14	2014/15	2015/16*	Change 2005/06 – 2012/13	Change 2005/06 – 2014/15
Annual Allocation HS:GS (%)	95:54	100:73	95:63	95:53	95:37		
Annual Use (GL)	830	941	699	730	526	+111	-100
Crop Water Use (%)							
- rice	43	39	34	35	26	-4	-8
- pasture	8	5	4	4	2	-3	-4
- cereal /oilseed	22	24	24	24	18	+2	+2
- vegetables	3	2	3	2	2	-1	-1
- cotton	0	9	10	8	15	+9	+8
- citrus / vines	17	16	20	20	24	-1	+3
- other	7	5	6	7	13	0	0

Table 9 shows that since 2005/06 water use has declined following Government purchases by around 14% in years of similar surface water allocations (2014/15). This decline is similar to the proportion of general security water entitlements recovered for the environment since 2009. The data also indicates a shift in crop water use away from rice (-8%) and pasture (-4%) principally towards cotton (+8%) with smaller increases in water use on cereal/oilseed crops and vines/citrus.

The annual allocation associated with the general security water entitlements recovered for the environment (270 GL) equates to 143 GL at 53% allocation (2014/15) and 170 GL at 63% allocation (2013/14). The relative reduction in surface water use within each of these years within the Coleambally and Murrumbidgee Irrigation Areas totalled 148 GL in 2014/15 and 167 GL in 2013/14 compared to water use in 2005/06. This suggests the reduction in annual water use is similar in volume to the total reduction in allocations associated with the entitlements recovered for the environment. This in turn suggests that Murrumbidgee irrigators have not generally purchased allocations to offset the net reduction in water availability.

The significantly lower annual allocation in 2015/16 resulted in substantially less water use within both the Murrumbidgee and the Coleambally Irrigation Areas. There was also a major shift in water use away from rice (9%) and winter crops (3-6%) and an increase in cotton (7-14%).

7.3 NSW MURRAY

Irrigation water use within the NSW Murray includes extractions by surface water users within the joint irrigation schemes, private diverters and groundwater users. Murray Irrigation, centred on Finley

and Deniliquin is the largest joint scheme. There are several smaller schemes of which the largest are Western Murray, centred on Dareton and West Corurgan and Moira located in the central Murray valley.

Table 10 shows the Commonwealth directly purchased approximately 8% of the High Security entitlements on the NSW Murray and secured a further 2% through on-farm infrastructure savings. By contrast, it directly purchased around 15% of the General Security Entitlements and recovered another 6% through on-farm infrastructure improvements. Compared to the Murrumbidgee relatively low volumes of LTAA were recovered from supplementary or conveyance loss entitlements. The majority of the General Security water entitlement purchases occurred prior to 2012/13.

Table 10: Commonwealth recovery of water entitlements from the NSW Murray

Class of entitlement	ML issued (Murray Lower Darling Water Sharing Plan 2016)	Recovery (ML) related to Infrastructure investments	Direct purchases (ML)	Other purchases (ML)	Total (ML)	Recovery as proportion of the total of that entitlement (%)	LTAA (ML)
Conveyance	330,000	11,990			11,990	4	9,400
General Security*	1,750,325	94,984	253,273		348,257	21	282,088
Groundwater		1,551			1,551		1,551
High Security	199,331	4,343	15,068		19,411	10	18,442
Supplementary	502,579	4,333			4,333	2	3,184
Unregulated		184			184		145

Water use in the NSW Murray is dominated by Murray Irrigation's customers and to a lesser extent those of Western Murray Ltd. At the time of privatisation (March 1995) Murray Irrigation held slightly over 70% of the General Security Entitlements within the NSW Murray Valley. Over 80% of the high security entitlements were held within Western Murray Ltd, centred on Dareton.

Table 11: Water use in MIL before and after the Basin Plan (MIL Annual Compliance Report 2015 pg 20-21)

Year	2005/06	2012/13	2013/14	2014/15	2015/16	Change 2005/06- 2012/13	Change 2005/06 - 2014/15
Annual Allocation GS: MIL Dividend (%)	63:0	100:7	100:12	61:2	23:6		
Carryover from previous year (GL)	210	430	101	220	152		
Annual Use (GL)	985 (887 excluding the Snowy Advance)	1263	924	739	339	+278	-246 (-148 excluding the Snowy Advance)
Crop Water Use (%)							
- rice	49	54	53	45	11	+5	-4
- Annual Pasture	25	17	15	20	31	-8	-5
- Perennial pasture	11	7	5	5	7	-4	-6
- Cereals	10	15	14	17	30	+5	+7
- Other	5	4	7	9	22***	-1	+4
- Cotton	0	1	1	1	1	+1	+1
Annual Trade into MIL (excl Govt)	+93**	+150	-7	+100*	+20	+63	-50

Note *NSW Murray Valley trade net +20GL Ref NSW Office Water

** In addition 98GL was transferred into MIL as a Snowy advance

*** This included 11% of water used on other summer crops, excluding horticulture

Table 11 shows that water use has declined by around 17% since 2005/06 for years with similar allocation levels (e.g., 2014/15) – if the access to water enabled through the “Snowy Advance” (an agreement between Murray Irrigation and Snowy Hydro Limited to allow early season access to up to 200 GL of water) is subtracted from the annual usage on farm. The data also indicates a shift in crop water use away from rice (-4%) and pasture (-11%) principally towards cereal/oilseed crops and other summer crops, including corn/maize and cotton.

In 2014/15, the 63% allocation to the General Security entitlements purchased by Government (348 GL) equated to 219 GL. The relative reduction in surface water use in 2014/15 within Murray Irrigation totalled 148 GL compared to water use in 2005/06, after excluding the Snowy Advance of 98 GL made in that year. Given that Murray Irrigation holds around 70% of the General Security entitlements within the valley, this suggests the reduction in annual water use is similar in volume to the total

reduction in allocations associated with the entitlements recovered for the environment. As with the Murrumbidgee, this suggests that NSW Murray irrigators have not generally purchased allocations to offset the net reduction in water availability.

In 2015/16, a season with a very low General Security allocation, there was a significant shift in crop water use, away from rice to annual pasture, other summer crops and winter crops. The rise in commodity prices for lamb and beef and the dairy industry's reliance on the purchase of NSW allocations saw an increased focus on annual pasture water use. Temporary water traded at values around \$250/ML for much of the season, which saw water historically used for rice production used instead either for winter crop production, traded on the annual market or carried forward to the following year. The gross margin per ML for rice was projected to be \$175-225 for crops producing district average yields.

7.4 POSSIBLE FUTURE TRENDS

The market price for water at any point is a function of supply and demand. The supply side at any point depends on current allocation levels and the outlook for future allocations. In average to wet years in the southern-connected Basin, demand is driven at the margins by the relative profitability of different interruptible irrigation crops, most of which are grown in NSW.

Water market prices and the directions of trade are therefore strongly influenced by the relative profitability of different interruptible enterprises in NSW. In that context, it is important to understand what the future might hold for irrigation in NSW.

Historically round 60-70% of the water available in southern NSW was used for rice production. The relative proportion used for rice has now declined to 35-45%. This change has been driven by the adoption of higher value enterprises, or in the case of winter crop production, improved management, and investments in improved irrigation systems and layouts.

The way water is used in southern NSW will continue to improve, and the enterprises making most use of water will continue to change. Three likely future changes in NSW will have implications for Victorian irrigators, and it is important to note that they will become more important in relative terms as water continues to be recovered for the environment and the consumptive pool shrinks further. Those future changes include the adoption of:

- (i) Higher value annual cropping systems
- (ii) Lower water-use, higher value rice farming systems
- (iii) Larger-scale horticultural production systems

The area of **higher value winter and summer annual cropping systems** in southern NSW is expected to increase. The diversification already seen in parts of the Murrumbidgee is expected to extend further and to spread into the NSW Murray (properties in the Victorian Murray are generally too small to take advantage of these systems) as irrigators become more familiar and more confident with these systems. The area sown to cotton and corn in particular will continue to increase, and the management of winter crops will continue to improve, leading to a higher proportion of the

consumptive pool being used on these crops. Automated irrigation systems and improved layouts are also leading to increased crop yields, improved application efficiency and diversified cropping systems in both valleys.

Lower water use rice farming systems will assist NSW irrigators to adjust to the effects of the Basin Plan. For example, the rice industry recently released shorter growing season varieties with twofold benefits; they will enable double cropping in rotation with higher producing winter crops, and the rice crop itself will use around 15-20% less water. While this could lead to more water being available for other enterprises, it is more likely the water will be used for rice production, due to the increased return per unit of water, and the existing grower skills and industry infrastructure. This may make it easier for rice growers to compete on the water market in years of average to below average allocations.

The next priority is to breed varieties and develop agronomic packages for cold-tolerant rice varieties that do not need the heat bank effects of ponded irrigation systems. This is expected to reduce water use per hectare, increase grain yields and encourage the use of irrigation layouts more compatible with the best practice for high yields for the other crops grown in rice-based cropping systems.

Large-scale horticultural production systems, particularly nut crops, have increased significantly in the Murrumbidgee valley in recent years. Developments are also occurring in the NSW Murray around Kyalite. Continued expansion of these plantings will increase the demand for water, particularly in years of low water availability.

7.5 IMPLICATIONS FOR VICTORIA AND THE POTENTIAL FOR FURTHER INDUSTRY SHIFTS

NSW Murray irrigators have actively traded allocations in most years over the past two decades. Most of these allocations were sourced from either the NSW Murray Valley or the Murrumbidgee. In both 2012/13 and 2013/14 in excess of 210 GL was traded on Murray Irrigation's Water exchange. The NSW Office of Water reported that only 20 GL of water was traded into the valley in 2014/15.

In 2015/16, the Inter Valley Trade of allocations from the Murrumbidgee to the Murray was confined to a shorter period than in earlier years. This reflected increasing demand from NSW Murray Valley water users but also from Victorian and SA (horticultural) water users during a period of low water availability. Because Murrumbidgee water can be traded to the NSW and Victorian Murray below the Barmah choke, it is attractive for horticulturalists in the Mallee regions of Victoria, NSW and South Australia – especially during years of low allocations in Victoria and South Australia.

NSW Murray irrigators have also established arrangements to source water in years of low allocations against general security entitlements. This has included borrowing water from the Barmah Millewa Environmental water account when the General Security annual allocation is less than 30% and establishing an 'allocation' advance or forward release of water from the Snowy Mountains Corporation. Both these instruments have reduced the demand for annual trade of water into the region at these times.

Apart from 2011/12 and 2012/13 when high allocation levels and vast stores of carryover meant that water was abundant in Victoria, there has been limited annual trade from Victoria to NSW in recent

years. One reason is that Murray Irrigation's Water exchange was traditionally seen as enabling faster transfers with irrigators being able to buy allocations from within Murray Irrigation and to use them on the same day. The introduction of Victoria's online trading system, and the increased activity of water brokers have helped to further integrate the water market.

More importantly, the returns generated by Victorian water users in the horticulture and dairy industries have generally exceeded those generated by NSW users growing annual crops. Victorian irrigators' relatively fixed demands for water mean however, that in wet years some of their allocations are surplus to their requirements and they sell the surplus at low prices to annual croppers in NSW.

7.6 NSW STRUCTURAL ADJUSTMENT PRESSURES ARISING FROM WATER RECOVERY

Many irrigators who sold water entitlement to the Commonwealth retained their land in anticipation of being able to purchase allocations to secure their annual water requirements. Others who sold their land as well, sold it to irrigators with similar expectations. The net result was that while Government purchases reduced seasonal water availability, the demand for allocations was not reduced to the same extent.

In dry years, this adds pressure to the allocation market resulting in higher prices. In 2015/16 water prices exceeded the unit returns per ML, at district average yields, for most summer and winter crops in NSW. As a result many NSW irrigators sold their water, with flow-on effects for the regional economy.

At the time of writing, in November 2016, at 100% allocations, water was selling for approximately \$80/ML in the NSW Murray and \$100/ML in the Murrumbidgee. Historically, when allocations were 100% water prices were expected to be in the order of \$30-50/ML. The increase has meant profits have been reduced for those irrigators dependent on allocation purchases, at a time when they would traditionally have expected to build up their financial reserves to carry them through the years of low allocations.

Structurally, individual farm businesses have increased in size, there is greater reliance on allocation trade, irrigators are striving to diversify their production systems to include higher value crops, there is less rice being grown and rice processing infrastructure is being underutilised while cotton processing infrastructure is being expanded. With less water being used, water delivery charges inside the irrigation areas serviced by the larger water delivery companies are expected to increase as those companies strive to meet their predominantly fixed costs. Similarly, regional service industries have experienced a decline in sales as a result of the reduction in the consumptive pool and the associated reduction in plantings, and they are now more exposed to seasonal variations in actual water use as a result of market prices.

The water market in the southern-connected Basin is now more active and more 'global'. This combined with the strong incentive for irrigators and industries to adopt strategies to increase their returns per ML of water used in NSW, may ultimately reduce the volume of water traded into Victoria, particularly in medium and medium-wet water availability years.

7.7 SUMMING UP

Government purchases of General Security entitlements equate to 21% of the Murray total and 14% of the Murrumbidgee total. Small volumes of high security entitlements have been purchased from both valleys. Annual water use has declined in southern NSW by a volume similar to the annual allocation for the water entitlements purchased by Government, indicating that net trade from Victoria and South Australia has not changed.

The reduction in the consumptive pool has driven structural adjustment at the farm, industry and regional scales. Irrigators have gradually responded by shifting water away from rice towards other summer crops and winter crops. Corn and cotton plantings have increased, initially in the Murrumbidgee valley where cotton gins have been built at Darlington Point and Hay. NSW irrigators are increasingly using forward markets to reduce season-to-season business variability.

Annual water use is evolving in southern NSW as irrigators consider how best to respond to the changed business environment. The large volumes of carryover suggest a level of uncertainty as irrigators contemplate future management strategies. Plantings of higher return annual crops and perennial crops are likely to expand as irrigators become more confident in the production and marketing of these crops.

Irrigators and industries will seek to increase the returns per ML through improved management and through research and development. Recent developments in the rice industry are an example. These structural adjustments may result in less water being traded into Victoria in the future especially if the marginal returns per ML approach those for dairying and horticulture.

In the short to medium term water is likely to trade into Victoria in low allocation years when allocation prices exceed \$200 per ML. In medium to high availability years there will be greater demand for allocation trade within NSW valleys as demonstrated in 2013/14, 2014/15 and 2016/17. The future demand for allocations in NSW will be determined by the relative profitability of the enterprises adopted by irrigators, irrespective of regional boundaries. As an example, the expansion of horticulture in the Murrumbidgee valley is likely to compete for water currently traded from the Murrumbidgee valley to the horticultural sector in northern Victoria, in years of low water availability.

8 THE IMPACTS OF THE BASIN PLAN AT THE REGIONAL SCALE

8.1 OVERVIEW

The analysis in this report has mostly compared the impact of the Basin Plan in Victoria in four broadly defined regions; LMW districts, LMW diverters, GMW districts and GMW diverters. The analysis of the counterfactual in Chapter 3 shows LMW's districts and diverters using the same volume of water with the Basin Plan as they do in the counterfactual. The impacts of the Basin Plan in Victoria are concentrated on GMW's districts and diverters.

Chapter 2 showed that there are significant pockets of horticulture amongst GMW's districts and diverters and that the Basin Plan had to date not affected the total volume of their water use. Chapter 6 showed that the impacts of the Basin Plan are felt most strongly in the irrigated dairy industry where the necessary adjustments add complexity and risk to farming.

We have not examined detailed impacts on mixed farming systems which RMCG's (2016) analysis of ABARES data suggests now accounts for around 10% of water use in the GMID. Nor have we examined in detail the impact on GMW's diverters. Both populations are more divergent than can be done justice in a high-level, short timeframe report such as this. Importantly both types of irrigators also have more flexibility than GMID dairy farmers. Mixed farmers can use water more opportunistically than dairy farmers, and GMW diverters are free of the fixed costs associated with the upkeep of GMW's delivery system.

Irrigated dairying is the mainstay of GMID. Dairying can be outcompeted by irrigated industries that can pay more for water, and it can be outlasted by industries better adapted to variable water availability. Thus if irrigated pasture is a prerequisite underpinning the irrigated dairy industry, that industry must shrink. Concerns about the future of dairy are a major contributor to doubts about the business model in the GMID. This contrasts with the growing confidence in the future of LMW's districts based on recent horticultural rejuvenation.

This chapter is focused on the future of the GMID. It is concerned primarily with the impact of the Basin Plan on how the fixed costs of running the GMID can be met given the reduction in total water use. It is also concerned with the lack of integration between the Basin Plan's water recovery efforts through buy back and through off-farm infrastructure projects.

8.2 THE NATURE OF THE PROBLEM

Before the unbundling of water entitlements in Victoria in 2007, all water entitlements were tied to specific parcels of land and the spatial distribution of these entitlements provided a good guide to where the water was most likely to be used. Now around 7% of all entitlements are not tied to land, but for the time being the spatial distribution of the remaining entitlements still provides a reasonable proxy for where they are most likely to be used.

In that context it is important to note that between 30 June 2001 and 30 June 2015 the volume of high reliability entitlements 'tied to land' in the GMID decreased from 1,648 GL to 992 GL, a 40% decrease (TC&A 2016, Table 5). The decrease includes a contribution to the system-wide movement of 175 GL

of privately owned entitlements no longer tied to land. Allocations against a large proportion of these ‘not tied to land’ entitlements will be used in the GMID in many years – if this were to be apportioned between LMW and GMW diverters in the same ratio as entitlements currently tied to land it would amount to 116 GL¹⁵. A more realistic estimate of High Reliability Water Shares supporting irrigated enterprises in the GMID is therefore 1,108 GL, a 33% decrease since 2001.

To put this in perspective, this 540 GL reduction is greater than the volume of all high reliability entitlements held in the Murray Valley and Loddon Valley (formerly Pyramid-Boort) Irrigation Districts in 2001. The key difference in this comparison is that rather than being concentrated in a small number of locations, the purchases have been scattered throughout the GMID (Figure 47). Because the changes in GMW customers’ water demands are spread throughout the network, opportunities to rationalise the network are much harder to identify and realise than they would have been had the transfers been concentrated in discrete areas.

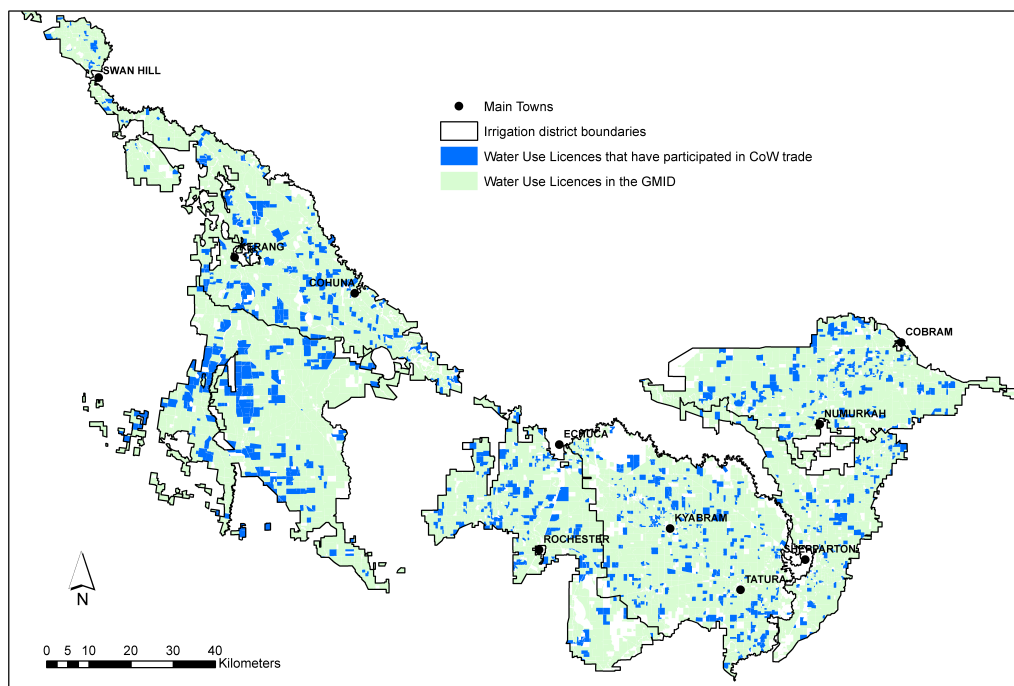


Figure 47 – Spatial distribution of water entitlements traded to the Commonwealth from farms in the GMID

Reduced water deliveries, and a potential reduced customer base, are resulting from:

- Commonwealth acquisition of High Reliability Water Shares for the environment
- Entitlement trade to LMW diverters to support continued horticultural expansion
- Decreasing water availability resulting from climate change.

¹⁵ The GMID holds 66% of entitlements tied to land in Northern Victoria. 116 GL is 66% of 175 GL.

When entitlement trade out of irrigation districts was first allowed, there was an annual 2% limit on the total volume that could be traded out in any one year. This was intended to slow the rates of change in order to give communities time to adjust. This was lifted to 4% under the National Water Initiative, and was eventually abolished in order to comply with the Basin Plan Water Trading Rules in July 2014. While the limit was in place Victoria allowed exemptions to target Commonwealth water purchases to less productive areas or areas where infrastructure was being rationalised to avoid the loss of water in modernised areas and improve regional productivity (DSE 2009 and GMW 2016c). However, the abolition of the limit rendered those efforts largely unsuccessful.

Any reductions in water availability associated with climate change will compound the challenges posed by this reduction. Long-term reductions in water availability associated with climate change are uncertain, but under a medium climate change scenario DSE (2008) estimated water availability would decrease by around 25% by 2055. GMW (2016a) assumed a reduction of 20% in historic flows for the purposes of estimating deliveries for the most recent price review.

8.3 FUTURE OUTLOOK

Buybacks, trade out of the district and the drying climate are expected to result in significantly lower water deliveries in the GMID. GMW (2016a) estimates that water demand in the GMID over the next eight years will be in the order of 1,150 GL per year. This assumes no further impact on High Reliability Water Shares from Commonwealth water recovery programs, and no further purchases from LMW's customers or horticultural developers in NSW or South Australia, but it does assume a 20% reduction in historical inflows due to climate change.

In the long term, average deliveries in the GMID are expected to be in the order of 1,200 GL¹⁶. This is 41% lower than long-term average deliveries of 2,020 GL modelled for Stage 1 of the Connections Project (NVIRP 2010, Table 2-2). In effect the Commonwealth's water recovery from off-farm infrastructure investments has been working at cross-purposes with its water recovery from buyback. On one hand the off-farm infrastructure investments have been providing more efficient services, on the other hand buyback has rendered those modernised services less cost effective.

Reduced deliveries are a major challenge to GMW because its extensive asset base requires routine annual maintenance, operations and renewal. Therefore, its costs are largely fixed. Consequently the average cost of maintaining the delivery infrastructure goes up as the volumes being delivered go down.

GMW has few options for managing the risk of reduced deliveries other than to design a tariff system that is predominantly based on fixed charges. These tariffs are vetted by the Essential Services Commission and seek to provide cost reflective pricing. While GMW's revenue is secure under the current arrangements, the marginal benefits its customers derive from its services are going down as total deliveries go down, and the effective price they pay to use each ML is going up. This is especially

¹⁶ This value is mid-way between GMW (2016a, Table 32)'s estimate of 1,150 GL and RMCG (2016, page 22)'s estimate of 1,260 GL.

the case for those of its customers who have sold entitlements and wish to irrigate opportunistically when allocation prices are low.

Up until 2005/06 there was a close alignment between the volume of water entitlements tied to land in the GMID and the volume delivered. As illustrated in Figure 48, the volume delivered was relatively lower during the height of the drought, but it has been relatively higher than entitlement volume since the drought broke; this is the combined result of the breaking of the drought, entitlement trade to LMW diverters, buyback, and the ability to hold water entitlements now without linking them to land.

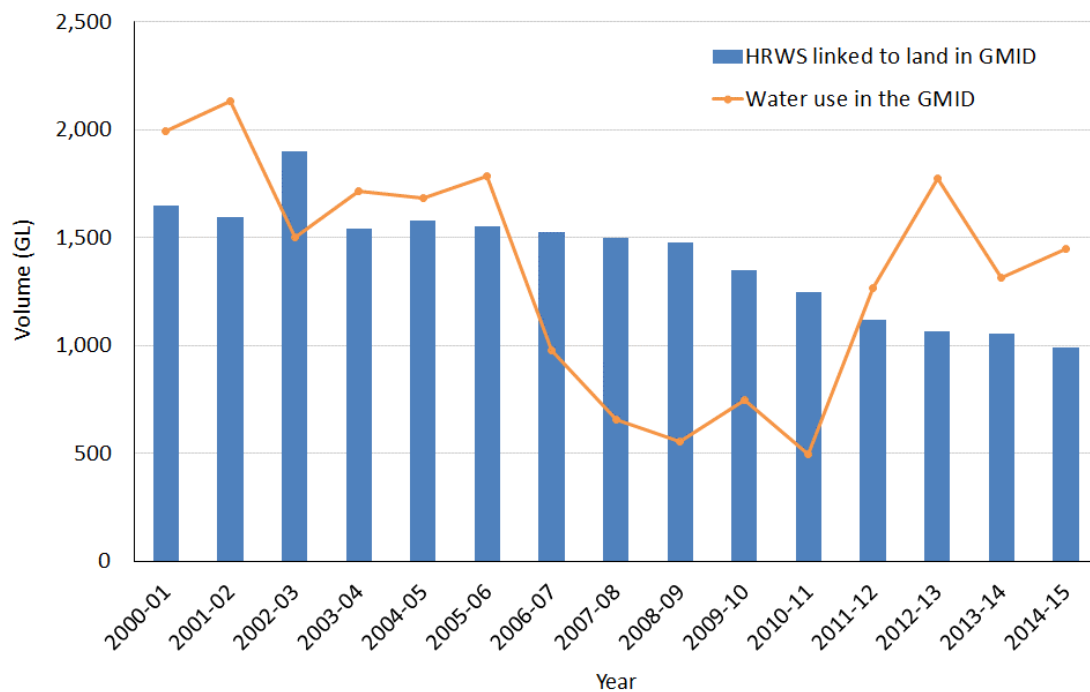


Figure 48: High Reliability Water Shares linked to land and water use in the GMID 2000/01 to 2014/15

Source: TC&A 2016 and GMW Annual Reports.

Figure 49 shows that another important relationship has also changed over a similar period. The number of GMID delivery shares created at the time of unbundling was directly related to the number of High Reliability Water Shares linked to land in the GMID at that time. While the number of those water shares has since dropped by more than 35%, for the combination of reasons outlined above, the number of Delivery Shares, against which GMID irrigators pay their fixed charges, has dropped by less than 5%.

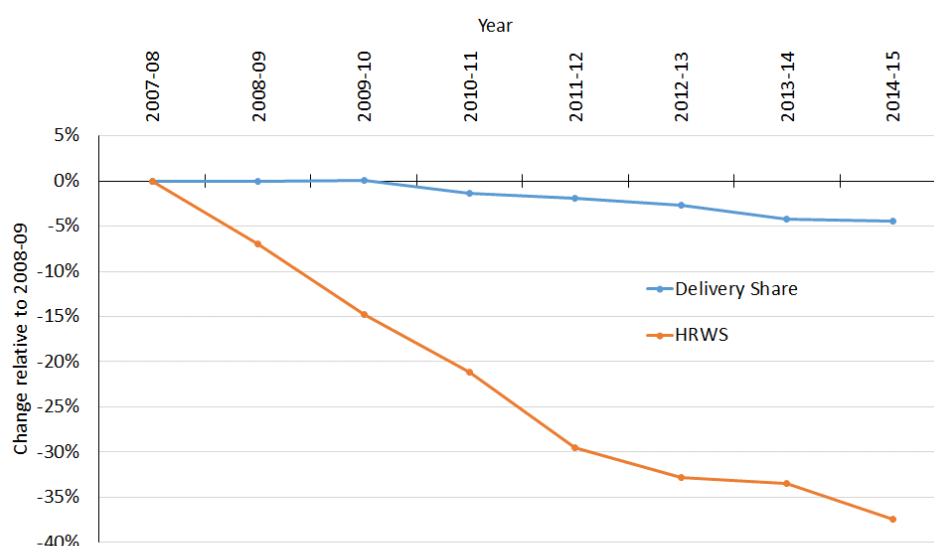


Figure 49: Change in Delivery Share and High Reliability Water Shares in the GMID relative to 2008/09 levels

Delivery Shares were initially designed as an instrument to ration the capacity of the delivery system during times of peak demand, but now that the off-farm infrastructure has been modified, rationing is now largely no longer necessary. Delivery Shares are now artefacts that reflect how much benefit landholders *could* derive from their access to the delivery system. As can be seen in Table 12, GMW's Infrastructure Access Fee, which is charged per Delivery Share, makes up the bulk of its customers costs of irrigation supply.

Table 12 – Breakdown of charges for a large irrigation customer in GMID – fixed charges are shaded blue

Fees	Charge per unit	Charge subtotal	Proportion of total charge
Entitlement Storage HRWS (\$/ML)	\$10.57	\$4,333.70	13%
Entitlement Storage LRWS (\$/ML)	\$5.18	\$-	0%
Service Point Remote Operate (\$/service point)	\$400.00	\$800.00	2%
Infrastructure Access (\$/Delivery Share)	\$4,454.00	\$20,933.80	62%
Infrastructure Use (\$/ML)	\$9.34	\$3,829.40	11%
Surface drainage service (\$)	\$100.00	\$100.00	0%
Surface drainage area (\$/ha)	\$11.73	\$1,524.90	5%
Surface drainage Water Use (\$/ML)	\$5.60	\$2,296.00	7%
TOTAL		\$33,817.80	100%

Source: Fees from GMW Pricelist 2015/16

When Delivery Shares and the Infrastructure Access Fee were introduced there was some expectation that as irrigators sold entitlement they would trade or retire delivery share. As will be discussed further below, this has not turned out to be the case. As a proportion of 2008/09 levels, High Reliability Water Shares have decreased by 37% and delivery share by 4% (Figure 49). Changes in water deliveries are more complex to analyse as seasonal conditions affect both allocation and use levels, as does the use of carryover and allocation trade. But over the long-term average water use is expected to decline in similar proportions to High Reliability Water Shares, unless there are allocations against Low Reliability Water Shares or allocations can be traded from NSW, LMW or South Australia.

The ratio of High Reliability Water Shares to Delivery Shares in the GMID has decreased from close to 90:1 in 2009 to 60:1 in 2016 (Figure 50). Large customers with similar changes in their own ratios would see their effective charges per ML of HRWS increase (Figure 50).

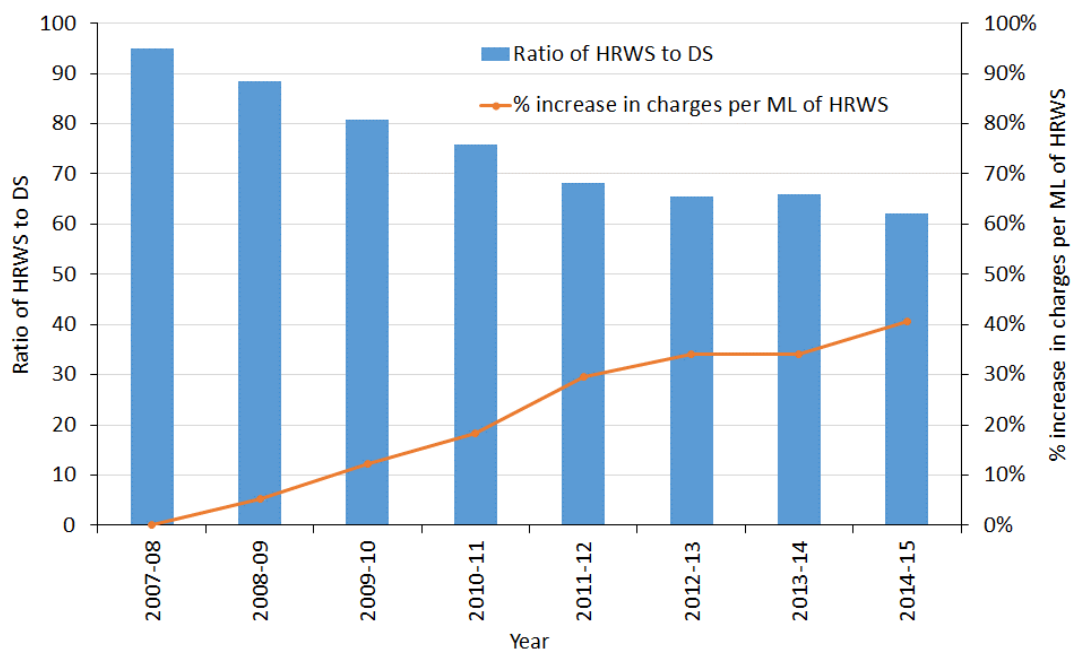


Figure 50: Ratio of High Reliability Water Shares to Delivery Shares and the percentage increase in Large Customer charges per ML of HRWS as HRWS is sold

Source: Delivery Share data provided by GMW.

8.4 THE DELIVERY SHARE CONUNDRUM

Because Delivery Share charges are tied to land, landholders must keep paying charges even after they sell their water entitlements – unless they pay to terminate their Delivery Shares. Under the Minister's *Water Charge (Termination Fees) Rules 2009*, the termination charge is capped at 10 times the annual infrastructure access fee.

During recent consultations on the 'reset' of the GMW Connections Project, many of GMW's customers complained that they did not need or want all of their delivery shares. They also said that they either could not afford to terminate them, or they did not believe that they should have to pay to

terminate them. Balanced against this however, was a general desire to remain connected to the system in an effort to maintain land values (TC&A, 2016).

This argument demonstrates a degree of cognitive dissonance, that is, it demonstrates a degree of the uncomfortable tension that comes from holding two conflicting thoughts at the same time. The theory of cognitive dissonance sees those contradictory thoughts serving as a driving force compelling the mind to acquire or invent new thoughts or beliefs, or to modify existing beliefs, so as to reduce the amount of dissonance (conflict) between attitudes, emotions, beliefs or behaviours. In the extreme, people's mental health can depend on them being able to reduce the conflict between those different thoughts.

The dissonance here is that on one hand many of the people consulted expressed a desire to reduce their delivery shares without having to pay the termination fees; on the other hand many were fearful of being disconnected from the delivery system, or giving up their delivery shares, for fear of a reduction in their property values. In part at least, this helps to account for some of the difficulties involved in delivering the Connections Project without the reset. In theory, the present value of the ongoing stream of delivery share charges should be discounted from property values in any case, but in practice people appear to be more willing to absorb smaller on-going annual liabilities rather than accepting a larger 'once-off' loss (TC&A, 2016).

The Victorian Government through its Water Plan: Water for Victoria has committed to a review of Delivery Shares.

8.5 TRANSFORMING THE GMID

There are two main aspects to modernisation, renewal and rationalisation. Renewal replaces old distribution infrastructure with modern equipment and technology that improves water efficiency. Rationalisation removes some infrastructure or channels or modifies them to provide different levels of service (DSE 2009).

Modernisation of the GMID began in the late 1990s through projects such as Central Goulburn 1234 and reconfiguration planning and implementation. The early programs set the basis for the Connections Project Stages 1 and 2. The Connections Project Stage 2 is due for completion on 31 October 2020. Irrigators, the Victorian Government, and Commonwealth Government and Melbourne water retailers have all invested heavily in the modernisation programs.

The modernisation programs are a key part of the Victorian Government's and GMW's approach to pursue the multiple objectives of recovering water for the environment without decreasing the volume of water entitlements available to consumptive users. It has also generated significant economic activity throughout the region.

In 2013 GMW released its Blueprint (GMW, 2013b), which contained a strategic framework to deliver three initiatives over five years. These were designed to bring together a number of the response measures discussed above. It was specifically designed to address the challenge that approximately 30% of the water within the GMID has been sold. It sought to:

1. Transform the business of GMW to make it lean and more customer focused

2. Redesign tariffs so they are simple and better reflect infrastructure costs in the future
3. Deliver the Connections Project and realise improvements in customer-service levels.

A core component of the Business Transformation Program was to deliver a reduction in total operating expenditure of \$20 million per year by 2018. By the end of 2015/16 \$8.4 million of annual savings were expected across the business (GMW 2013).

8.6 SUMMING UP

The dairy industry is the mainstay of the GMID. Less water delivered to dairy farms means irrigation customers' tariffs will increase significantly unless up to 40% of delivery system infrastructure in place before the GMW Connections Project began can be rationalised (GMW 2009). The random nature of Commonwealth water purchases across the region contribute to the difficulty of rationalising infrastructure.

The effect of lower deliveries on GMW's bottom line should be minimal while the business is protected by largely fixed tariffs. But more and more, irrigators are paying for delivery share they do not use. They are either unable or unwilling to pay for termination of delivery share. The Victorian Government has committed to reviewing this issue since GMW cannot be protected indefinitely.

The comparison between observed water use and the counterfactual outlined in Chapter 3 suggests that, at the system scale, there has been a 23–25% reduction in Victorian water use in recent years; at the same time irrigated horticulture has continued to expand. Before the Basin Plan and water recovery, mature horticultural irrigation requirements in the southern-connected Basin would have accounted for approximately 42% of the consumptive pool of high reliability entitlements. At current levels of water recovery the full maturity of the recently planted orchards are likely to account for 51% of the consumptive pool of high reliability entitlements (assuming that there is no further growth in horticultural production).

In fact, there is reason to believe that horticultural production will continue to expand. As outlined in Appendix 5, the approvals process for new irrigation developments in the Victorian Mallee is currently dealing with proposals that, at maturity, will require a further 25 GL, and Lower Murray Water staff have been approached by potential investors doing due diligence on proposals that might account for further 91 GL in the next three to five years. Not all of these proposals will proceed, but at this stage the trend is for continued horticultural expansion.

In the context of the continued expansion of non-interruptible irrigation enterprises in the southern-connected Murray-Darling Basin, the Basin Plan has reduced the heterogeneity of irrigation demands. It is putting pressure on the semi-interruptible enterprises like dairying because in times of drought both horticulture and dairying ultimately rely on a combination of the allocations against Victoria's high reliability water shares and allocations against the smaller pool of South Australian entitlements and NSW high security entitlements.

It is the quantum of the allocations against Victoria's High Reliability Water Shares in excess of horticultural irrigation demands, which will determine long-term average annual milk production in northern Victoria. In medium-wet years, the trade of allocations into Victoria from NSW will boost that baseline production. However, there is a limit to the allocation volumes that can be traded into Victoria, in order to ensure that the resource set aside for the traded commitment can be preserved in storage without spilling.

By contrast there are no limits on trade into the NSW Murray Valley from Victoria or South Australia. Similarly there is no volumetric limit on trade from the Murrumbidgee to Victoria or South Australia, but no more than 100 GL of traded water can be stored in the Murrumbidgee storages at any one time; traded water must be physically called out of the storages before additional trade can occur. More sophisticated IVT rules for the Victorian and NSW Murray could perhaps provide more advantages to Victorian dairy farmers in dry years and NSW rice growers in wet years.

By contrast, the rice industry is poised on the verge of possibly two plant-breeding breakthroughs that may enable it to adjust to the impacts of the Basin Plan. Water trade between regions and between industries will continue to be driven by relative returns as users become more familiar with their global water environment. If NSW is successful in its endeavours to increase returns per ML, either from rice (which currently uses 35-40% of available water) or from adopting better management strategies for its annual crops or increasing the scale of higher returning crops like cotton and horticulture, that may affect the size of the consumptive pool available to dairy farmers.

10 SOCIO-ECONOMIC IMPACTS OF THE BASIN PLAN

In broad terms, Neil Barr's treatise, *The House on the Hill* (Barr 2009) sets out the basis for establishing the counterfactual to be compared with observed changes in the socio-economic status of Victorian communities exposed to the impacts of the Basin Plan. Put simply, Barr (2009) explains the story of people leaving the land, the decline of football clubs, the disruptions in family farming dynasties and the rise of corporate agriculture. He further explains the ongoing decline of most small towns in Victoria as well as the continued, consolidated growth, for various well-explained reasons, in several key centres in regional Victoria. The Basin Plan may accelerate some of these trends, and slow others, but it did not cause them.

The specific counterfactual cannot yet be described however, because following in Barr's footsteps relies on observed changes in five-yearly census data. The most relevant available census data was collected in 2011, the year before buyback peaked. The previous census in 2005, in the midst of the millennium drought, predated the Basin Plan, and the data from the most recent census, in 2016, was not available at the time of writing.

As discussed in more detail below, for the sake of completeness, Appendix 1 records trends in population, employment, unemployment and median weekly income for several northern Victorian towns and centres where irrigation is important to the regional economy. The data there is drawn from the five censuses between 1991 and 2011. It will be for future writers, however, to observe any changes in these trends in the census data of 2016 and 2021. It will be for them also to establish the arguments about what might reasonably have been expected to have happened without the Basin Plan and make the necessary comparisons. We expect however that the first-principle arguments we have outlined in the earlier chapters will help them in that regard.

Changes to water use and irrigated production bring with them the potential for significant community and social change. Previous sections of this report have identified that water recovery under the Basin Plan has brought about change.

The data presented in Chapter 3 shows that the Basin Plan has decreased irrigation water use, especially on farms in communities in and around GMW districts. As explained in Chapter 6, it has also decreased irrigated production, especially on farms in communities in and around dairy regions. This can be expected to have flow on effects that will show up in future census data. As discussed in Chapter 6, the MDBA foresaw these impacts in the Socioeconomic Analysis that accompanied the Regulatory Impact Statement for the Basin Plan (MDBA, 2011c). It warned that the gross value of irrigated agricultural production there would be reduced by 12.9 per cent (\$88.2 million).

As outlined in Chapter 4, the Basin Plan provided benefits, at the farm scale, for those irrigators who participated in either the buyback, the on-farm efficiency measures or both. Data from the Victorian Water Register also indicates however that the majority of Victorian irrigators who participated in the buyback, but remained in irrigated farming, were more reliant on allocation purchases after the buyback than they were before. Water recovery under the Basin Plan has increased water allocation prices (for given seasonal conditions), and there are now a large number of farmers (especially dairy farmers) highly exposed to water allocation markets given their reductions in held water entitlement.

A key finding in Chapter 6 is that dairy farmers whose business models depend on allocation purchases are now confronting decisions about their willingness and ability to adopt more complex feeding strategies. Their farming risk has increased, but the nature of this risk was masked for four years by the high level of carryover resulting from the extraordinarily high rainfall years of 2010/11 and 2011/12.

As shown in Chapter 3 (Figure 13) allocation prices rose sharply in 2015/16, and as reported by DELWP (2016a) *“Uneasiness about the water market became apparent going into the spring of 2015, after many months of renewed rainfall deficiency. ... [And] Media outlets reported assertions about speculators ‘corrupting’ the market, and calls for such participants to be excluded”* (DELWP, 2016a). That report demonstrated that there had been no increase in trade by speculators, and it concluded that irrigators in the GMID whose business model include reliance on allocation trade would be competing with LMW diverters when NSW allocations were low. Put differently, the financial stress associated with running a dairy farm reliant on allocation purchases is a socio-economic impact of water recovery under the Basin Plan.

Water recovery under the Basin Plan has also been a significant contributing factor (in combination with continued horticultural development) to the change in expected water use by interruptible and semi-interruptible Victorian irrigation industries. Water use by farms in these industries (such as dairy and cropping) are expected to be more variable in the future and more significantly curtailed in the event of drought as a result of the water recovery undertaken to date (Chapter 6). This in turn is making the modernised off-farm infrastructure in the GMID less cost-effective, and it is therefore driving up the marginal fixed costs associated with each ML of annual average use in the GMID (Chapter 8).

In combination with the continued horticultural expansion outlined in Chapter 5, water recovery under the Basin Plan has resulted in Victorian horticultural crops requiring 40% of the total available water when allocations against Victorian High Reliability Water Shares are 100%. This compares with 32% in the counterfactual, and as will be explained in Chapter 11, if there is further water recovery, this would rise to 46% in the 2750 GL and 51% in the 3200 GL water recovery scenarios. In a repeat of 2008/09 allocation levels (35% on the Murray and 33% on the Goulburn) more horticultural land would be at risk of being dried off as a direct result of water recovery under the Basin Plan. This increased risk to Victorian horticulturalists is a socio-economic impact of the Basin Plan.

Translating these impacts into socioeconomic impacts is complicated by the wide range of other factors that affect individuals and communities and contribute to social wellbeing — which in the absence of the 2016 and 2021 census data currently prevents the establishment of a defensible detailed counterfactual. However, a robust counterfactual must include long-term trends that have been observed such as the declining role of agricultural jobs in total employment (discussed later and observed in available census data, 1991 to 2011).

There is a range of social metrics available that provide insights into the social and community impacts of water recovery under the Basin Plan. These include:

- Population and demographics
- Employment, and the composition between different industries

- Income
- Wellbeing

This class of information has been used previously by the EBC consortium (2011) to consider the potential community impacts of the Basin Plan. The map below includes different categories of relative vulnerability:

- Category 1 (purple): Small towns that are highly dependent on irrigated agriculture — Reductions in water availability could increase the speed and extent of these changes for those communities
- Category 2 (blue): Small diverse towns with high-value irrigation, tourism and other sectors — They are insulated to some extent from the impacts of reduced water availability
- Category 3 (orange): Larger towns that are highly dependent on irrigated agriculture — These centres are robust with current diversion limits but would be highly exposed to proposed reductions in water availability
- Category 4 (brown): Large, diverse growing regional centres — These are relatively insulated from reductions in water availability in the region

EBC (2011) note that it is very important to recognise that relative vulnerability does not necessarily mean that towns will be more negatively affected by the Basin Plan. Other factors are also important; in particular, the relative exposure of towns to the proposed changes is critical. Not all vulnerable towns will necessarily face significant reductions in irrigation activity under the Basin Plan.

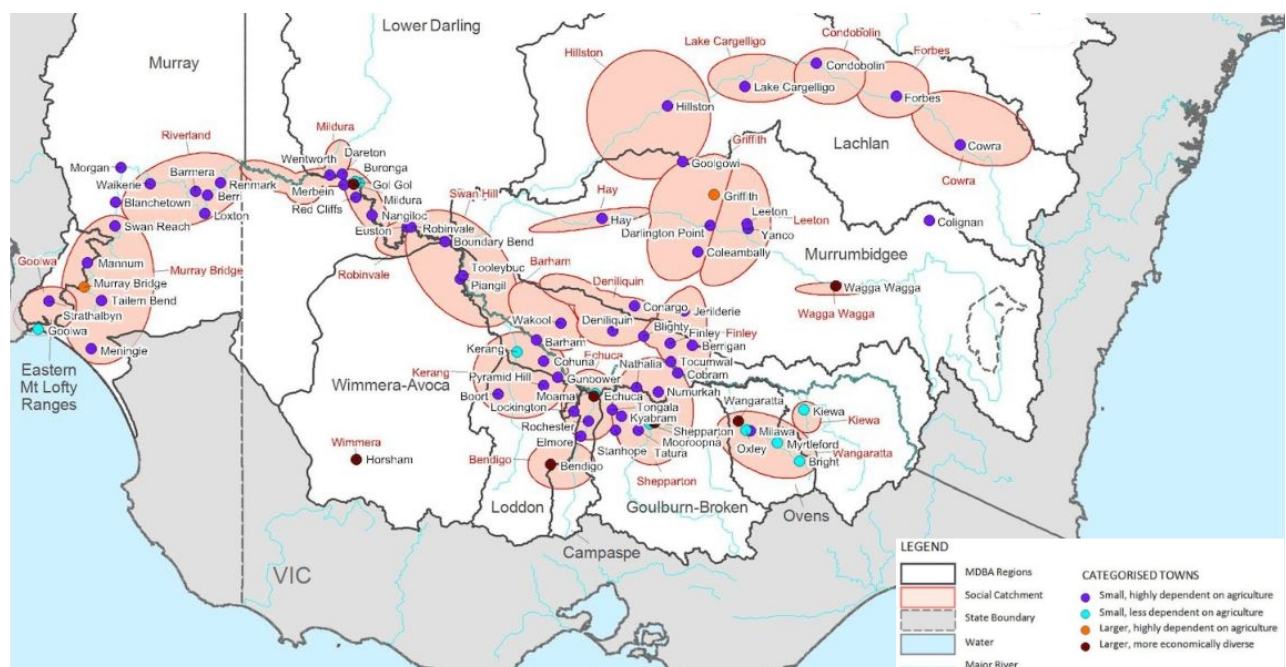


Figure 51: Social catchments in the southern Murray-Darling Basin (and Lachlan), showing relative vulnerability of towns to reduced irrigation

Source: EBC 2011

Table 13: Category 1 towns in Victoria by CMA region

Mallee	North Central	Goulburn Broken	North East
Merbein	Boort	Tatura	Kiewa *
Red Cliffs	Bridgewater*	Nathalia	Myrtleford
Robinvale	Cohuna	Numurkah	
	Elmore	Cobram/Barooga	
	Kerang	Kyabram	
	Newbridge*	Rochester	
	Pyramid Hill	Stanhope	
		Lockington	

*Category 1 or 2

The only Category 3 town identified in Victoria was Echuca/Moama (category 3 or 4).

Social evidence is primarily obtained from the ABS Population Census. Although a census was conducted in 2016, the latest available census data is from the 2011 census. This means that much of the available social data is useful for understanding the context of potential social change, rather than providing evidence that the water recovery under the Basin Plan has resulted in particular types of change in particular localities.

One source of more recent data is the University of Canberra Regional Wellbeing Survey that was conducted in 2013, 2014 and 2015. The 2014 data has been used to prepare “People and communities” and “Farmers and agriculture” reports (plus an additional release on dairy farmer wellbeing) — discussed below. The forthcoming “Environment and natural resource management” report analyses the Murray-Darling Basin Plan — participants were asked if they had views about the Basin Plan, and if they did, they were asked their views about the process and impacts of the Plan.

The DEDJTR team working with the data from the Regional Wellbeing Surveys was able to provide the data relating to the Basin Plan for this project. They had only recently received access to the 2015 data, so it is graphed for the first time in Appendix 1.

10.1 ABS DATA

Each census, employment data is collected down to the level of subgroups of industries as defined by the Australian and New Zealand Standard Industrial Classification (ANZSIC). In line with the ABS production data, the employment information is used at the NRM level.

The table below demonstrates the significance of dairy farming to employment in Goulburn Broken, North Central and North East. Employment in dairy product manufacturing is nearly as great, with a greater concentration in the Goulburn Broken region. Fruit and tree nut growing is similarly important to employment, with the greatest employment in the Mallee. The distribution of fruit and vegetable processing employment is focused in the Goulburn Broken for this 2011 census data and this may have changed for the forthcoming 2016 census data due to changes in the fruit industry moving from canning to fresh fruit.

Table 14: Regional employment data by industry

	Goulburn Broken	Mallee	North Central	North East	Total
Dairy Cattle Farming	1,872	0	1,128	480	3,480
Dairy Product Manufacturing	1,233	7	551	275	2,066
Fruit and Tree Nut Growing	1,246	1,882	549	277	3,954
Fruit and Vegetable Processing	1,140	271	283	39	1,733
Total	5,491	2,160	2,511	1,071	11,233

Source: ABS census data

Additional detail is available as these industry types are disaggregated to the lowest level collected (the 4-digit ANZSIC categorisation) as in the table below.

Table 15: Regional employment data by 4-digit ANZSIC categorisation

	Goulburn Broken	Mallee	North Central	North East	Total
Manufacturing					
Fruit and Vegetable Processing	1,139	271	283	40	1,733
Dairy Product Manufacturing, nfd	38	0	16	18	72
Milk and Cream Processing	125	0	193	64	382
Ice Cream Manufacturing	8	0	0	8	16
Cheese and Other Dairy Product Manufacturing	1,065	4	338	191	1,598
Agriculture					
Dairy Cattle Farming	1,871	0	1,128	480	3,479
Fruit and Tree Nut Growing, nfd	690	102	98	22	912
Grape Growing	123	1,230	153	130	1,636
Kiwifruit Growing	26	0	0	21	47
Berry Fruit Growing	35	4	7	12	58
Apple and Pear Growing	184	0	57	36	277
Stone Fruit Growing	134	26	161	14	335
Citrus Fruit Growing	17	314	20	0	351
Olive Growing	20	21	41	19	101
Other Fruit and Tree Nut Growing	15	189	16	16	236
Total	5,490	2,161	2,511	1,071	11,233

Source: ABS census data

To provide additional socio-economic context for the regions on northern Victoria, summary charts are provided in Appendix 1. A common trend is the declining role of agricultural jobs in total employment, over the period to 1991 to 2011.

10.2 REGIONAL WELLBEING DATA

The 2015 Regional Wellbeing Survey included a number of questions asking survey respondents about their expectations of how the Basin Plan would impact:

- the health of the environment in the Murray- Darling Basin
- the economy in the Murray- Darling Basin
- communities in the Murray- Darling Basin
- the Murray-Darling Basin as a whole
- the respondent's household
- the business the respondent works in
- the respondent's local community
- the health of the respondent's local environment

Appendix 1 reports the responses provided by 285 Victorian irrigators in north-west and north central Victoria (the Loddon-Mallee and Hume RDAs). A high proportion of responses considered that the Basin Plan would have a 'very negative' impact on the economy and communities of the MDB and the household/business/community that the respondent worked in.

The "Farmers and agriculture" report (UC 2015) looked at irrigators who have invested in improving on-farm irrigation infrastructure in the last five years.¹⁷ Victoria had the lowest proportion of irrigators who had made such investments (55%), compared to the Australian average of 61%. Of all irrigators surveyed, 23% responded that a Government grant was a source of funding used to invest in on-farm irrigation infrastructure (however, this is not reported by State). Farmers who had invested in upgrading infrastructure reported, on average, very similar life satisfaction to those who had not.

The survey also asked questions about water trade. 7% of Victorian irrigators responded that they had sold water shares to the government in 12 months to October 2014. Over the same period, 7% bought water shares, 11% planned to buy water shares but did not, 6% sold water shares to a private buyer, and 6% planned to sell water shares but did not.

Irrigators who had sold or transferred entitlements, or who had wanted to sell but had not done so, were asked why they wanted to sell entitlements (Figure 11.15). They could select more than one reason for wanting to sell. At the Australian aggregate level, the most common reasons were financial: high fixed entitlement charges (41%), and a higher relative return being achieved by selling water versus using water on their own property (35%). This was followed by having opportunity in the form of surplus water (31%). Financial necessity was a driver of many sales, particularly low return from the farm business (27.5%), and needing to reduce debt (27%). Others were selling entitlements to fund other farm investments (27%). Less commonly, irrigators transferred entitlements as part of requirements to access infrastructure upgrade programs (20%). Least common was selling as part of

¹⁷ http://www.canberra.edu.au/research/faculty-research-centres/ceraph/regional-wellbeing/survey-results/2014-survey-results/Farmers-and-agriculture_LR.pdf

downsizing the farm enterprise (14%) or planning to exit farming (9%), although this sample does not include those irrigators who sold and subsequently exited.

The most common reasons for buying allocation were needing additional water to meet farm business needs (72%), and low rainfall (71%). Just over a quarter of those who reported buying allocation did so because they were using a business model in which they had sold all entitlements and instead obtained water by buying it on the temporary market (26%). As the representativeness of respondents to these questions is not known there is a large potential margin of error for these findings.

The dairy farmers surveyed were dominated by Victorian dairy farmers (87% of the sample)¹⁸. However, this would have included dairy farmers outside northern Victoria, such as in Gippsland. In 2014, dairy farmers on average reported higher 'global life satisfaction' compared to other farmers. Dairy farmers also were much more likely to be engaged in water allocation purchases than the 'all farmers' average.

¹⁸ <http://www.canberra.edu.au/research/faculty-research-centres/ceraph/regional-wellbeing/survey-results/Dairy-Farmer-Wellbeing-2014.pdf>

11 THE IMPACTS OF THE BASIN PLAN FOR THREE FUTURE SDL SCENARIOS

This section considers the impacts of three future SDL scenarios. The scenarios are:

- The recovery of 2,100 GL (i.e., with 650 GL of offsets being subtracted from the Basin Plan target recovery of 2750 GL).
- The recovery of 2,750GL, which is what is targeted in the Basin Plan – without any offsets being achieved.
- The recovery of 3,200GL, which includes the Basin Plan target of 2750 GL plus an additional 450 GL recovered through on-farm efficiency measures achieved with neutral or positive socio-economic impacts.

The composition of the required water recovery for each scenario is set out in Appendix 2.

11.1 A BROAD COMPARISON WITH THE COUNTERFACTUAL

The scenarios for future water recovery all involve constraints on water availability (as compared to the counterfactual of no Basin Plan water recoveries).

In terms of additional water recovery:

- The low water recovery scenario — the additional water recovery required (beyond that already contracted in 2015/16) is negligible.
- The medium water recovery scenario — the additional water recovery required from 2015/16 is in the order of 650GL LTAAY.
- The high water recovery scenario — the additional water recovery required from 2015/16 is in the order of 650GL LTAAY as above plus an additional 450GL from on-farm efficiency investment, totalling 1,100GL LTAAY.

Even though the low water recovery scenario would not require significant additional water recovery, the future impacts would include the impact of current water recovery when drought conditions return as well as the interaction between industry changes and the reduced consumptive pool of water available for irrigation and urban use (as compared to the counterfactual of no water recovery) under future climate variability and potential climate change.

In the absence of Basin Plan water recovery, the growth of horticulture in the north-west of Victoria is still expected to occur. This in itself changes the structure of water demand between relatively fixed horticultural demands and the interruptible and semi-interruptible water demands that coexist in the southern MDB.

The water recovery activities will also change the structure of water demand, directly and indirectly. On-farm water recovery projects will directly change the way in which water is used on the farm invested in: this may be new investment that would not have otherwise occurred; or may bring forward investment that would have occurred in the future; or it may subsidise investment that was already going to occur. There will also be indirect effects on the way farmers intend to use water as

they adapt to the higher opportunity cost of water (i.e. water allocation prices) and the increasingly variable water available for use by interruptible and semi-interruptible water demands.

11.2 IMPACTS AT THE FARM SCALE

The combination of water recovery and industry change into the future is expected to increase water allocation prices (for given seasonal conditions), as it has already done over the period of Basin Plan implementation to date.

Price impacts in water allocation markets would be expected to be greater for higher scenarios of water recovery. Importantly, the effect of on-farm investments to secure water recovery (such as the 450 GL of up-water from Efficiency Measures) are less well understood than the effects of water recovery through buyback or delivery system upgrades.

Analysis presented in Appendix 4 finds that on-farm water savings are expected to have price effects similar to delivery system water savings in wet-to-average years, but the price effects of on-farm water savings projects are closer to that of buyback when conditions are drier. In aggregate, these price effects influence the outcomes for those farm enterprises that did not participate in on-farm program, or may temper the direct benefits enjoyed by program participants.

These changes to the price of water allocations would encourage changes to water use given that water allocation prices represent the opportunity cost of using water. The effect of this would be expected to be negative on those farmers that are reliant on water allocation purchases (i.e. their holdings of water entitlements are not sufficient to provide for water demands that must be met). The effect would be expected to be positive for those farms that are highly flexible in their water use and can sell allocations for higher prices.

11.3 IMPACTS AT THE SYSTEM SCALE

At the system scale, the impacts of water recovery scenario would occur in the context of future impacts, including:

- Maturation of current horticultural investments
- Continued expansion of horticulture
- Climate variability and climate change

As discussed throughout this report, water recovery to date has changed consumptive water availability. The increase in horticultural demand has compounded this effect to reduce the water that might be expected to be used by Victorian dairy and cropping (see figure below). The charts below represent the expected distribution of water availability to consumptive use in northern Victoria. The horizontal axis aligns the outcomes from the seasonal conditions observed in the past 20 years. The blue bars are the total volume allocated to Murray and Goulburn entitlements. The orange bars are the (relatively) fixed water demands of horticulture in the Victorian Mallee and GMID. The volumes are not observations, but rather the estimated consumptive pool and horticultural demands pre-Basin Plan and at current levels of water recovery and horticultural development. (The calculations are explained in Appendix 5.)

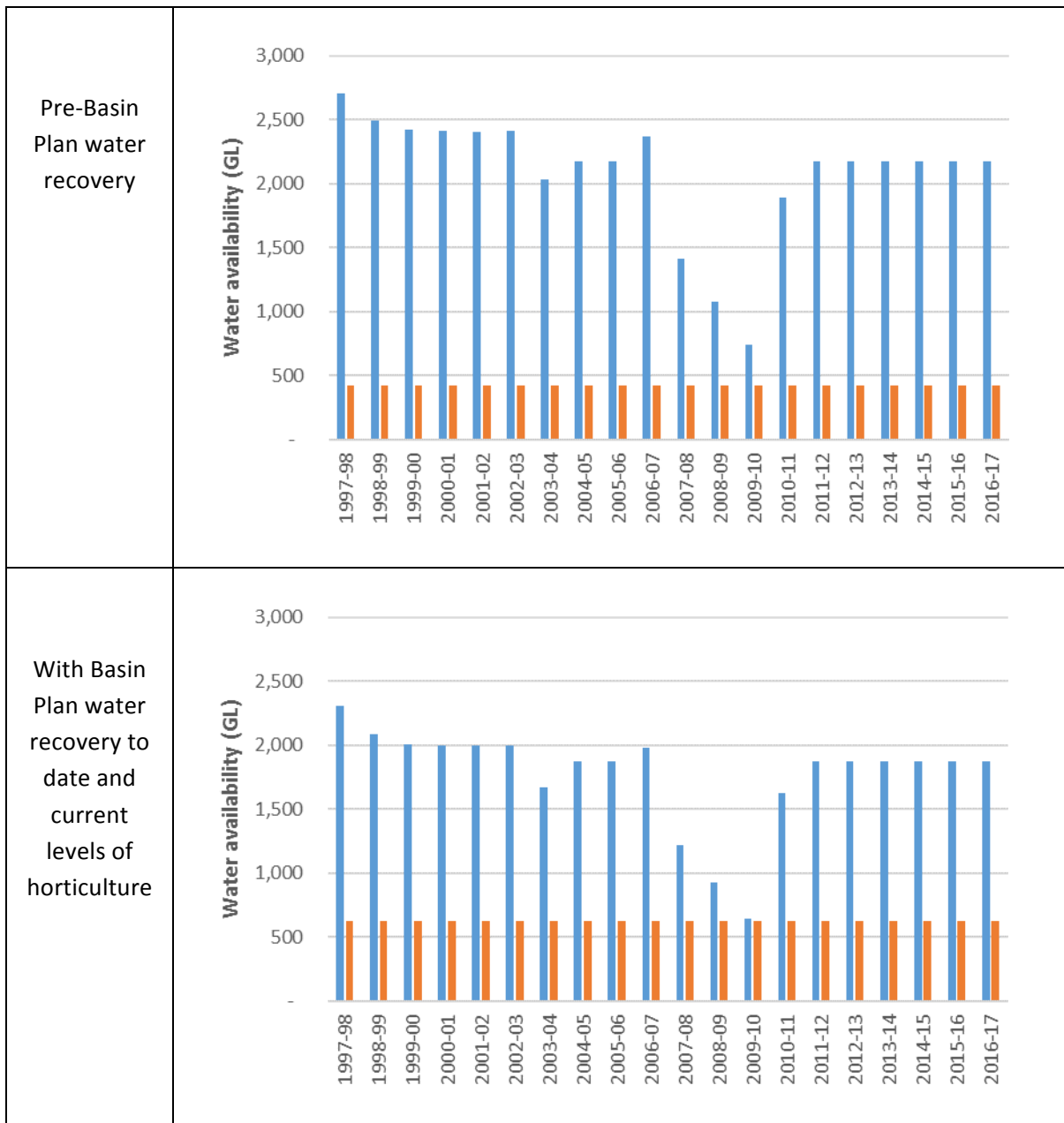


Figure 52 Distribution of water availability (pre-Basin Plan and current) (ML)

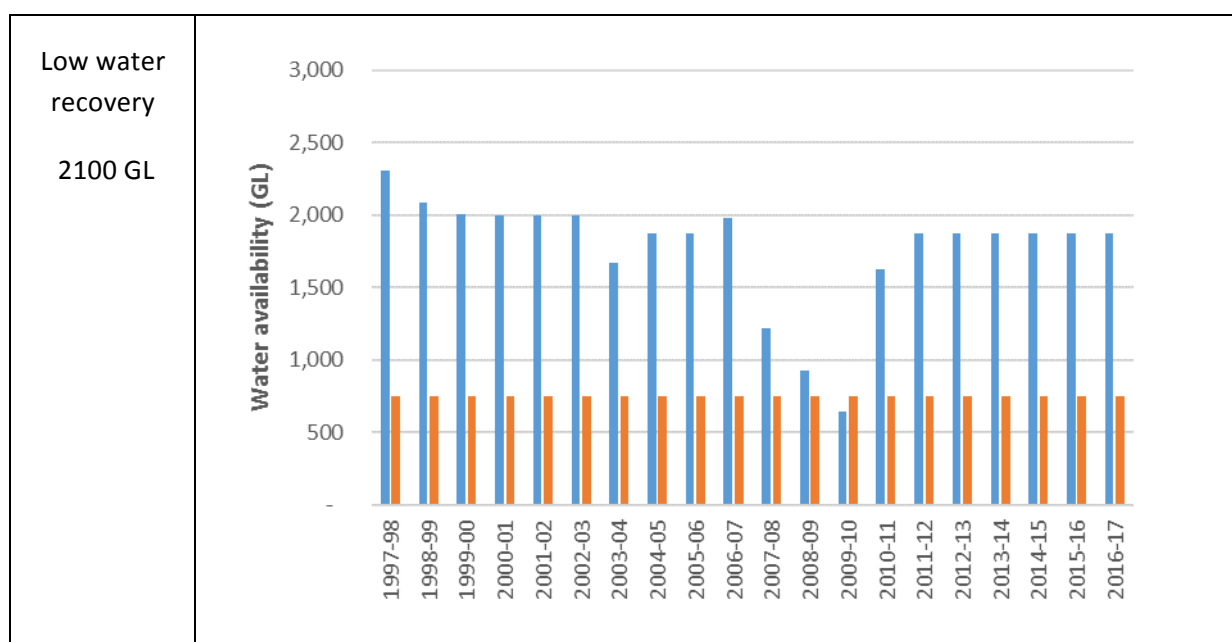
Note: Horticultural demand is charted as 423GL pre-Basin Plan (326GL Mallee plus 97GL GMID) and 623GL current (526GL Mallee plus 97GL GMID) based on the data in Appendix 5. Current water recovery is in line with achieving 2100GL.

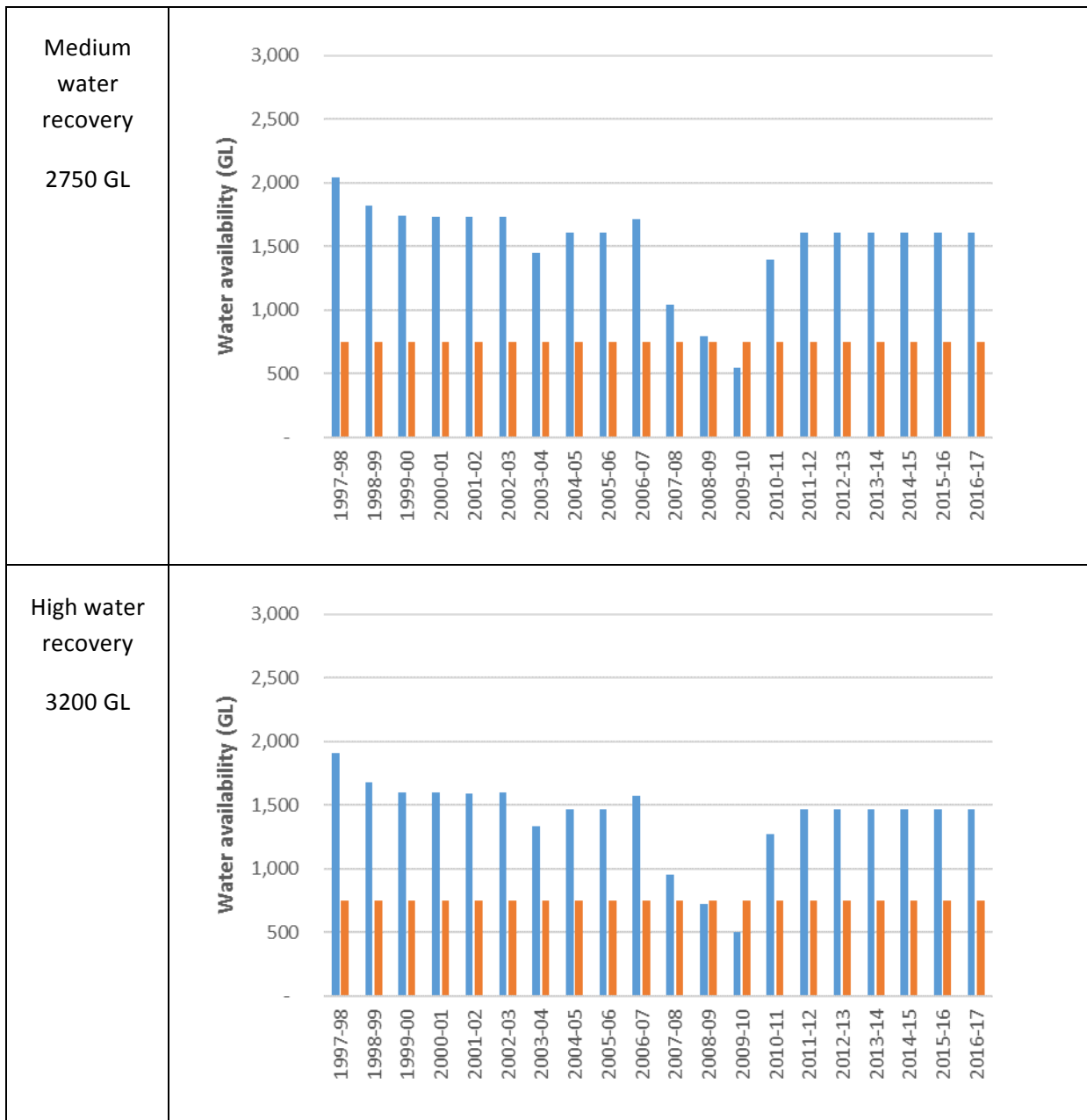
Overall, a decrease in the water that might be expected to be used by Victorian dairy and cropping (the blue bars above the orange bars) has been observed. In order to interpret the figure, the table below presents a number of metrics. The metrics are also presented for the counterfactual, where industry change has occurred to current levels but water recovery has not occurred.

Table 16: Metrics comparing the distribution of water availability (current)

	Pre Basin Plan	Current observations with water recovery	Current counterfactual: without water recovery
Average volume in excess of horticultural requirements (GL)	1665	1150	1465
Coefficient of variation of volume in excess of horticultural requirements	0.29	0.35	0.33
Allocations/Entitlements in excess of horticultural requirements in repeat of 2008-09 drought	18%	1%	8%

Into the future, the horticultural water demands are expected to increase (Aither 2016a). At a minimum, this is from the maturation of current planting (estimated to be 652.2 GL in the Mallee – see Appendix 5) plus existing horticulture totalling about 97GL (RMCG, 2016) in the GMID. Using this, the charts below present the water availability distribution information for the low, medium and high scenarios of water recovery.





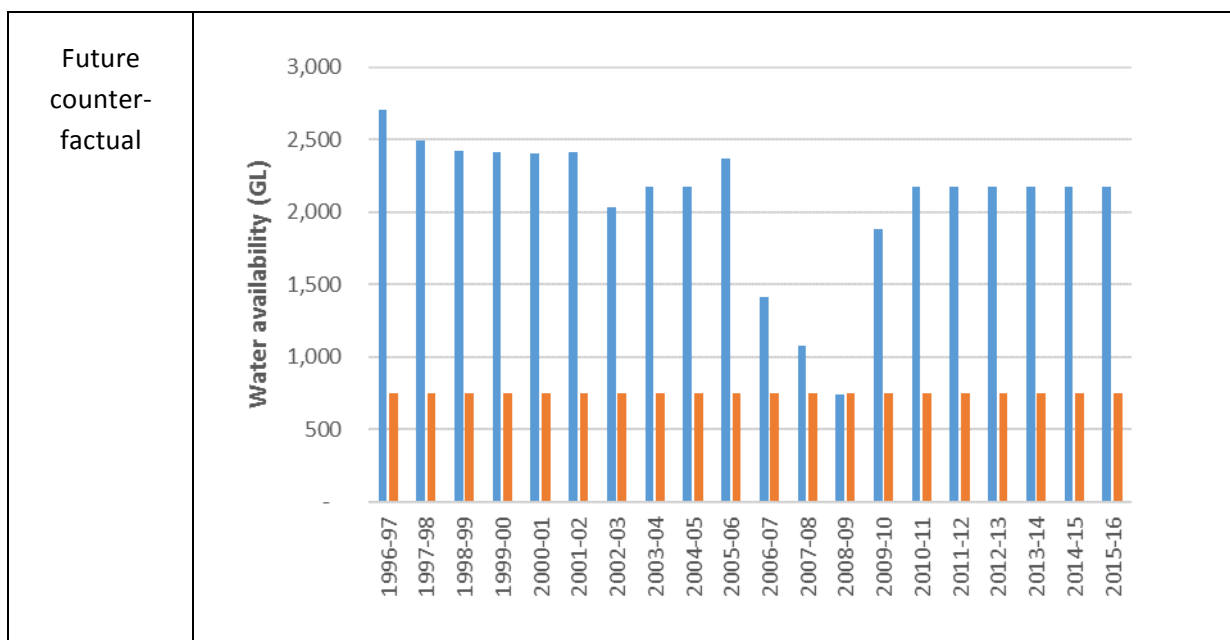


Figure 53 Distribution of water availability (future scenarios)

Note: Future horticultural demand is charted as 749GL (652GL from the maturation of current plantings in the Mallee plus 97GL in the GMID). Low water recovery is in line with achieving 2100GL, medium water recovery 2750GL and high water recovery 3200GL.

These scenarios can be compared using the previous metrics (as presented in (Table 17)). This suggests that, even at the current level of water recovery (the low water recovery scenario) there will not be enough (-10%) water allocated in northern Victoria to maintain Victorian Mallee and GMID horticulture in a severe drought, let alone any other water user. Further, the growth of horticulture and the water recovery to date mean that the outcomes of a severe drought will be more acute than observed in 2008/09 (when Allocations/Entitlements in excess of horticultural requirements were 18% — see table above). Under the medium and high scenarios, this threshold is significantly breached.

Table 17: Metrics comparing the distribution of water availability (future scenarios)

	Low water recovery scenario	Medium water recovery scenario	High water recovery scenario	Future counterfactual: without water recovery
Average volume in excess of horticultural requirements (GL)	1024	783	655	1339
Coefficient of variation of volume in excess of horticultural requirements	0.39	0.45	0.50	0.36
Allocations/Entitlements in excess of horticultural requirements in repeat of 2008-09 drought	-10%	-23%	-34%	-1%

The average volume that might be expected to be used by interruptible and semi-interruptible water demands reduces significantly as the future water recovery increases. Importantly, this volume is also increasingly variable (as measured by the increasing coefficient of variation).

An expected consequence of this would be a decrease in average year milk production. Although the exact change will depend on how dairy farms can adapt to these changes into the future, the magnitude would be expected to be significant. For example, the broad magnitude of the reduction in the 20-year average volume (in excess of horticultural requirements) of 1,665 GL to 1,150 GL (-31%) observed from pre Basin Plan implementation to current, aligns with the broad magnitude of the reduction in GMID milk production. The future scenarios observed a further reduction in the average volume (in excess of horticultural requirements) to 1,024 GL (-38%), 783 GL (-53%) and 655 GL (-61%), respectively for the low, medium and high water recovery scenarios. Offsetting the impact of these reductions on milk production would be the benefits of dairy farm adaptation strategies (including on-farm investments funded by the Commonwealth or otherwise). Productivity improvements and water use efficiency improvements would mean that the magnitude of any production impacts are not as great as the magnitude of the change in water available for use. This mitigating factor may be short-lived if many on-farm water recovery projects are bringing forward investment that would have occurred in the future.

The reduced water availability for the types of water use that occurs in GMID raises concerns that thresholds may be reached for dairy processing or GMW viability.

- Dairy processing sector (under capacity or factory closure)
- GMW viability (increasing likelihood of years when GMW delivery would cease or be significantly curtailed)

The impacts would also be greater if recalculated for the expected additional horticultural investment (of varying certainty) that has been approved or proposed in the Mallee region and surrounds. The 652.2GL (based on mature water use of current plantings) could be defensibly revised upwards by the between 50GL and 200GL (see Appendix 5). The above calculations are based on only maturation of current plantings, rather than expected future investment, in order to provide a conservative estimate of expected water availability issues.

The impacts would also be significantly greater if climate change shifts the hydrological variability from the historical record to lower levels of aggregate water availability.

This analysis of the distribution of water availability focuses on Victoria, because of the extensive hydrological modelling that has been undertaken to inform the Northern Region Sustainable Water Strategy. Analysis was also undertaken on the 125-year historical record, and the two climate change scenarios that were presented in the Sustainable Water Strategy. In further assessing the socio-economic impacts of water recovery, the MDBA would be well placed to bring together compatible hydrological modelling results for all systems for the southern MDB, between which water can be readily traded.

An approach to broaden the above analysis to the southern MDB is to consider the consumptive water availability across the connected system, and the allocation levels that would be required to meet the combined horticultural demands in the region.

Section 5.4 presents an estimate of total combined mature horticultural water demand of 1,393.3 GL for the entire southern MDB. Under extreme dry conditions, such water demands are likely to be the marginal water purchasers (as was observed in the late 2000s when water allocation prices of \$1,200 per ML were observed). Also, under dry conditions, Victorian LRWS and NSW General Security licences are unlikely to receive allocations and therefore the analysis is focused on high reliability entitlements in NSW, Victoria and South Australia.

Table 18 presents the allocation levels to entitlements held in the consumptive pool that are required to meet the horticultural water demand of 1393.3GL. It is assumed that NSW high security licences receive 95% and that Victorian and South Australian high reliability entitlements receive the same allocation determination. Further, the estimates are based on water recovery via on-farm investment occurring on interruptible and semi-interruptible farms, such that the horticultural water demands are not reduced.

Table 18: Breakeven allocation levels to meet horticultural demand of 1393.3GL

	Prior to water recovery	Current / low water recovery scenario	Medium water recovery scenario	High water recovery scenario
NSW HS	95%	95%	95%	95%
VIC HRWS	32%	40%	46%	51%
SA High	32%	40%	46%	51%

The table shows how continued water recovery (in the context of increased future horticultural demands) lead to an increase in the 'break even' level of allocations required. This means that there is an increased likelihood of such a threshold being breached.

The dry year water availability may also be considered as a ceiling to horticultural investment in northern Victoria and the southern MDB more broadly. By reducing the water available in the consumptive pool in years of extreme drought — when it is required to meet the fixed water requirements of horticultural biological assets (trees and vines) — the Basin Plan water recovery can be considered to have limited the expansion of horticultural investment. If further water recovery is pursued then this may put at risk the water requirements for current investment. The table below presents a Victorian perspective, and it should be noted that this is an estimate of investment dollars, not production or value-added dollars.

Scenario	Potential impact on Victorian horticultural investment
2100 GL recovery scenario	<p>At current levels of water recovery, in a repeat of 2008-09 allocation levels there would be 16 GL more water available than it takes to meet the full irrigation requirements for horticulture. When the existing plantings mature however, there would be a shortfall (-110 GL).</p> <p>Without water recovery, there would still have been a small shortfall as existing planting mature of 8 GL of High Reliability Water Shares. Developers need to be aware of this risk, but based on the historical record they may judge that the risk is worth taking.</p> <p>At 12ML/ha the additional shortfall of 103GL could have developed another 8550ha. At \$19,000/ha this is \$162 million of total investment that has hypothetically already been forgone.¹⁹</p> <p>An alternative way of considering is that, when the existing plantings mature, the additional shortfall of -103GL puts 8850 ha of existing horticultural development at risk, which represents \$162 million of existing investment.</p>
2750 GL recovery scenario	Under medium future water recovery, there would be an additional shortfall of -193GL in a repeat of 2008-09 allocation levels. This puts 16000ha of existing plantings at risk, which represents \$306 million of existing investment.
3200 GL recovery scenario	Under high future water recovery, there would be an additional shortfall of -241GL. This puts 20000ha of existing plantings, at risk, which represents \$381 million of existing investment.

¹⁹ This is at the conservative end of development costs provided by from DELWP (Mildura).

At the southern MDB scale, horticultural investments are underpinned by high reliability water entitlements. In the drought years (before water recovery commenced, most of the water available came from allocations to Victorian High Reliability water shares (HRWS), NSW High Security entitlements (in the Murray and Murrumbidgee), and South Australian High reliability. In 2007/08 there was 0% allocated to NSW Murray General Security entitlements and 13% allocated to NSW Murrumbidgee General Security entitlements. In 2008/09 there was 9.6% allocated to NSW Murray General Security entitlements and 21% allocated to NSW Murrumbidgee General Security entitlements.

The water use in each of these years is estimated in the chart below. The water use by horticulture is estimated to have grown, while water use in other industries respond to seasonal water availability.

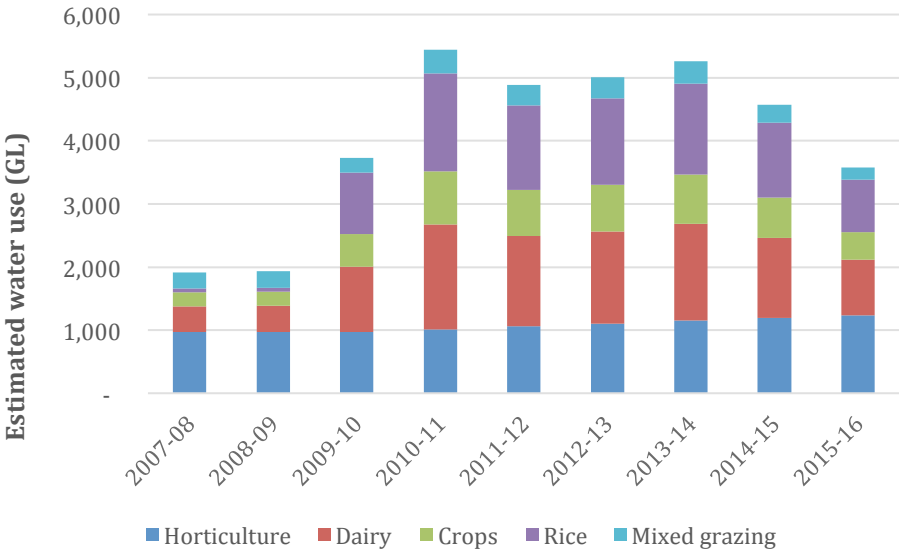


Figure 54 Estimated historical water use in the southern-connected Basin

It should be noted that these estimates attribute allocated water to industries based on their geographic use, actual water use could differ to these estimates as a result of carryover.

If this sequence of water allocations were to be repeated, then given the current level of water recovery and the maturation of existing horticultural plantings, then proportionally the horticultural industries would account for a larger proportion of total use.

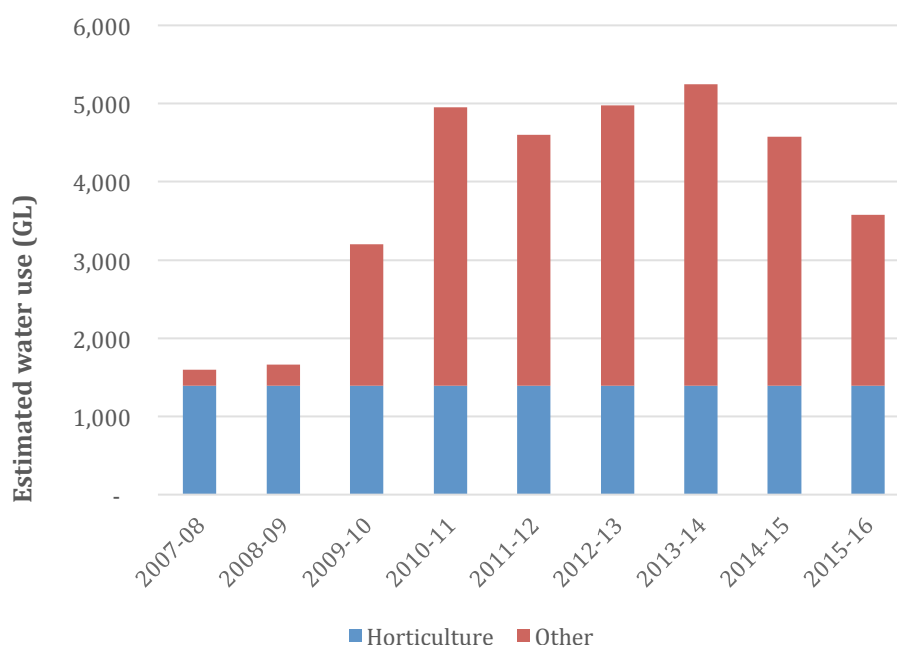


Figure 55 Estimated water use in a repeat of historical conditions, given current horticultural development

In the drought year of 2008/09, total trade out of the Murrumbidgee (which was shored up by allocations against the high security entitlements surplus to the requirements of then extant horticultural plantings in the Murrumbidgee) was 165 GL. Because this is higher than volume that can be set aside, at any one time, under the current Murrumbidgee Inter-valley Transfer (IVT) limits, it is important to understand the implications of the current rules for a repeat of those drought conditions.

The chart below shows that the IVT would be expected to effectively limit all non-horticultural water use to within the Murrumbidgee valley. This assumes that the Murrumbidgee IVT limits trade out of allocations to Murrumbidgee general security to 100GL annually — in reality, the IVT operation is more complex and would also constrain trade out of allocations to Murrumbidgee high security as well since the volume of Murrumbidgee High Security licences (380GL) exceeds Murrumbidgee horticultural demand (160GL).

In a repeat of 2008/09 involved lower allocations to NSW General Security licences, then water availability would be further constrained. If instead NSW General Security allocations were in line with 2007-08 level, then the water allocated in the southern-connected Basin would be roughly equal to total horticultural requirements — however 120GL of this would be constrained within the Murrumbidgee due to the IVT; a shortfall of 119GL for horticulture would therefore result. If there were 0% allocations against NSW General Security entitlements, there would be a shortfall of 219GL in meeting horticultural requirements (Figure 56).

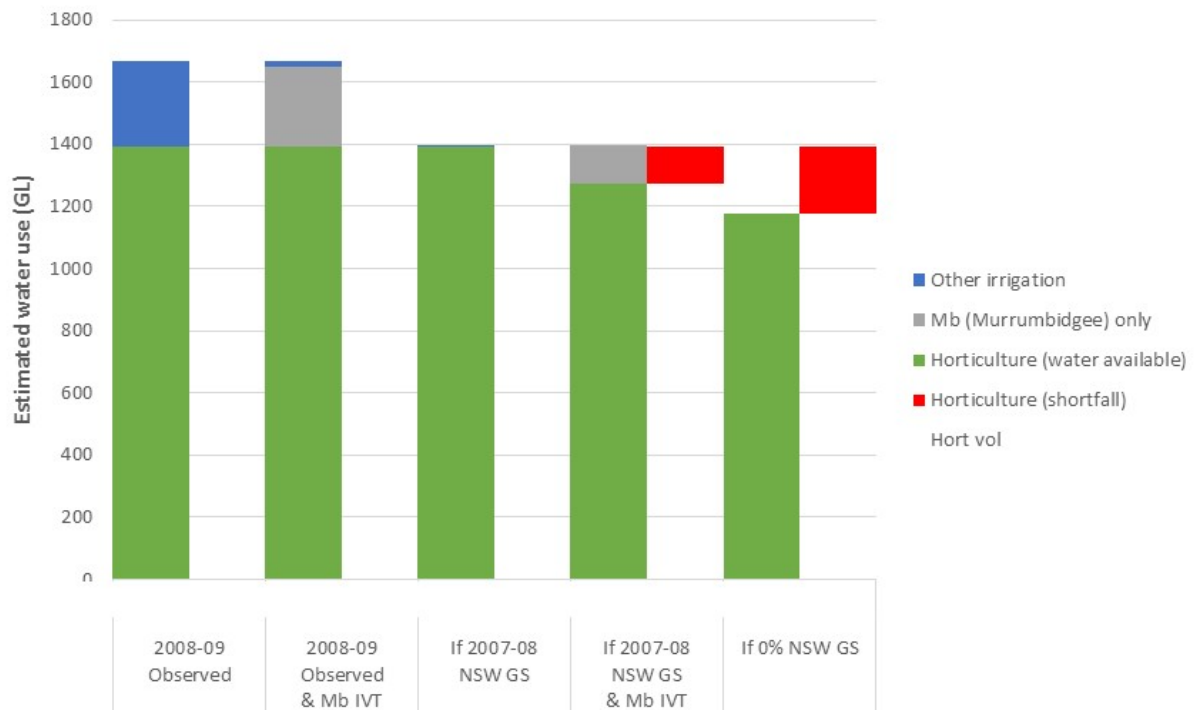


Figure 56 Distribution of water use in a repeat of 2008/09, with IVT and/or reductions to NSW GS

The charts above integrating current water recovery also form the low water recovery scenario presented in this report.

Figure 57 brings together the estimated water use under the observed conditions 2007/08 and 2008/09, with the water availability that would exist under similar seasonal conditions in the future when horticultural demands are 1393GL and the low-, medium- and high-water recovery occurs.

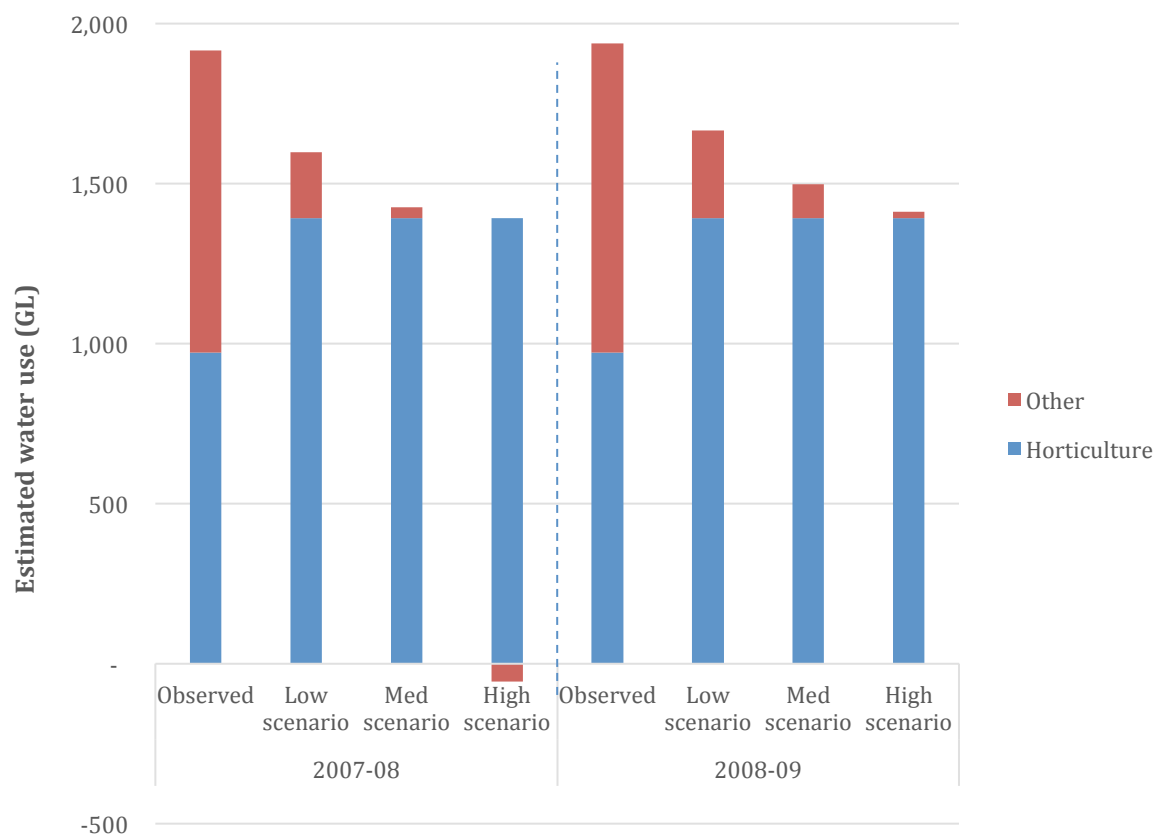


Figure 57 Distribution of water use in repeat of 2007/08 and 2008/09, and water recovery scenarios

Under a repeat of these dry conditions, horticultural demands might be met under the current/low water recovery scenario. However, under the medium and high water recovery scenarios, shortfalls would eventuate especially once the consequences of the Murrumbidgee IVT are taken into account.

11.4 IMPACTS IN GEOGRAPHIC INDUSTRY CENTRES

The impact of future scenarios would be expected to be concentrated in the same communities and geographic industry centres that were identified to be relatively vulnerable to impacts from the Basin Plan (as identified in Chapter 10).

Impacts from reduced potential milk production would be concentrated in GMID, with flow on effects in towns where dairy processing occurs.

Drought impacts that require significant rationalisation of horticultural developments would involve competition between horticultural farms in Victoria, NSW and SA with adjustment expected (to varying degrees) in all States.

12 ENVIRONMENTAL OUTCOMES AND BENEFITS

12.1 THE METHOD USED TO DETERMINE SDLS

The Commonwealth Water Act 2007 requires the Basin Plan to limit the amount of water that can be taken from the Murray-Darling Basin for use over the long-term. The Basin Plan aims to do this through the establishment of new long-term sustainable diversion limits (SDLs), which come into effect in 2019.

These SDLs will replace the existing cap on water use and are set at both catchment and Basin-wide scales. The Water Act 2007 requires these limits to be determined through an assessment of the Environmentally Sustainable Level of Take, or ESLT. To fulfil that requirement, the MDBA assessed how much water can be taken from the Basin without compromising the environment (MDBA 2011a).

The MDBA (2011b) developed a method for determining the ESLT, which it presented in a report along with the outcomes of the assessment. The method involved adopting the basin-wide objective to achieve a healthy-working basin and then determining associated ecological objectives. More specific flow-related ecological targets were then set. The MDBA (2011a) then designed flow targets to protect or reinstate ecologically significant parts of the flow regime in order to sustain:

- the current extent of water-dependent habitats and vegetation communities in a healthy, dynamic and resilient condition — for their intrinsic values as well as the habitat they provide for conservationally-significant fauna
- viable populations of conservationally-significant fauna by providing recruitment opportunities, recolonisation opportunities and refuge habitat
- ecosystem functions that support these targets.

Ultimately flow targets, based on ecological needs, were determined for selected sites along the Basin's rivers. The locations were called hydrologic indicators sites. A simplified outline of the process is shown in Figure 58. The flow targets included flow volume, duration, timing and frequency. Comparing achievement of the flow targets for a range of water recovery scenarios was one of the major factors in determining the 2,750 GL water recovery target and corresponding basin-wide SDL.

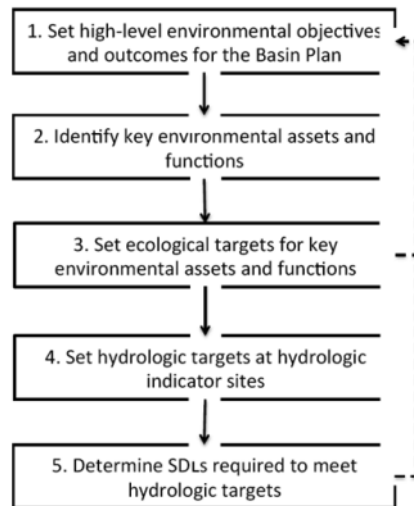


Figure 58: Simplified outline of the method used to determine the ESLT (Source: Figure 2, Young et al. 2011)

The method used to determine the ESLT relies strongly on two assumptions (Overton et al. 2014). The first is that meeting the flow requirements at the hydrological indicator sites will result in flow requirements being met across the whole reach represented by the site. The flow targets were based mainly on the flow or habitat requirements for recruitment opportunities of native fish, healthy condition of vegetation, and successful breeding of water birds. The second assumption was that by achieving the flow targets a range of additional biodiversity, ecosystem function, and ecosystem resilience targets specified under the Basin Plan, but not specifically modelled, would also be met.

Other uncertainties included the:

- estimates of the flow metrics required by plant and animal populations, especially flow frequency (MDBA 2011b)
- practicality of delivering the flows represented in the hydrological models
- uncertainties inherent in the hydrological models – they are only a coarse representation of reality (although the best representation available at the time)
- ecological health of environmental assets is determined by a range of factors of which flows are just one element.

The inherent uncertainty in environmental outcomes was recognised by scientific reviewers of the ESLT method (Young et al. 2011, page 30):

Give the uncertainties involved the Panel strongly recommends the MDBA commit to an adaptive approach to implementation of the Basin Plan informed by a well-designed ongoing environmental monitoring and evaluation program that supports longer-term knowledge generation in order to iteratively refine the ESLT and SDLs.

An interpretation of what, ecologically, can be realistically achieved with the Basin Plan under the proposed SDLs has not yet been clearly articulated, either at the site level or the Basin level.

And by the MDBA (2012, pg 2)

The results contained in this report are for a selection of scenarios, and the outcomes presented are indicative of a feasible change in flow regime given the modelled level of reduction in diversions... the final outcomes achieved may be different to those contained in this report.

Following the determination of the ESLT governments formally recognised, through the inclusion of an SDL Adjustment Mechanism in the final Basin Plan, that additional environmental outcomes can be achieved by better use of the available environmental water. The adjustment mechanism includes the supply measures program that enables more efficient use of environmental water to reduce the water recovery from consumptive purposes while achieving equivalent environmental outcomes.

The above discussion does not mean that the Basin Plan won't deliver significant environmental gains. It simply means that the specifics about what outcomes can be achieved are uncertain. The following section about the potential environmental outcomes delivered by the Basin Plan must be read in this context, recognising that significant effort has gone into better understanding the potential environmental outcomes since the ESLT was determined.

12.2 EXPECTED ENVIRONMENTAL OUTCOMES

The MDBA's aspiration for the Basin, as expressed in MDBA (2014a) is *...we are trying to achieve improvement in the health of the river system — through more natural and variable flows*. The expected outcomes are described for river flows and connectivity, vegetation, waterbirds and fish. A summary of environmental outcomes for each from MDBA (2015) is reproduced below.

River flows and connectivity:

- Maintained base flows at about 60% of natural levels
- Improved overall flow:
 - 10% more into the Barwon–Darling
 - 30% more into the River Murray
 - 30–40% more to the Murray mouth (and it open to the sea 90% of the time)
 - Maintained connectivity in areas where it is relatively unaffected - between rivers and floodplains in the Paroo, Moonie, Nebine, Warrego and Ovens
- Improved connectivity with bankfull and/or low floodplain flows:
 - by 30–60% in the Murray, Murrumbidgee, Goulburn and Condamine–Balonne
 - by 10–20% in remaining catchments
- Maintain the Lower Lakes above sea level.

Vegetation:

- Maintenance of the current extent of:
 - about 360,000 hectares of river red gum; 409,000 ha of black box; 310,000 ha of coolibah forest and woodlands; and existing large communities of lignum
 - non-woody communities near or in wetlands, streams and on low-lying floodplains
- Maintained condition of lowland floodplain forests and woodlands of:
 - river red gum
 - black box
 - coolibah
- Improved condition of southern river red gum

Waterbirds:

- Maintained current species diversity of:
 - all current Basin waterbirds
 - current migratory shorebirds at the Coorong
- Increased abundance - 20–25% increase in waterbirds by 2024
- Improved breeding:
 - up to 50% more breeding events for colonial nesting waterbird species
 - a 30–40% increase in nests and broods for other waterbirds

Fish:

- Improved distribution of key short- and long-lived fish species across the Basin
- Improved breeding success for:
 - short-lived species (every 1–2 years)
 - long-lived species in at least 8/10 years at 80% of key sites
 - mulloway in at least 5 out of 10 years
- Improved populations of:
 - short-lived species (numbers at pre-2007 levels)
 - long-lived species (with a spread of age classes represented)
 - Murray cod and golden perch (10–15% more mature fish at key sites)
- Improved movement - more native fish using fish passages.

Some preliminary work has also been done to estimate the salinity benefits of the recovery, transfer and use of Basin Plan environmental water. Under the Basin Salinity Management 2030 strategy salinity benefits and costs are measured as part of a pollutant-trading framework. Credits are allocated for actions that lower Murray River salinity at Morgan SA and debits are allocated to actions that increase salinity at Morgan.

MDBA (2014b, page 31 and 32) gives very preliminary estimates for Basin Plan dilution flow credits of - 58 EC (2,800 GL water recovery scenario). Debits from floodplain watering are estimated at 33 EC. Debits from Basin Plan water recovery projects could also be substantial. Although difficult to quantify at this stage, overall a net salinity credit is expected from Basin Plan water recovery, transfer and use.

12.3 MEASURED ENVIRONMENTAL OUTCOMES

The MDBA, states and the Australian Government work together to monitor, evaluate and report on Basin Plan environmental outcomes. This approach reflects that the work can be done more efficiently as a collective rather than separately. Environmental monitoring projects relate to the key themes of hydrology, inundation, vegetation, waterbirds and fish.

Together with partner governments the CEWO has developed a comprehensive program of operational monitoring and short and long-term intervention monitoring across the Murray-Darling Basin.

Operational monitoring in Victorian reaches and wetlands is carried out by waterway managers or storage managers as part of water deliveries for the VEW (the Commonwealth transfers allocation to the VEW for delivery to Victorian rivers and wetlands).

Short-term monitoring by the CEWO is coordinated with other monitoring programs such as Living Murray and the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP), although each agency supplements monitoring and reports separately, e.g. in the Lower Goulburn River and Lower Broken Creek the CEWO commissioned the University of Melbourne to monitor and report on ecosystem response to environmental water in 2013/14²⁰ (DOE 2016) and the VEW published the information in Reflections.

The CEWO has established the Long-term Intervention Monitoring Project to monitor and evaluate the contribution of Commonwealth environmental water delivery in the Murray-Darling Basin over five years to June 2019. Monitoring will be undertaken in seven areas including the Goulburn River.

The MDBA acknowledges that it will take some time for the full effects of Basin Plan monitoring to be seen because of lags in biological responses and because the Basin Plan, and associated water recovery, will not be implemented in full until 2024 (MDBA 2015a). Other complicating factors in attributing environmental outcomes to the Basin Plan include natural variability in system condition and Basin Plan implementation being only part, although a significant part, of a much broader integrated program of waterway and catchment management across the Basin.

At this stage the reporting of environmental outcomes is generally short-term and site or event specific. It is also almost as much about learning how river and wetland ecosystems will respond to environmental watering as reporting on responses. For example Table 19 shows reporting on fish and vegetation related outcomes from the use of Commonwealth environmental water in the Lower Goulburn River in 2014/15.

²⁰ Viewed 18 November 2015 <https://www.environment.gov.au/water/cewo/publications/monitoring-ecological-outcomes-cew-delivered-goulburn-broken-13-14>

Table 19: Highlights and implications of environmental watering in the lower Goulburn River in 2014/15 (Source: Table in Executive Summary of Webb et al. 2016)

Matter	Year 2 highlight	Implications for adaptive management
Bankside vegetation abundance and diversity	Areas of the bank inundated by the spring environmental flow events had improved vegetation abundance and diversity pre- to post-flow, while the remainder of the bank showed no effect. This demonstrates the value of bank wetting as the climate grows drier over summer.	We believe that benefits to bankside vegetation may be greater if the first extended spring flow is delivered earlier. This would allow plants to grow in response to bank wetting before air temperatures increase significantly as we move into summer.
Fish assemblages, and the spawning and movement of golden and silver perch	Golden perch exhibited a strong spawning result to spring environmental flows, with eggs and larvae being collected in numbers never before seen following environmental flows. Golden perch also exhibited strong movement responses to environmental flows, mostly moving down the river to spawning areas.	While we are now able to achieve good spawning outcomes for golden perch, adjusting the timing of the second spring fresh will be important for determining how closely spawning is tied to temperature. Future data collection will improve our understanding of the importance of antecedent flows on fish spawning, and whether spawning responses translate to recruitment.

13 CONCLUSIONS

The Commonwealth buyback of water entitlements under the Basin Plan provided timely assistance to many enterprises with high levels of debt accumulated during the drought. Most of the buyback was from Victoria, and more particularly the vast majority of high reliability entitlements secured through buyback were from Victoria over the period 2009/10 to 2011/12.

The characteristics of water use in the southern-connected Basin have changed significantly as a result of the Basin Plan. The consumptive pool has decreased significantly and the mix of industries has changed; horticulture, with its relatively fixed water demands now accounts for a larger proportion of the consumptive pool. It is now at the point where in a repeat of 2008/09 allocation levels, horticultural use could account for all the available water. The proportion of the consumptive pool dedicated to horticulture will increase as horticulture continues to expand.

Because buyback was weighted towards high reliability entitlements, the remaining consumptive pool will yield more variable allocations at the Basin-scale. This has changed the risk profile for those irrigators who must compete with horticulturalists for allocations in dry years.

If water recovery had not occurred, water use in the GMID would have been 29-31% higher in the past three years (2013/14 to 2015/16). Accordingly, GMID milk production could be expected to have been about 30% higher than was observed. The foregone production would otherwise have had significant flow-on effects in towns and communities where farm inputs are sourced and where dairy manufacturing occurs.

Water use by horticulturalists would have been largely the same with and without the Basin Plan because the higher marginal value of water in horticulture means cutbacks occur in other uses.

Irrigators have been adapting, but the recent relative abundance of water since buyback was completed (with the notable exception of 2015/16), has enabled many irrigators to maintain water use through water allocation purchases. Consequently many of the socio-economic impacts of the Basin Plan may not be observed until the next drought.

While further water recovery through government investment in on-farm efficiency savings may benefit the farm enterprise being funded, it may have adverse effects on other water users and irrigation communities..

On-farm water savings have similar characteristics to off-farm water savings in wet-to-average years. However, because most of the investments have occurred on farms that support interruptible and semi-interruptible enterprises, in dry and extreme dry years the on-farm projects serve to reduce the consumptive pool; those irrigators have less water to sell to non-interruptible horticulturalists in dry sequences. This will elevate allocation prices in dry years.

A key finding of this report is that Victorian irrigators who sold water entitlements to the Commonwealth are now more reliant on allocation purchases than they would have been without the Basin Plan. This has increased their farming risk. The nature of this risk was masked for four years by the high level of carryover resulting from the extraordinarily high rainfall years of 2010/11 and 2011/12. The issue here is that dairying is semi-interruptible for only so long. Compounding this, as a

result of the spatially random nature of the Commonwealth buyback, the effective costs of delivering water in the GMID, where most irrigated dairying occurs, will increase significantly unless up to 40% of delivery system infrastructure in place before the GMW Connections Project began can be rationalised (GMW 2009).

1 SOCIO-ECONOMIC DATA

This report makes use of a range of socio-economic data in analysing, quantifying and describing the effects of Basin Plan water recovery. In the interests of repeatability, this appendix sets out:

- The set of metrics and indicators used in this report
- The socio/economic context information for each region
- The results of the 2015 Regional Wellbeing Survey questions relating to the Basin Plan.

1.1 METRICS AND INDICATORS USED IN THIS REPORT

This section brings these threads of evidence together into a set of metrics and indicators that can be used to reproduce or revisit this analysis in the future.

The range of other contributing factors that may affect the same metric complicates the link between water recovery and a given metric. Analysing causal links therefore requires careful examination and a degree of judgement.

The report analyses the different elements of socio/economic risk — vulnerability, exposure and impact — at the different scales of the region, the farm enterprise and the community, and it uses the metrics outlined in this appendix to inform that analysis. The table below provides some examples of how metrics inform the understanding of the different elements of socio/economic risk at different scales.

Table 20: Framework for incorporating socio-economic data

	Region/Industry	Farm enterprise	Community
Vulnerability	Example: Regions dominated by interruptible and semi-interruptible irrigation activities are sensitive to changes in water availability	Example: Farms with high levels of debt are highly sensitive to change (such as in profitability)	Example: Wellbeing, employment and income levels inform the relative sensitivity of a community to change
Exposure	Example: The expected change in water use (the observed versus the counterfactual) due to water recovery informs the exposure to change	Example: Farms that have sold entitlement and rely on allocation purchases are exposed to the changes water recovery has on water allocation prices if their water demands are not flexible	Example: A community highly dependent on irrigated industries is more exposed to changes in irrigated production
Impact	Example: The expected change in irrigated production (the observed versus the counterfactual) due to water recovery	Example: The profit impact of water recovery effects on water allocation prices, and the risks associated with more volatile water access as the system becomes more 'brittle'.	The causal link between water recovery community impact is complicated by the multitude of other factors that affect community outcomes

The metrics used in the report are collated in the table below.

Table 21: Metrics used in the report

Metric	Data sources
Water use	<p>By region: Water register data provides information on Victorian water use, by system, by region, by licence holder type (irrigator, environment, water authority)</p> <p>Counterfactual water use: estimated based on above as well as Commonwealth DAWR (2016b) data on water recovery and Water register data on net interstate trade.</p> <p>Water used by irrigated agriculture by crop: ABS 4618.0 - Water Use on Australian Farms, 2014-15 reports annually VIC NRM regions for Pasture (grazing), pasture (hay), pasture (silage), rice, other cereals, fruit and nut trees, vegetables, flowers, grapevines.</p> <p>Water available for use: announced allocations to all sMDB water products</p> <p>Water available for use: Hydrological modelling from NRSWS and could be updated with newer DELWP modelling</p> <p>Horticultural water demands (current and mature): Mallee and sMDB estimates. Mallee CMA data, LMW data.</p>
Area irrigated by crop type	<p>ABS 4618.0 has total area and area watered for pasture (grazing), pasture (hay), pasture (silage), rice, other cereals, fruit and nut trees, vegetables, flowers, grapevines.</p> <p>Land use mapping project</p>
Irrigated agricultural output by crop or commodity	<p>ABS 4610.0.55.008: Gross Value of Irrigated Agricultural Production (GVIAP) available annually to 2013/14</p> <p>Industry groups have information on industry production. Notably, Dairy Australia report on GMID milk production</p>
Patterns of water trading	<p>Water register data provides detailed information on Victorian trades, and net interstate trade.</p> <p>Water register data analysis looked at actions before and after sale of water to Commonwealth</p> <p>ABARES water markets report broader market outcomes</p> <p>ABARES Farm Survey publications including information on the industry associated with water trading</p>
Measure of productivity	<p>Irrigation water use is supplementary water, so in addition to rainfall. A productivity index needs to be careful with capital (as per gross budget per ML), which is hard for opportunistic irrigation industries.</p> <p>Water use efficiency: reported in ABARES Farm Survey publications</p> <p>Profitability reported in ABARES Farm Survey publications, showing relativities between industries, across years, and spread of farms.</p>

Metric	Data sources
Measure of rate of return per unit of water used	Not used. ABS discontinued use of the metric of gross farm budget per ML based on advice from the Productivity Commission. Caution is advised if using these partial metrics.
Change in structure of irrigation industries (Number of agricultural businesses (no.), Number of agricultural businesses irrigating (no.))	Annual series in ABS 4618.0 . There is underlying trend in farm aggregation. Land use data project
Socio-economic context	ABS census data: on population, employment, income trends ABS census data: Employment on industry level 'Agriculture, Forestry and Fisheries'. ABS census data: Employment at 3-digit ANZSIC categorisation in 'Dairy Cattle Farming', 'Dairy Product Manufacturing', 'Fruit and Tree Nut Growing' and 'Fruit and Vegetable Processing' and also 4-digit level. Regional Wellbeing survey: "People and communities" and "Farmers and agriculture" reports available. The "Environment and natural resource management" report should provide insights when released.
Community relative vulnerability	EBC 2011: provides classification

The groups of metrics presented in the table are consistent with the groups used in <http://www.mdba.gov.au/publications/mdba-reports/murray-darling-basin-water-reforms-framework-evaluating-progress>

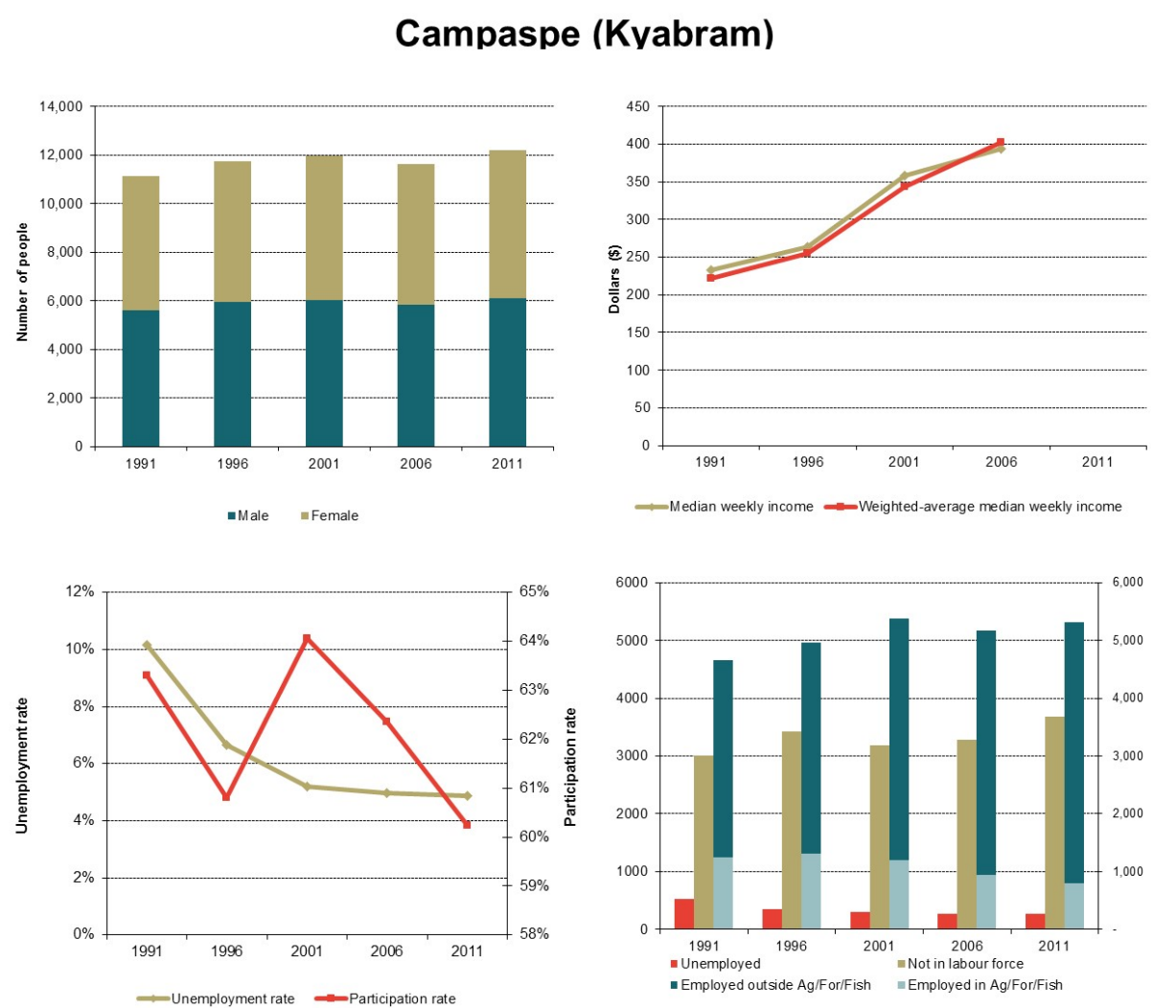
One exception is 'Measure of rate of return per unit of water used'. The use of such metrics is not recommended. ABS discontinued use of the metric of gross farm budget per ML based on advice from the Productivity Commission, since such measures do not take into account the differing capital requirements and other fixed costs that vary between industries. Caution is advised if using these partial metrics.

There are a number of metrics that will provide useful information in the future — notably when 2016 ABS Census data becomes available, when the Regional Wellbeing "Environment and natural resource management" report becomes available, and when the impact of a dry sequence can be observed given water recovery and changes to the mix of irrigation industries.

As noted above, when using this set of metrics care is required in the attribution of change to water recovery.

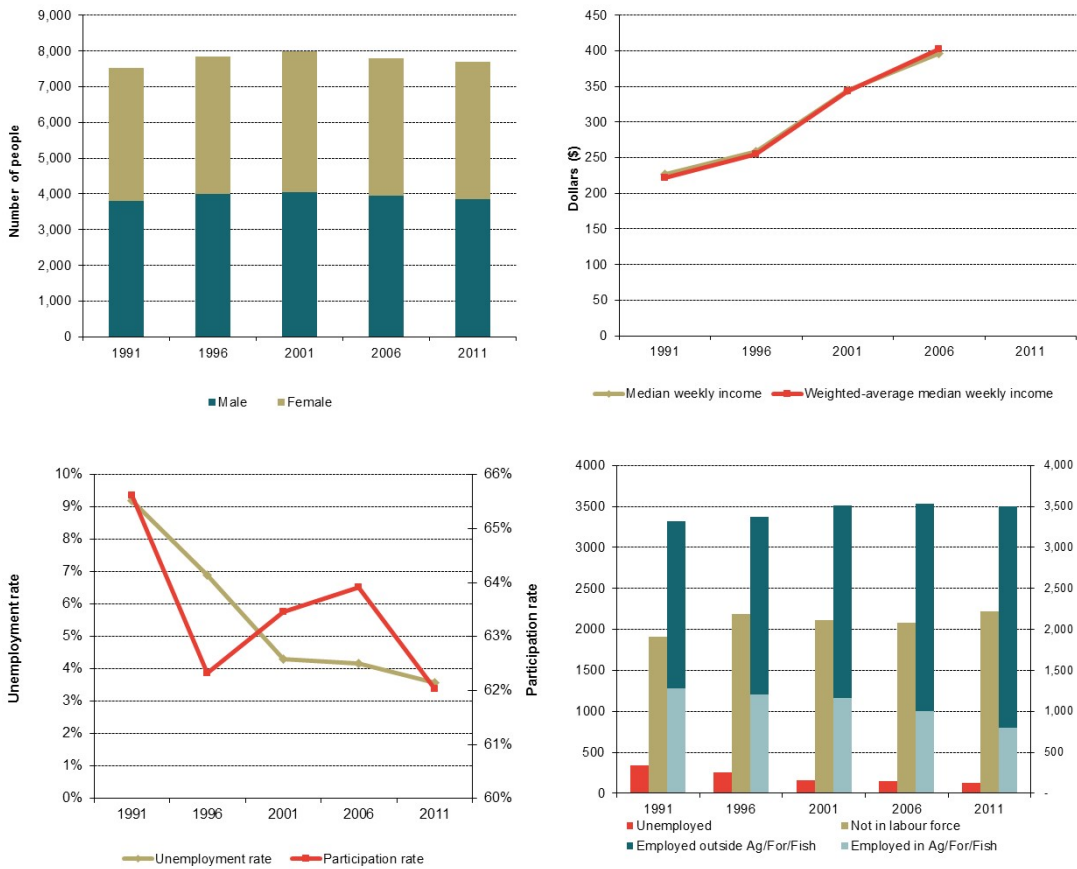
1.2 SOCIO-ECONOMIC CONTEXT INFORMATION

This section presents a set of data that provides the socio-economic context for the regions of northern Victoria. Information is included from 1991 to 2011 ABS Census on population, income²¹, unemployment and participation rates, and the disaggregation of employment between the Agriculture/Forestry/Fisheries sector and other sectors. A common trend is the declining role of agricultural jobs in total employment.

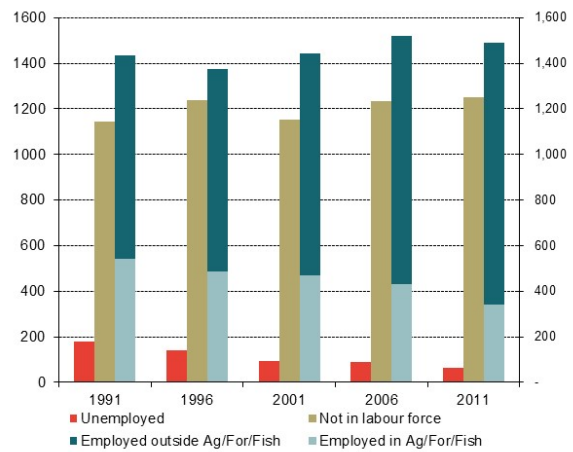
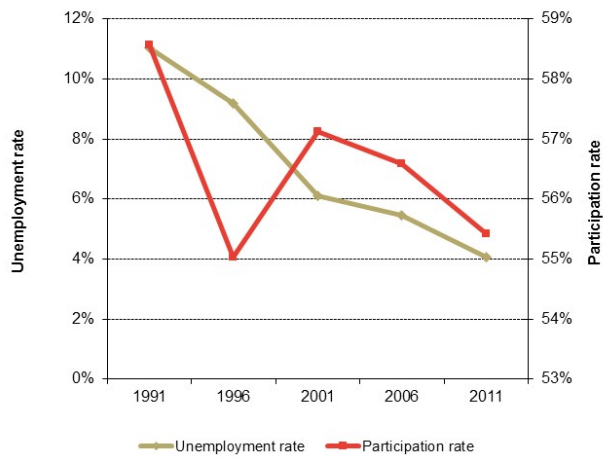
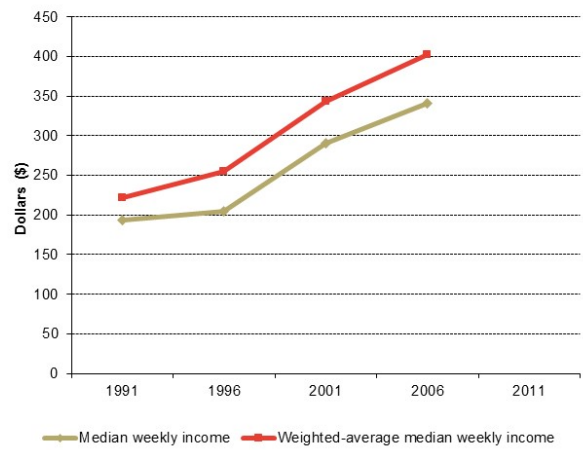
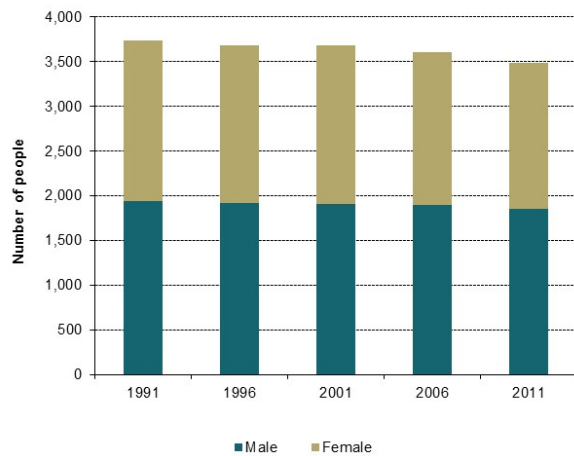


²¹ Note, median weekly incomes changed from individual to household for available 2011 census data and have not been included since comparisons cannot be made.

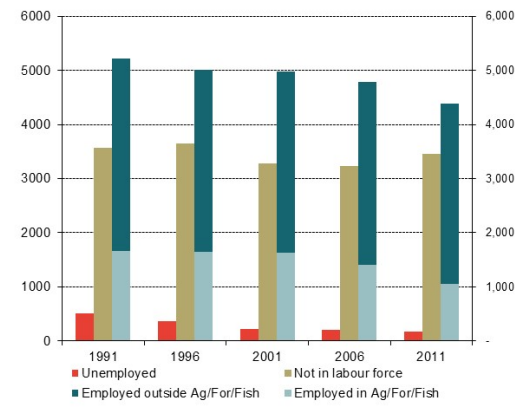
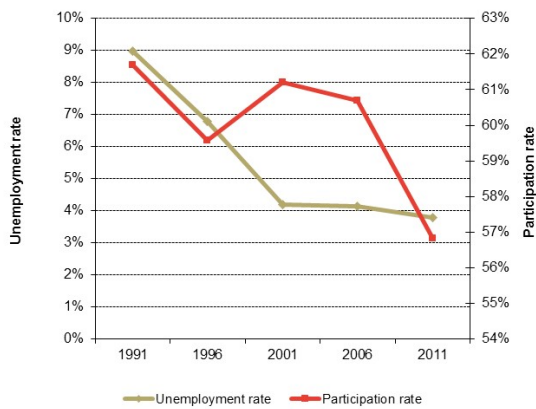
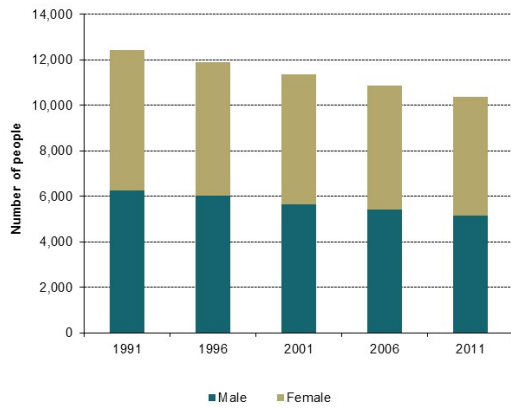
Campaspe (Rochester)



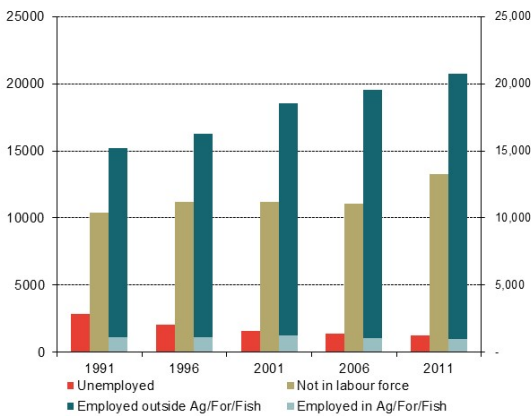
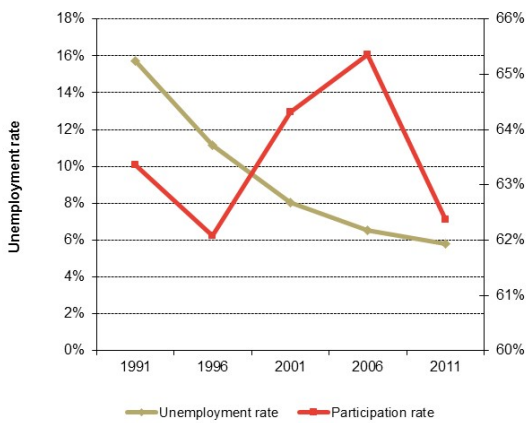
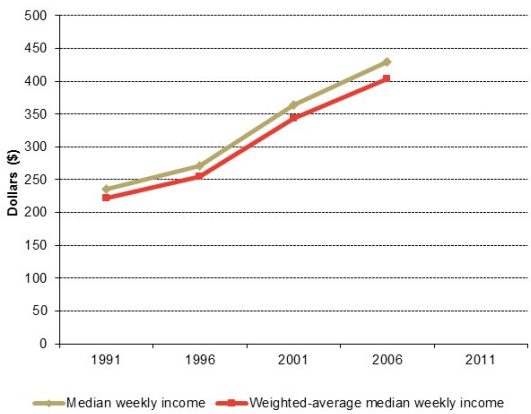
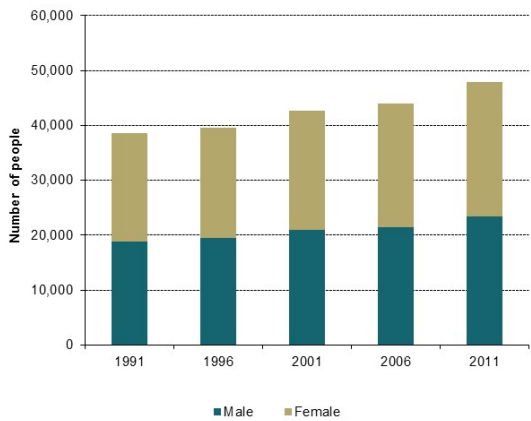
Campaspe (South)



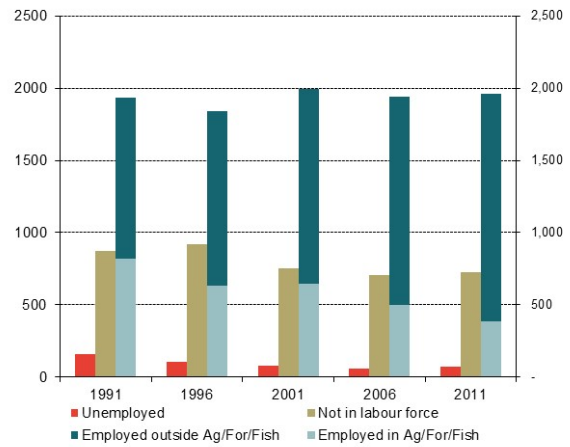
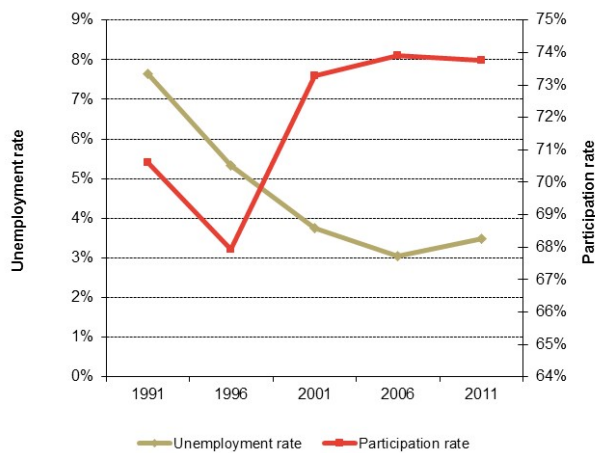
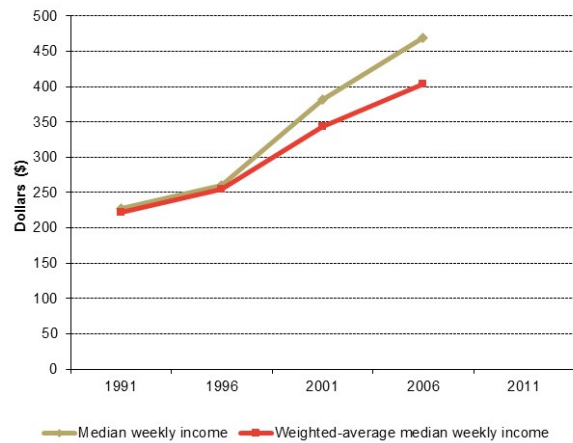
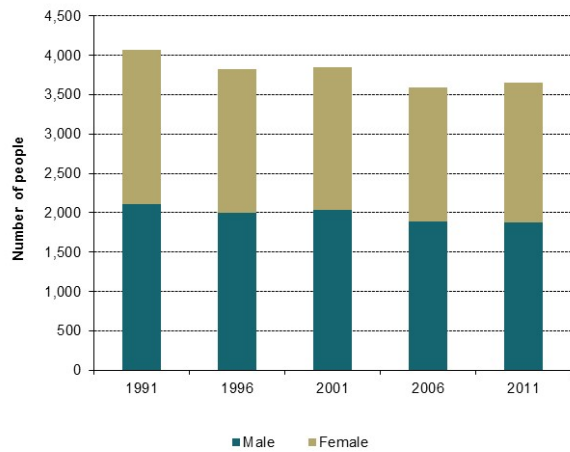
Gannawarra



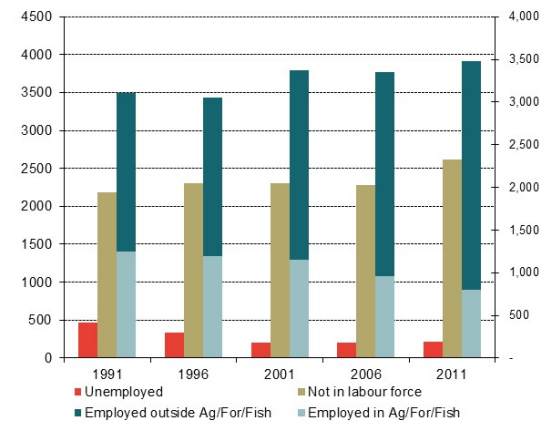
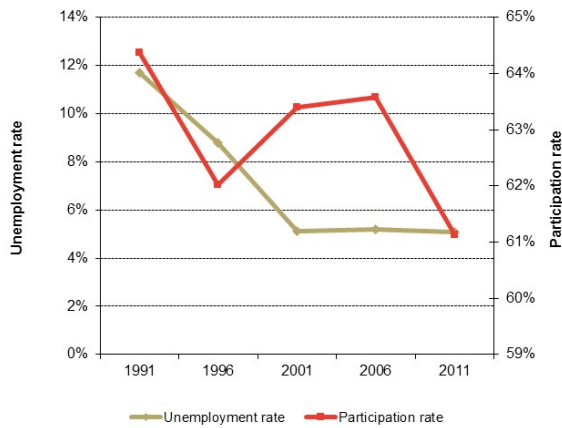
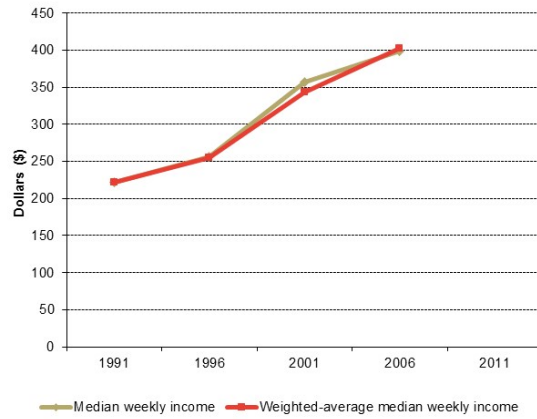
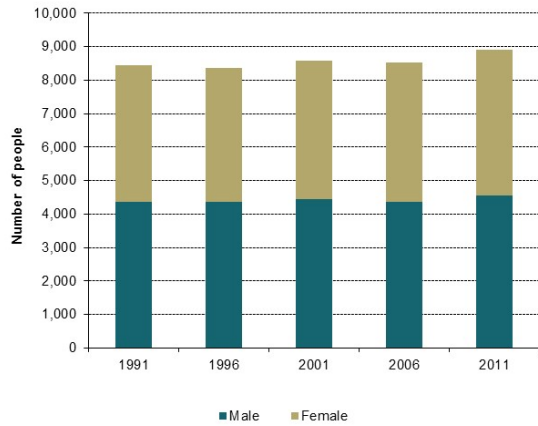
Greater Shepparton: Part A



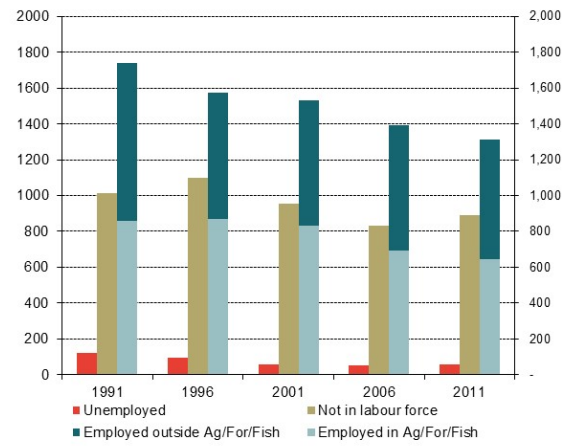
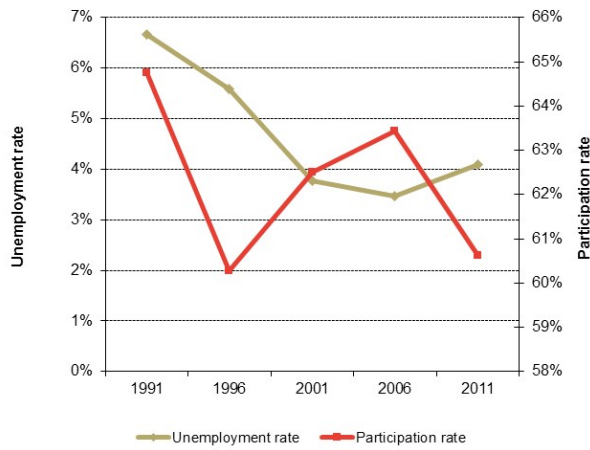
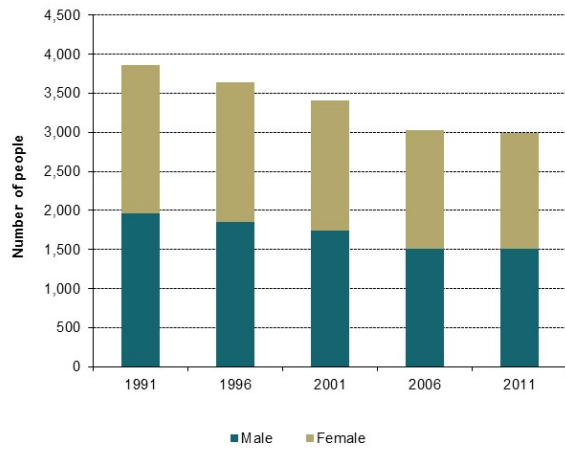
Greater Shepparton: Part B (East)



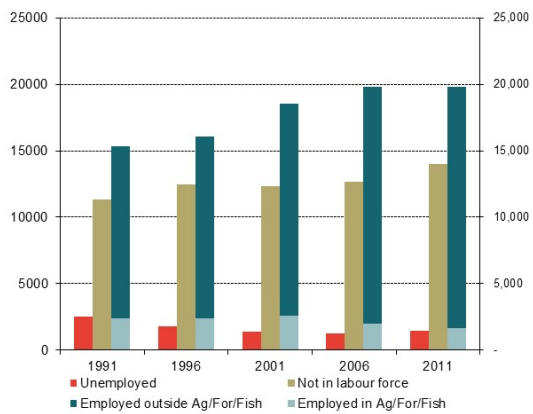
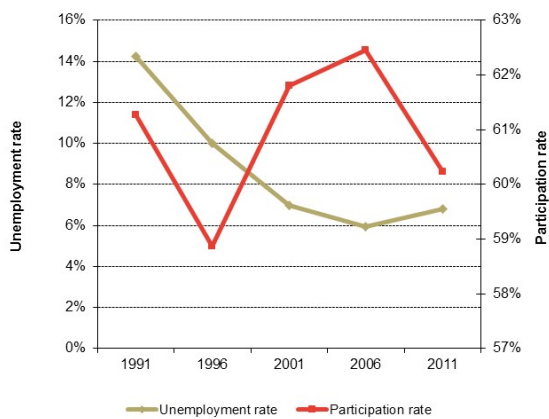
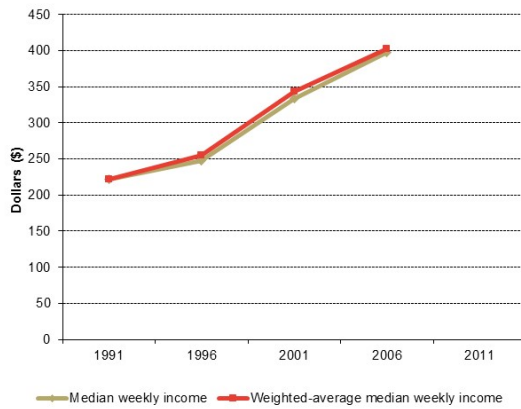
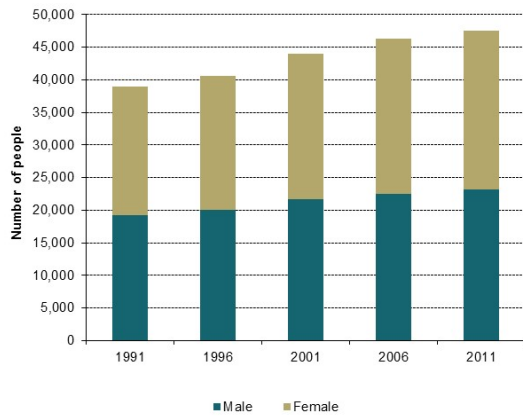
Greater Shepparton: Part B (West)



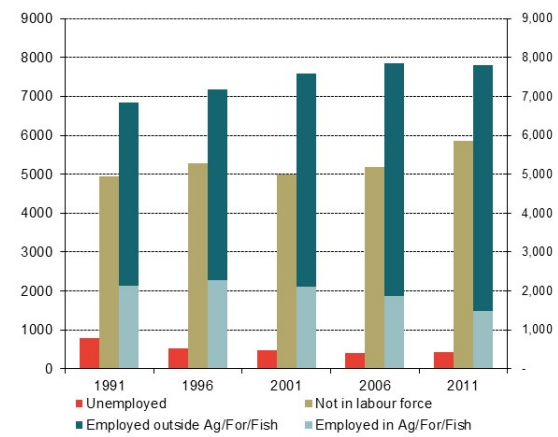
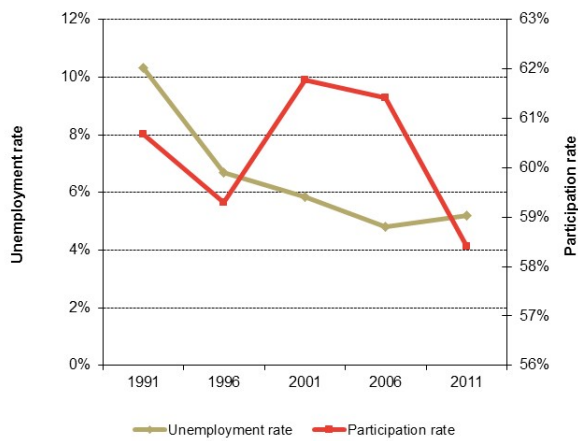
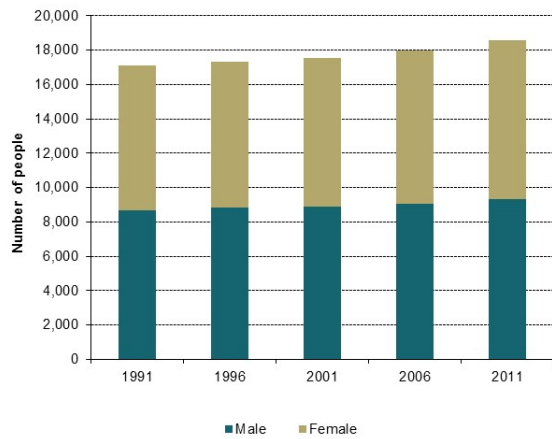
Loddon (North)



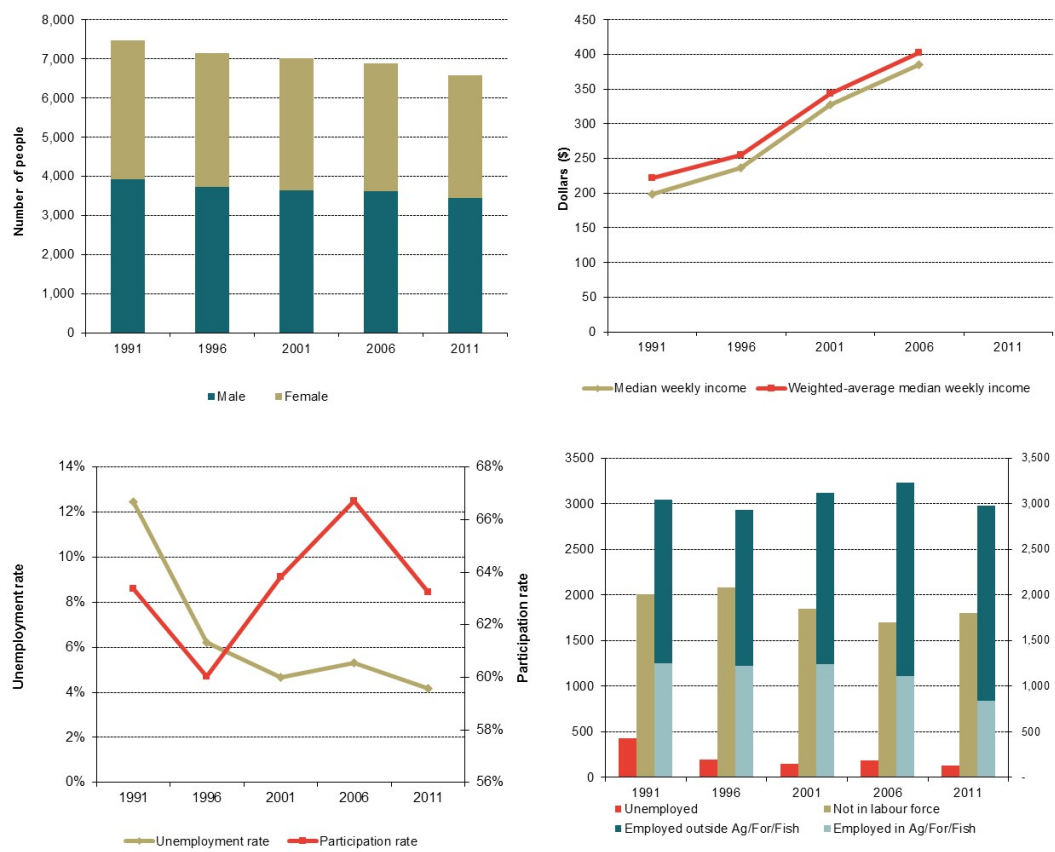
Mildura: Part A



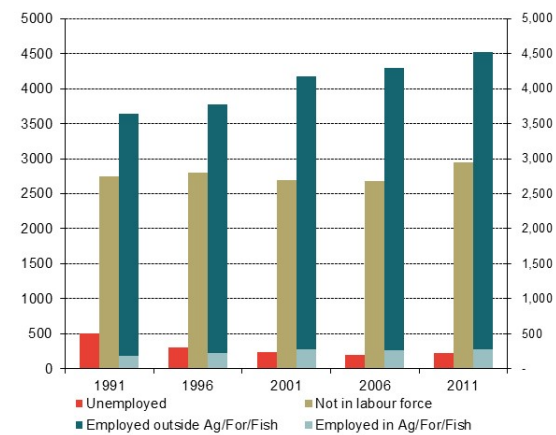
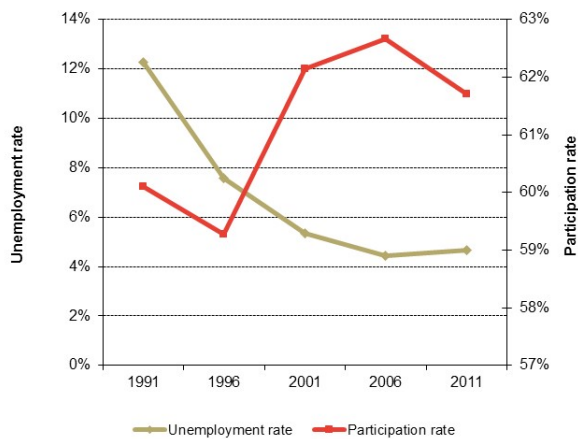
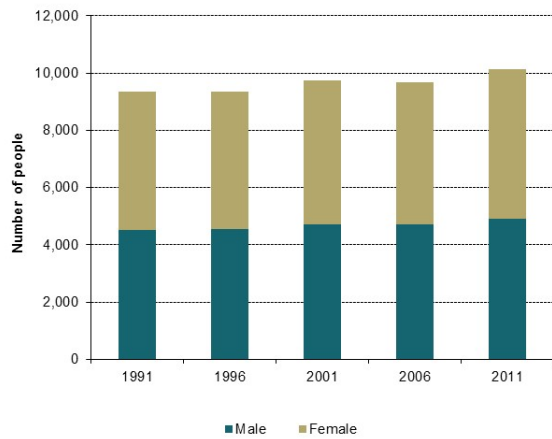
Moira (West)



Swan Hill (Balance)



Swan Hill (Central)



Swan Hill (Robinvale)



1.3 REGIONAL WELLBEING SURVEY

The 2015 Regional Wellbeing Survey included a number of questions asking survey respondents about their expectations of how the Basin Plan would impact:

- the health of the environment in the Murray- Darling Basin
- the economy in the Murray- Darling Basin
- communities in the Murray- Darling Basin
- the Murray-Darling Basin as a whole
- the respondent's household
- the business the respondent works in
- the respondent's local community
- the health of the respondent's local environment

Below are the responses provided by 285 Victorian irrigators in the Loddon-Mallee and Hume RDAs. These regions represent the north western and north central regions of Victoria. There were between 252 and 285 responses for each question.

In questions relating to the effect of the Basin Plan on community, economy and business, most respondents answer that the Basin Plan will have negative or very negative impacts (Figures 59–66).

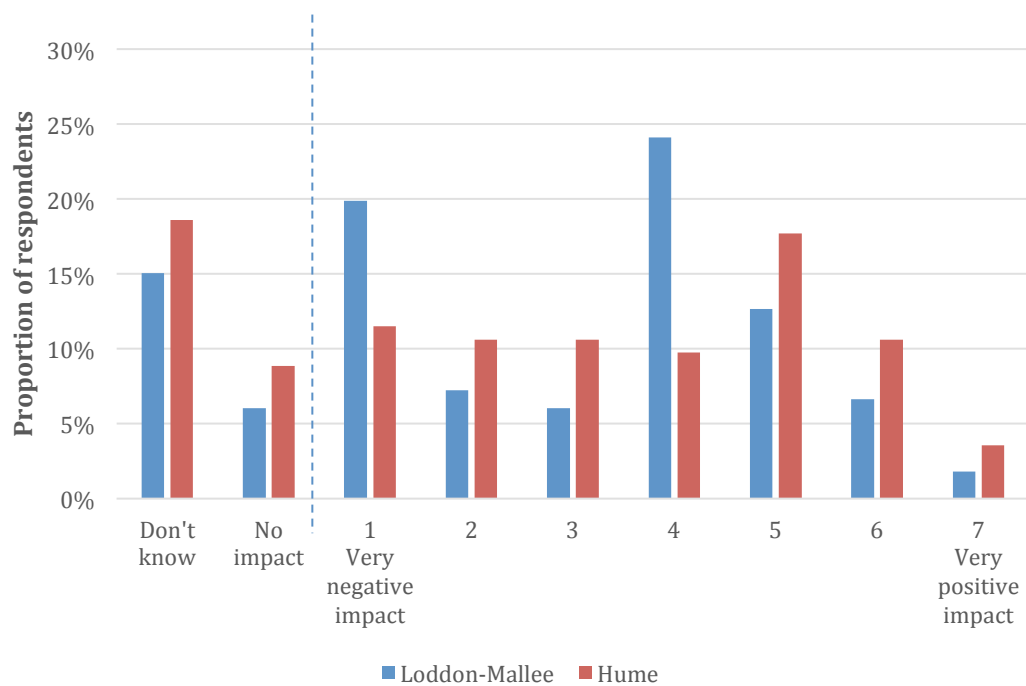


Figure 59 Expected effect of Basin Plan on the health of the environment in the Murray-Darling Basin

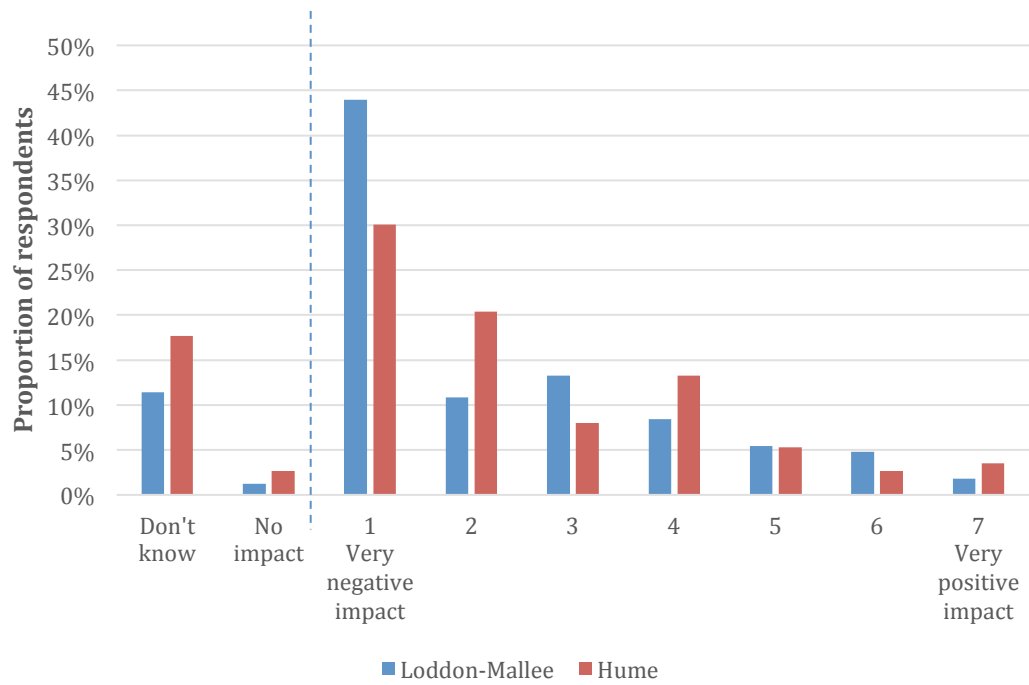


Figure 60 Expected effect of Basin Plan on the economy in the Murray-Darling Basin

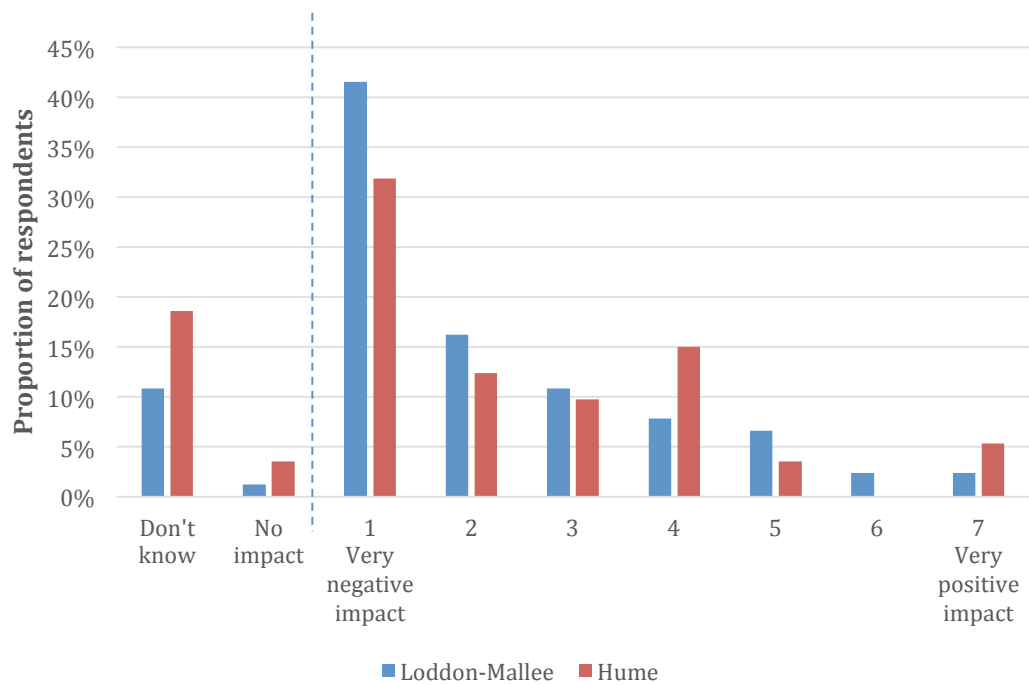


Figure 61 Expected effect of Basin Plan on communities in the Murray-Darling Basin

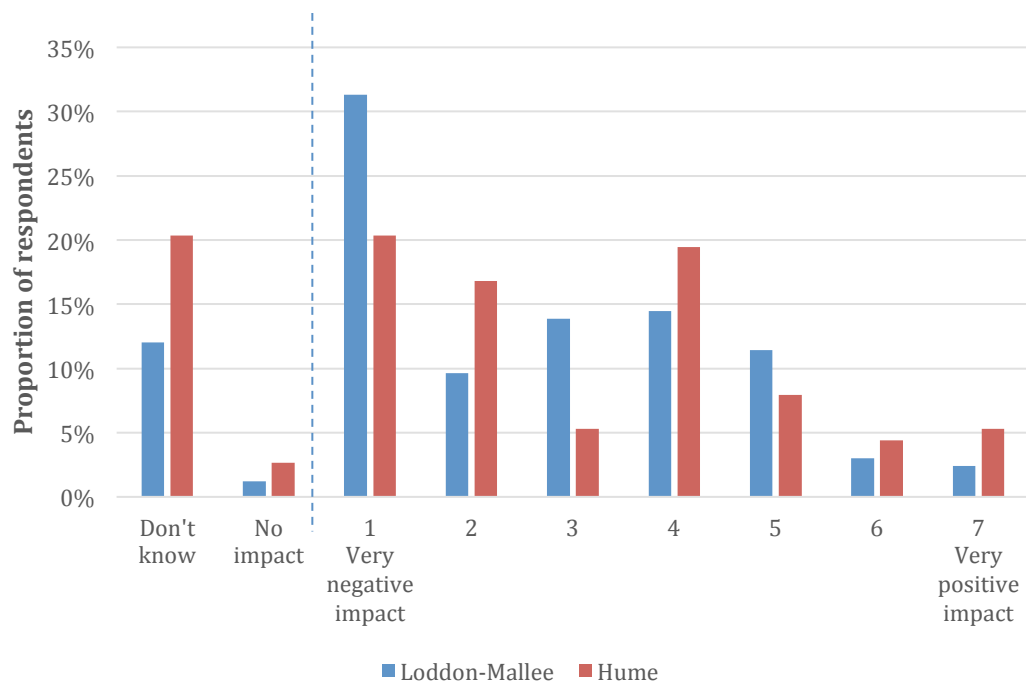


Figure 62 Expected effect of Basin Plan on the Murray-Darling Basin as a whole

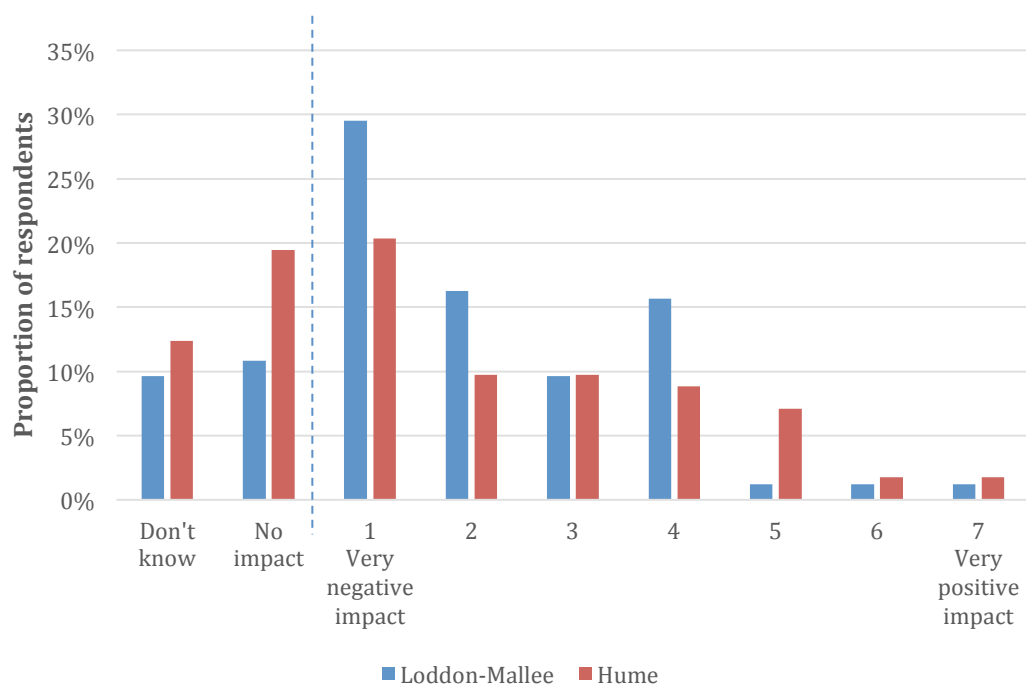


Figure 63 Expected effect of Basin Plan on my household

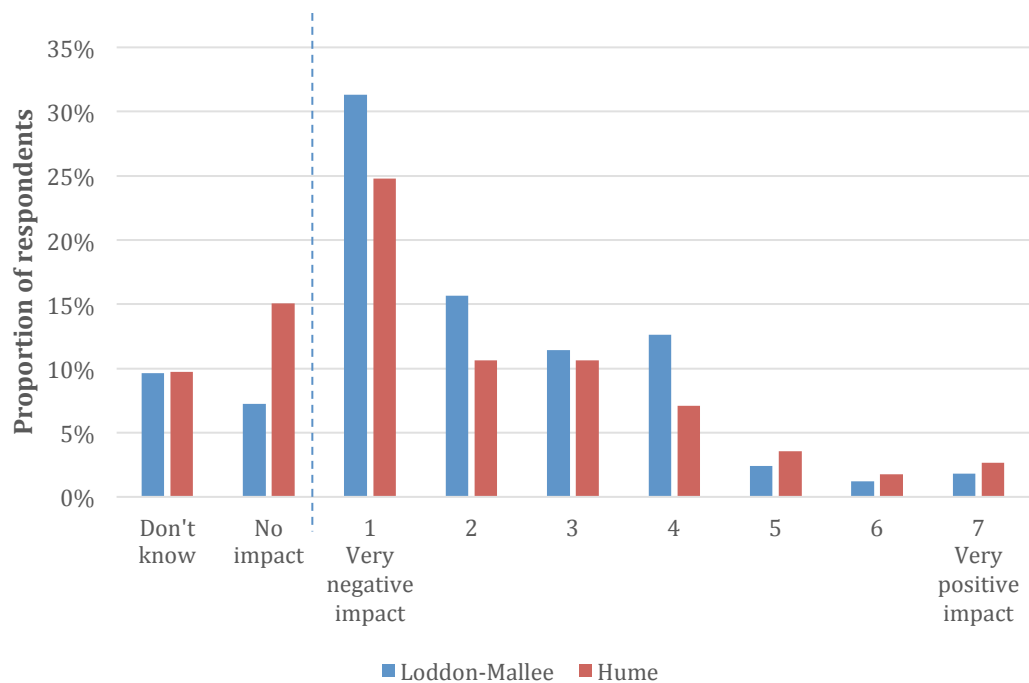


Figure 64 Expected effect of Basin Plan on the business I work in

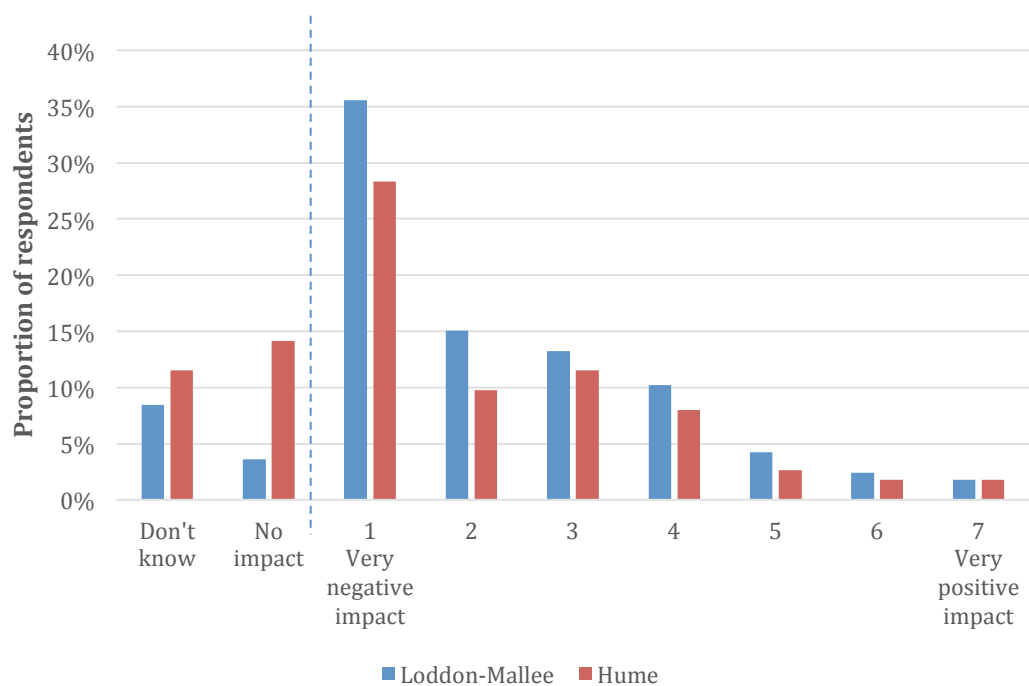


Figure 65 Expected effect of Basin Plan on my local community

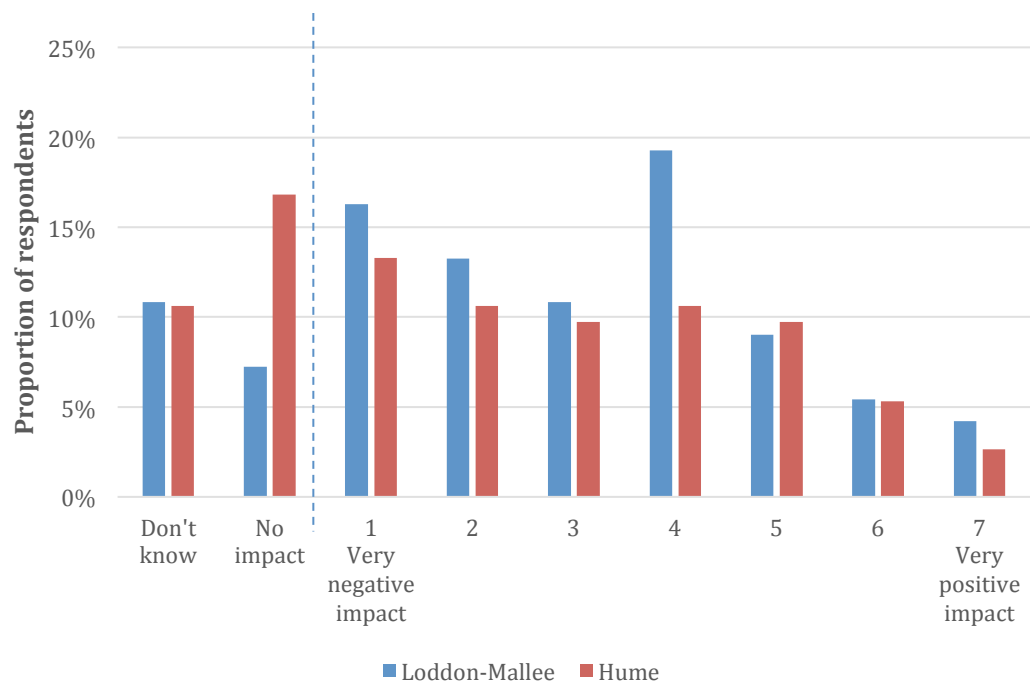


Figure 66 Expected effect of Basin Plan on the health of the local environment

2 BASIN PLAN SUSTAINABLE DIVERSION LIMIT (SDL) WATER RECOVERY SCENARIOS

2.1 Purpose

To define Sustainable Diversion Limit (SDL) water recovery scenarios and the corresponding volumes of water (LTAAY) and entitlement which may be removed from the consumptive pool in the sMDB and northern Victoria under the Basin Plan. Volumes are expressed as long-term averages unless explicitly stated otherwise.

2.2 Discussion

The project will assess the social and economic impacts of the Basin Plan to date (mid-2016) and possible impacts once water recovery is complete. Final water recovery volumes, the types of entitlement acquired and the methods used to recover water, are required to be able to assess the impacts of the latter, yet all remain uncertain. Three possible water recovery scenarios (LOW, MEDIUM and HIGH) are used to assess the range of possible impacts of the Basin Plan once water recovery is complete.

The starting point for determining water recovery scenarios is the Basin Plan's status quo of 2,750 GL, with 2,360 GL from the sMDB and 390 GL from the Northern Basin.

For simplicity in initial discussions, options are considered at a whole of Basin scale with Northern Basin recovery remaining unchanged. How to apportion water recovery between the Northern and sMDB and between States, methods used to recover additional water and what types of entitlement are recovered are then discussed.

Factors considered in defining water recovery scenarios and how additional water is recovered include the:

- Existing water recovery volumes
- Delivery of contracted water savings projects
- Allowable variation in water recovery under the SDL Adjustment Mechanism
- Volume of SDL offsets delivered by supply measures
- Volume of up-water delivered by efficiency measures
- Apportionment of offsets and up-water
- Commonwealth infrastructure investment and the 1,500 GL cap on water purchases.

LOW water recovery scenario

The SDL Adjustment Mechanism can vary Basin Plan water recovery by plus or minus 5% of the SDL of 10,873 GL, i.e. 544 GL.

The lowest allowable water recovery volume is 2,206 GL²². This ignores any changes to SDLs resulting from the Northern Basin Review.

Victoria has been consistent in seeking a maximum water recovery volume of 2,100 GL that can be achieved if 650 GL of offsets are delivered²³. To enable this Victoria developed the first version of the SDL Adjustment Mechanism, which following amendments, was incorporated into the Basin Plan. The basis for seeking a target of 2,100 GL was that, with environmental works, similar environmental outcomes to those achievable with 2,750 GL of water could be delivered. Also, no further water recovery beyond that already achieved or committed would be required, thus negating further impacts of water recovery on communities in northern Victoria. More recently the GMID Water Leadership Forum proposed amending the *Water Act 2007 (Cth)* and Basin Plan to allow the lowest allowable water recovery volume to be 2,100 GL.

The LOW water recovery scenario adopted is 2,100 GL. It is assumed that the 2,100 GL is achieved with 650 GL of offsets from Supply Measures and 0 GL of up-water from Efficiency Measures.

HIGH water recovery scenario

The highest allowable water recovery volume allowable under the Basin Plan is 3,294 GL²⁴.

The *Water Act 2007 (Cth)* states that one of the Objects of the Water for Environment Special Account is ...*increasing the volume of the Basin water resources that is available for environmental use by 450 GL*. No other funding is currently planned for Efficiency Measures meaning the maximum volume of up-water is likely to be 450 GL. Assuming zero GLs of offsets from supply measures, the maximum volume of Basin Plan water recovery will be 3,200 GL.

The HIGH water recovery scenario adopted is 3,200 GL. It is assumed that the 3,200 GL is achieved with 0 GL of offsets from Supply Measures and 450 GL of up-water from Efficiency Measures, i.e. on-farm infrastructure projects.

MEDIUM water recovery scenario

As with other scenarios the MEDIUM water recovery scenario will be determined by the net outcome from Supply and Efficiency Measures under the SDL Adjustment Mechanism.

Martin and Turner (2015) estimated plausible offsets from Supply Measures of 508 GL. More recent information from the MDBA and Commonwealth indicate high confidence in obtaining 300 GL of offsets. An average figure of 400 GL is probably the most likely outcome based on current information.

There is no information available about the most likely volume of up-water that will be obtained from Efficiency Measures. Such information will not be available until States complete assessments of social and economic impacts and advise the MDBA of the volume of additional water that can be recovered

²² 2,206 GL equals 2,750 GL minus 544 GL.

²³ See Walsh (2010) and (SKM 2012) for example

²⁴ 3,294 GL equals 2,750 GL plus 544 GL.

with neutral or better social and economic impacts. For the purposes of this exercise it is assumed that half the 450 GL of up-water will be obtained, i.e. 225 GL.

Based on the above one estimate of the MEDIUM water recovery scenario is 2,575 GL.

An alternative approach to quantifying the MEDIUM water recovery scenario is to take a point mid-way between the LOW and HIGH scenarios. This would give a volume of 2,703 GL. The volume is very close to the status quo 2,750 GL. If 2,750 GL is chosen then it is assumed that offsets from Supply Measures are equal to the volume of up-water from Efficiency Measures.

The MEDIUM water recovery scenario adopted is 2,750 GL. It is assumed that the 2,750 GL is achieved with 0 GL of offsets from Supply Measures and 0 GL of up-water from Efficiency Measures.

Apportionment of water recovery

COAG (2013) defines the default apportionment of offsets under the SDL Adjustment Mechanism. It apportions offsets between States and between the Northern and Southern Basins. The default apportionment is used for the LOW water recovery scenario (Table 22).

Table 22: Assumed apportionment of 650 GL of offsets from Supply Measures for the LOW water recovery scenario

	Apportionment (%)	Offset Volume (GL)
QLD	0	0
NSW Northern	5.8	37.7
ACT	0	0
SA	8.1	52.5
NSW South including Lachlan	44.7	290.3
Victoria including Wimmera	41.5	269.6
TOTAL	100%	650

No decision has been made on how to apportion the 450 GL of up-water between States or between the Northern and Southern Basins. For the HIGH water recovery scenario the 450 GL will be apportioned as per historical water use²⁵ (Table 23).

²⁵ MDBA (2016) presents the Baseline Diversion Limit (BDL) that is used to represent historical water use.

Table 23: Assumed apportionment of 450 GL of water recovery from Efficiency Measures for the HIGH water recovery scenario

	BDL (GL)	Apportionment (%)	Volume (GL)
QLD	2,306.9	16.9	76.2
NSW North	1,551.4	11.4	51.2
ACT	52.5	0.4	1.7
SA	700	5.1	23.1
NSW South including Lachlan	4,991.4	36.6	164.9
Victoria including Wimmera	4,020.5	29.5	132.8
TOTAL	13,623	100%	450

The Basin Plan defines the apportionment of water recovery for the status quo 2,750 GL²⁶. This apportionment is used for the MEDIUM water recovery scenario (Table 24).

Table 24: Assumed apportionment of water recovery for the MEDIUM water recovery scenario

	Required Recovery (GL)
Qld	174.5
NSW North	215.5
ACT	4.9
SA	184
NSW South (including Lachlan)	1,096
Victoria (including Wimmera)	1,075
TOTAL	2,750

Table 25 shows required water recovery by State if the recommended LOW, MEDIUM and HIGH water recovery scenarios and proposed apportionments are used. For comparative purposes it also shows required water recovery if all the legally available 544 GL of offsets are obtained with no up-water.

²⁶ Basin Plan (2012) – Schedule 2 lists the Local Reduction Amounts for each valley. Shared Reduction Amounts are cited under clause 6.05(3). As per clause 6.05(4) the Shared Reduction Amounts for the Northern Basin Zone are proportioned based on the BDL for each SDL resource unit.

Table 25: Required water recovery for each State for the LOW, MEDIUM and HIGH water recovery scenarios

	BP Max available offsets scenario (GL)	LOW water recovery scenario (GL)	MEDIUM water recovery scenario (GL)	HIGH water recovery scenario (GL)
Qld	176	174.5	174.5	250.7
NSW Northern	183	177.8	215.5	266.7
ACT	4.9	4.9	4.9	6.6
SA	140	131.5	184	207.1
NSW South including Lachlan	853	805.7	1,096	1,260.9
Victoria including Wimmera	849	805.4	1,075	1,207.8
TOTAL	2,206	2,100	2,750	3,200

Additional water recovery volumes

The MDBA and Commonwealth both provide regular updates on contracted water recovery. Table 26 presents contracted water recovery at 30 June 2016 from MDBA (2016b) and corresponding estimates of additional water recovery required under the LOW, MEDIUM and HIGH water recovery scenarios. It is important to note that not all entitlements from contracted water recovery have been transferred to the environment. For example in Victoria around 200 GL of entitlements (LTAAY) from contracted projects still need to be transferred to the Commonwealth. However, this assessment of additional water recovery assumes that contracted water recovery represents water already recovered.

Under the LOW water recovery scenario contracted water recovery in Victoria and SA already exceeds requirements. An additional 68.2 GL needs to be recovered from NSW in the sMDB.

Under the MEDIUM water recovery scenario an additional 650.5 GL needs to be sourced from the sMDB.

Under the High water recovery scenario an additional 973 GL needs to be sourced from the Southern Basin.

Table 26: Contracted water recovery at 30 June 2016 (Source: MDBA, 2016b) and estimated volumes of additional water recovery required under the LOW, MEDIUM and HIGH water recovery scenarios.

	Contracted water recovery (GL)	LOW Scenario	MEDIUM Scenario	HIGH Scenario
		Water to be recovered (GL)	Water to be recovered (GL)	Water to be recovered (GL)
Qld	87	87.5	87.5	163.7
NSW Northern	185.9	(8.1)	29.6	80.8
ACT	4.9	0	0	1.7
SA	143.9	(12.4)	40.1	63.2
NSW South including Lachlan	738	68.2	358.5	523.4
Victoria including Wimmera	823	(17.7)	251.9	384.7
TOTAL	1,982	155.7*	768	1,218

Notes:

*Excludes over recovery volumes in NSW Northern, SA and Victoria

Additional water recovery methods and entitlements

The methods used to recover additional water entitlements for the MEDIUM and HIGH water recovery scenarios is important as it determines whether the consumptive pool is reduced or not and the level of investment in 'structural adjustment'.

It is assumed that additional recovery for the MEDIUM scenario will be done using water market purchases.

It is assumed that additional recovery for the HIGH scenario will be done using water market purchase up to 2,750 GL and farm efficiency investment from 2750 GL to 3,200 GL.

The types of entitlement acquired through water recovery is also important, especially in Victoria, where HRWS are critical to the high value agricultural production in the horticulture and dairy sectors.

As a proportion of total water purchases (LTAAY) in Victoria to date, HRWSs represent 99% and 98% of purchases in the Victorian Murray and Goulburn systems. 98% of water purchases from Victoria have come from the Murray and Goulburn systems (DAWR, 2016b).

As a proportion of total water purchase (LTAAY) in NSW to date, General Security entitlements represent 94% of purchases. Over 99% of purchases have occurred in the Murray and Murrumbidgee systems (DAWR, 2016b).

All water purchases in SA have been High Security entitlements from the Murray system (DAWR, 2016b).

It is assumed that additional water purchases in:

- Victoria will be HRWS from the Murray (55%) and Goulburn (45%) systems
- NSW will be General Security entitlements from the Murray (63%) and Murrumbidgee (37%) systems
- SA will be High Security entitlements from the Murray system

Farm efficiency infrastructure programs in Victoria to date have predominantly acquired HRWS from the Goulburn and Murray systems.

It is assumed that water recovery from farm efficiency programs in:

- Victoria will be HRWSs from the Murray and Goulburn systems in the same proportion to purchases
- NSW will be General Security entitlements from the Murray and Murrumbidgee systems in the same proportion to purchases
- SA will be High Security entitlements from the Murray system
- ACT will not recover the 1.7 GL of up-water apportioned to them.

The Long Term Diversion Limit Equivalent factors used to convert recovery volumes to entitlement are taken from those agreed to by the Murray-Darling Basin Ministerial Council in November 2011 (v2.05).

Based on the above assumptions the additional water recovery by water system, recovery method and entitlement type for the LOW, MEDIUM and HIGH water recovery scenarios is presented in Table 27.

Table 27: Additional water recovery by water system, recovery method and entitlement type for LOW, MEDIUM and HIGH water recovery scenarios (entitlement volume not LTAAY)

State	System	Entitlement type	LOW	MEDIUM	HIGH		
			Purchase (GL)	Purchase (GL)	Purchase (GL)	Farm Efficiency (GL)	TOTAL (GL)
Vic	Murray	HRWS	0.0	145.8	145.8	76.9	222.7
	Goulburn	HRWS	0.0	119.3	119.3	62.9	182.2
NSW	Murray	General	53.1	278.8	278.8	128.2	407.1
	Murrumbidgee	General	39.4	207.3	207.3	95.3	302.6
SA	Murray	High	0.0	44.6	44.6	25.7	70.2

sMDB irrigation water availability

Based on the above analysis water availability for irrigation in the sMDB before the Basin Plan (30 June 2007), currently (October 2016) and at the completion of Basin Plan water recovery for the three water recovery scenarios is present in Table X (LTAAY) and Table Y (entitlement volume). The volumes are for the major entitlements in the sMDB:

- Victorian HRWS
- Victorian LRWS
- NSW High security
- NSW General security
- SA High security

Table 28: Water availability for irrigation from the five major entitlement types in the sMDB pre and post Basin Plan for three water recovery scenarios¹. Figures are in GL LTAAY

SDL Resource Unit	Entitlement type	Pre Basin Plan (30 June 2007) ²	Current (Oct 2016) ³	LOW (2,100 GL recovery)	MEDIUM (2,750 GL recovery)	HIGH (3,200 GL recovery)
Southern Basin NSW Zone	High	474	530	530	530	530
	General Security	2,609	1,921	1,853	1,563	1,398
Southern Basin Vic Zone	HRWS	2,160	1,662	1,662	1,410	1,277
	LRWS	241	227	227	227	227
Southern Basin SA Zone	High	509	419	419	378	355
Southern Basin Total		5,993	4,758	4,690	4,107	3,787
Decrease from 30 June 2007 (GL)		0	1,236	1,304	1,886	2,207
Decrease from 30 June 2007 (%)		0	21%	22%	33%	37%

Notes:

(1) LTDLE volumes determined using 'Long Term Diversion Limit Equivalents Factors for Entitlements in Murray-Darling Basin Valleys, 29 November 2011 version 2.05'

(2) NSW:

- High and General Security entitlement volumes for the Murray and Lower Darling were taken from - Water Sharing Plan for New South Wales Murray and Lower Darling Regulated Rivers Water Sources 2003. Viewed on 20 October 2016 at <http://www.legislation.nsw.gov.au/#/view/regulation/2003/186/part6>
- High and General Security entitlement volumes for the Murrumbidgee were taken from - Water Sharing Plan for the Murrumbidgee Regulated Rivers Water Source 2003. Viewed on 20 October 2016 at <https://jade.io/article/281013>

- Environmental holdings were subtracted from total available entitlements. Volumes of environmental entitlements held at or before 30 June 2007 were taken from the NSW Environmental water register. Viewed 19 October at <http://ewr.water.nsw.gov.au/ewr/main/ersearchAEWByLoc>

Victorian HRWS and LRWS entitlement volume pre Basin Plan taken from the following sources (no adjustment was made for environmental water holdings):

- Bulk Entitlement (Broken System - Goulburn-Murray Water) Conversion Order 2004, Conversion Amending Notice 2007
- Bulk Entitlement (Campaspe System - Goulburn-Murray Water) Conversion Order 2000, Conversion Amending Notice 2007
- Bulk Entitlement (Eildon-Goulburn Weir) Conversion Order 1995, Conversion Amending Notice 2007
- Bulk Entitlement (Loddon System - Goulburn-Murray Water) Conversion Order 2005, Conversion Amending Notice 2007
- Bulk Entitlement (Ovens System - Goulburn-Murray Water) Conversion Order 2004, Conversion Amending Notice 2007
- Bulk Entitlement (River Murray - Goulburn-Murray Water) Conversion Order 1999, Conversion Amending Notice 2007

SA High reliability entitlement volume pre Basin Plan taken from Draft Water Allocation Plan for the River Murray Prescribed Watercourse, Table 3, page 17. No adjustment was made for environmental water held in the irrigation pools.

- (3) The difference between water availability for irrigation on 30 June 2007 and October 2016 is mainly attributable to water recovery for the Basin Plan. 191 GL (LTAAY) in NSW and 30 GL (LTAAY) in Victoria was recovered for Snowy and Living Murray Initiatives during this time meaning that 1,015 GL (LTAAY) is attributable to Basin Plan water recovery. This water recovery volume also needs to be subtracted from the LOW, MEDIUM and HIGH water recovery scenarios to obtain the decrease in the consumptive pool attributable to the Basin Plan.

Conversely, there are significant volumes of contracted water recovery that is yet to be transferred to the CEWO that would further decrease water availability for irrigation. The volume is not known (but CEWO holds 1,712 GL)

Conversely, a significant volume of NSW supplementary entitlement (around 175 GL (LTAAY)) has been recovered for Basin Plan purposes. This recovery is not included in the table. Nor is the NSW conveyance entitlements held by the CEWO.

NSW:

- Total High and General Security entitlement volumes for the Murray and Lower Darling were taken from- NSW Murray Lower Darling Water Sharing Plan 2016
- Total High and General Security entitlement volumes for the Murrumbidgee were taken from - Murrumbidgee Water Sharing Plan 2016

- CEWO environmental holdings were subtracted from total entitlement volumes. Entitlement volumes were viewed on 19 October 2016 at <https://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment>
- Other environmental holdings were also subtracted from total available entitlements. Entitlement volumes were viewed on 19 October 2016 at <http://ewr.water.nsw.gov.au/ewr/main/ersearchAEWByLoc>

Victorian:

- Total water shares were taken from the Victorian Water Register on 19 October 2016 at <http://waterregister.vic.gov.au/water-entitlements/entitlement-statistics>
- CEWO environmental water holdings were subtracted from total water shares. Entitlement volumes were viewed on 19 October 2016 at <https://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment>
- VEWL environmental water holdings were subtracted from total water shares. Environmental entitlement volumes were taken from Table 1.3.1 of VEWL Seasonal Watering Plan 2015/16

SA High reliability entitlement volume is an estimated figure. The CEWO held 151 GL of SA High reliability entitlement on 19 October 2016 (<https://www.environment.gov.au/water/cewo/portfolio-mgt/holdings-catchment>). The majority of the CEWO holdings were recovered for Basin Plan purposes – the Commonwealth’s summary of water recovery progress as at 31 July 2016 indicated that 131.3 GL (LTAAY) of gap bridging water was held by the Commonwealth (viewed at <http://www.agriculture.gov.au/water/mdb/progress-recovery>). It was assumed that 100 GL of this entitlement (90 GL LTAAY) was held in Consumptive Pool E which has a total entitlement volume of 565 GL (see Draft Water Allocation Plan for the River Murray Prescribed Watercourse, Table 3, page 17).

Table 29 – Water availability for irrigation from the five major entitlement types in the sMDB pre and post Basin Plan for three water recovery scenarios. Figure are entitlement volumes in GL (see Table 28 for notes on source of data)

SDL Resource Unit	Entitlement type	Pre Basin Plan (30 June 2007)	Current (Oct 2016)	LOW (2,100 GL recovery)	MEDIUM (2,750 GL recovery)	HIGH (3,200 GL recovery)
Southern Basin NSW Zone	High	500	558	558	558	558
	General Security	3,634	2,673	2,580	2,187	1,963
Southern Basin Vic Zone	HRWS	2,274	1,749	1,749	1,484	1,344
	LRWS	773	731	731	731	731
Southern Basin SA Zone	High	565	465	465	420	395
Southern Basin Total		7,746	6,176	6,083	5,380	4,991
Decrease from 30 June 2007 (GL)		0	1,570	1,663	2,366	2,755
Decrease from 30 June 2007 (%)		0	20%	21%	31%	36%

3 EFFECTS OF THE DIFFERENT APPROACHES TO WATER RECOVERY

The Commonwealth has engaged in three primary approaches to water recovery to achieve the SDLs of the Basin Plan. These are:

- Buyback – Entitlement purchases via a Commonwealth tender process
- Delivery system water savings – infrastructure projects involving delivery system modernisation
- On farm water savings – infrastructure projects involving on-farm irrigation upgrades

The costs of these are significantly different. The Department of the Environment (2014) noted that:

The ‘market multiple’ is the cost of water yield to the Australian Government compared with the prevailing market price for the same entitlement at the time of the project approval. On-farm irrigation upgrades generally yield water savings at a market multiple of between 2.0 and 2.5, whereas delivery system modernisation projects are usually more expensive in terms of the relative cost of the water savings.

However, often the outcomes of the two types of ‘water savings’ projects are considered comparable. This seems likely from comparative static analysis because:

- Delivery system water savings reduce the losses incurred with delivery of water via the IIO channel network. This means that the same volume of water can be delivered to farms while reducing river diversions (by the volume of the water savings). Hence the same water can be used on farm to produce the same level of farm output.
- On-farm water savings reduce the losses associated with on farm water use. The improvements to infrastructure result in greater water efficiency so that less water need be applied for the equivalent crop production.

For example, in the Department of the Environment (2014) discussion about Up-water / ‘Efficiency measures’

‘Efficiency measures’ are projects that recover additional water for the environment with neutral or beneficial social and economic impacts, such as through improved on-farm water use efficiency projects. Efficiency measures projects would be used to recover any water above the 2750 gigalitres needed to meet an adjusted SDL. These projects must do so without causing additional social and economic impacts from the overall decrease in the volume of water available for consumptive use. Some examples of efficiency measures include:

- *replacing or upgrading less efficient methods of on-farm irrigation; and*
- *lining channels to reduce water losses within an irrigation network.*

Similarly, reporting of water recovery generally reports on ‘buyback’ and ‘infrastructure projects’, where the latter is the sum of delivery system infrastructure projects and on-farm infrastructure projects.

However, this appendix suggests that there are complexities that need to be considered and that each of the three water recovery have subtly different effect on the ‘consumptive pool’ and on water markets. Each is discussed below (in the context of irrigation).

Ultimately, we conclude that on-farm water savings have effects similar to delivery system water savings in wet-to-average years, but the effects of on-farm water savings projects are closer to buyback when conditions are drier.

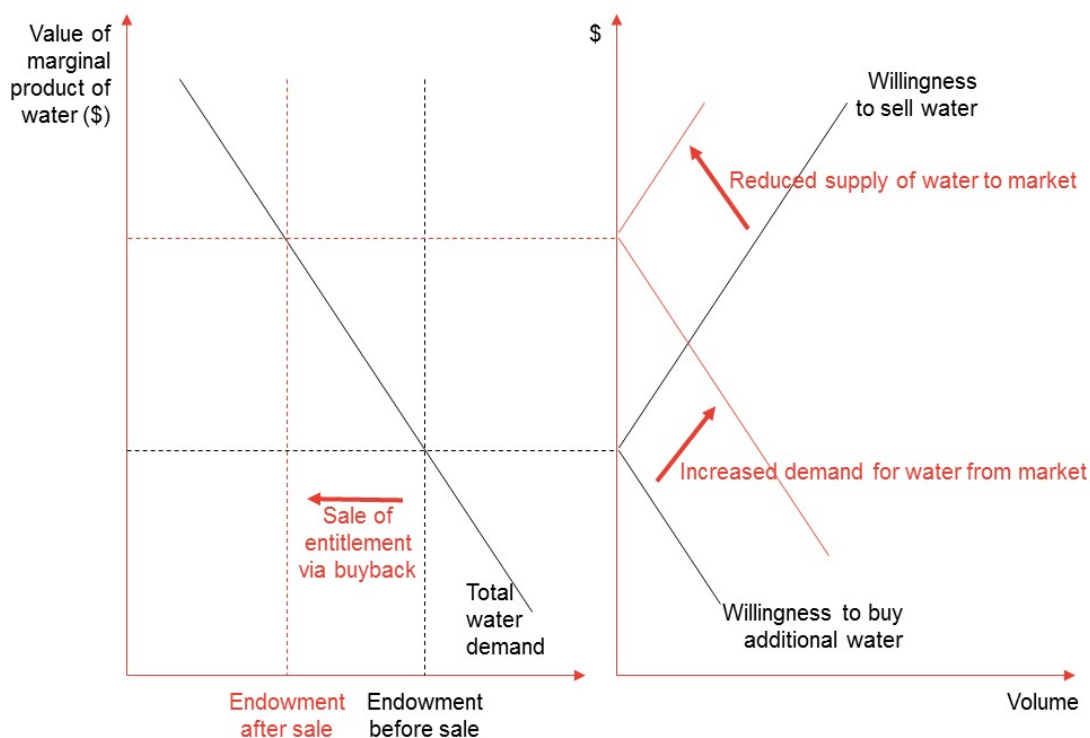
3.1 BUYBACK

Buyback involves the transfer of a water entitlement from an irrigation farm enterprise to the CEWH.

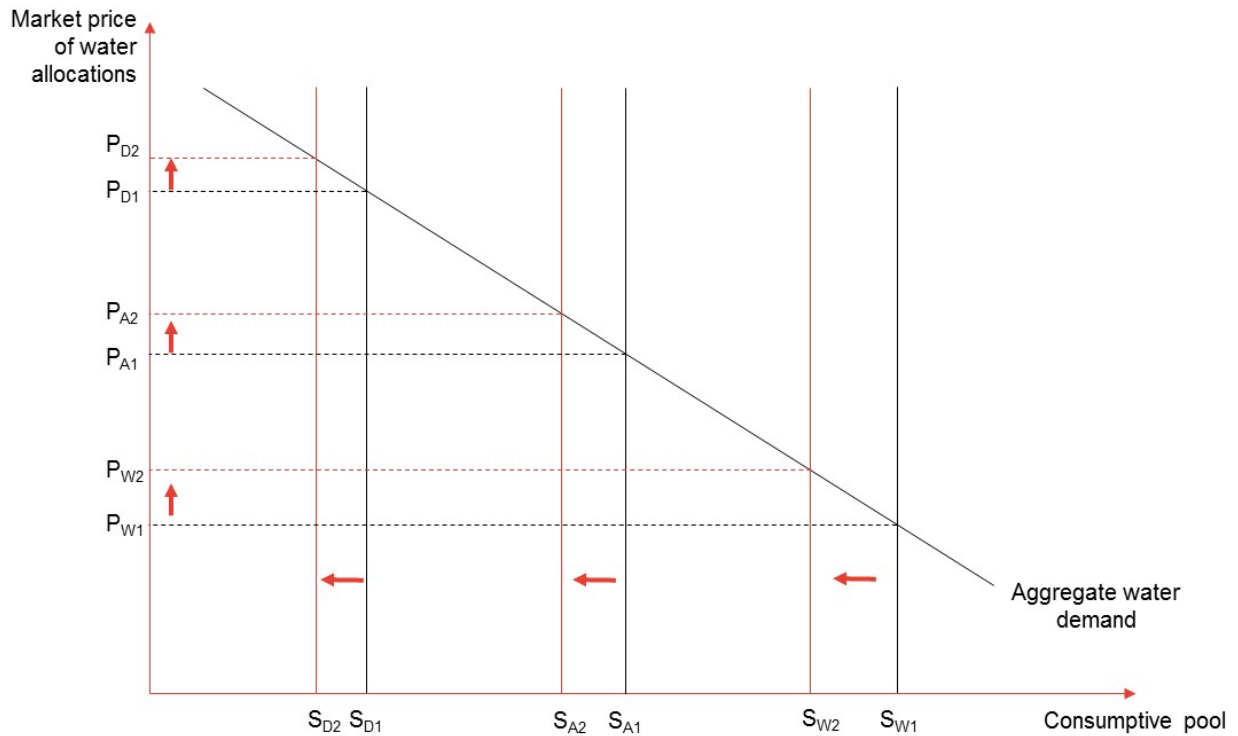
This means there are fewer water entitlements available for consumption.

The seller is compensated for the sale, at the price offered under the tender. Subsequent to the sale the irrigation farm enterprise may seek to continue water use as previously (via reliance on water allocation purchases or the purchase of replacement water entitlements). Alternatively, they may adjust the farm water demands (i.e. reduced water demands, or more opportunistic irrigation) or exit. The funds from the buyback will assist with water market purchases or farm adjustment.

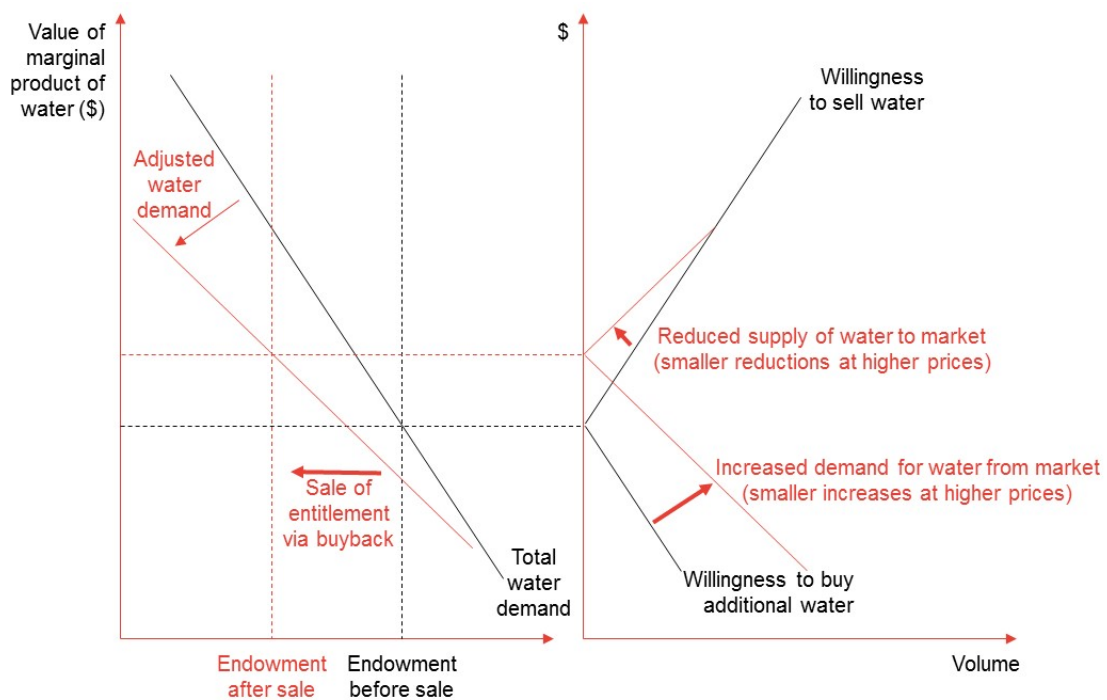
If the irrigation farm enterprise seeks to continue water use as before through reliance on the allocation market, at every price level it would increase the farms demand for volumes from the market (or reduce supply to market sales).



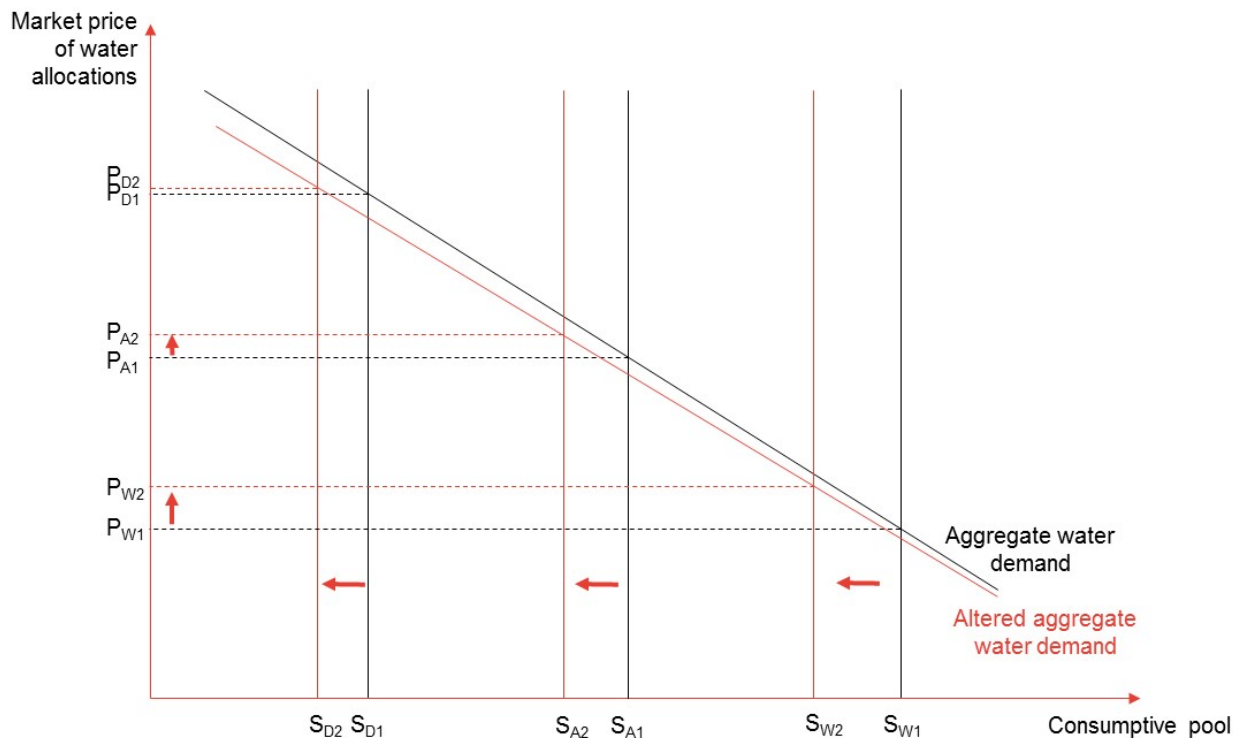
The expected effect of this would be to increase water allocation prices under all conditions (such as dry conditions when available supply is reduced from S_{D1} to S_{D2}).



If the irrigation farm enterprise adjusts to more opportunistic water use this will lead to smaller changes (compared to above) at higher prices.



The change in individual water demand will slightly alter aggregate demand. This leads to smaller price impacts in drier years (with higher prices) than in wetter years, as compared to the situation where buyback occurs and the seller does not alter farm water demands.



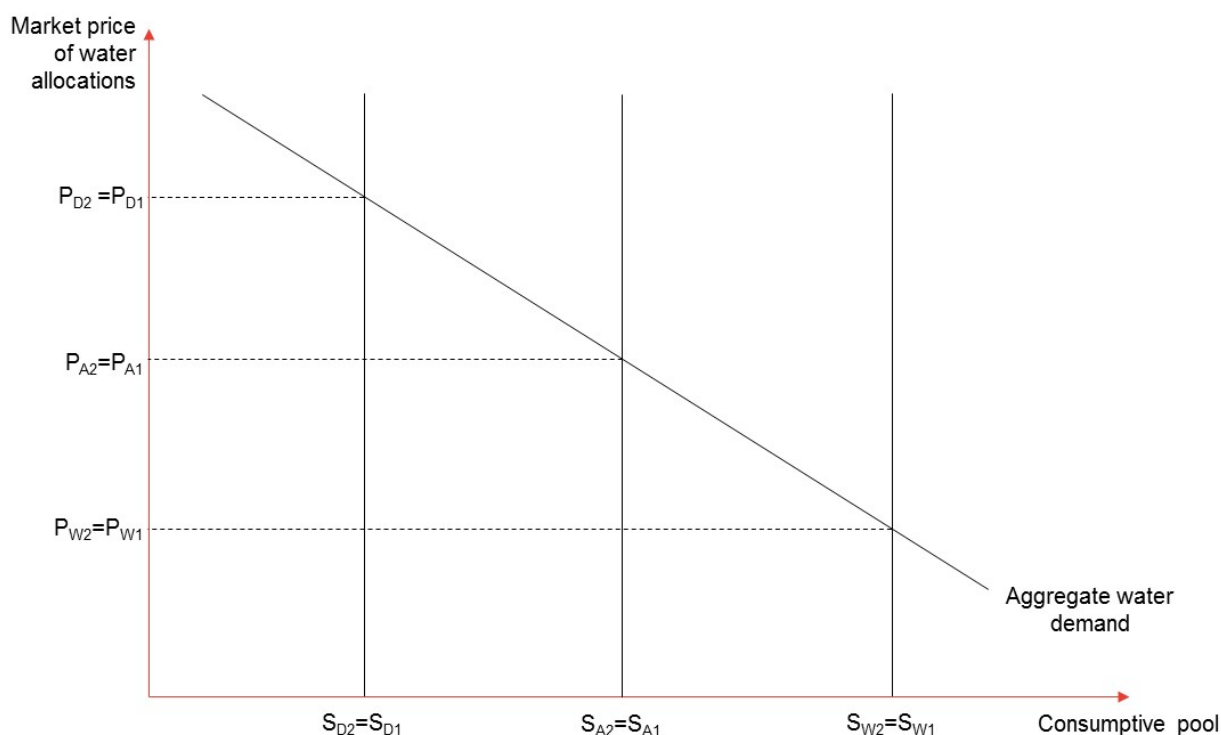
If the irrigation farm enterprise purchases replacement entitlements, then the subsequent seller may react in the above ways.

3.2 DELIVERY SYSTEM WATER SAVINGS

Delivery system water savings projects involves the conversion of a bulk entitlement conveyance volume into a water entitlement that is then transferred to the CEWH.

This does not change the number of water entitlements available for consumption.

This means the expected supply and demand for water are unchanged and prices would not be affected.



In application, there are more complex changes caused by delivery system water savings projects that cannot be represented in the simplified diagrams above, such as earlier season access to allocations and carryover.

3.3 ON FARM WATER SAVINGS

Like buyback, on-farm water efficiency projects provides direct benefits to the farm enterprise that participates in the Commonwealth program. Schirmer and Peel (2016)²⁷ report that 90 irrigators were asked how useful the grant was for their farm enterprise: 81% said the grant was very useful, 19% that it was moderately useful, and none said it was 'not useful'.

On-farm investments may occur when land is a significant constraint to irrigated production. In such a case, the water demand function might have a kink. At prices below P_1 the land is fully irrigated, whereas at price above P_1 no irrigation occurs. If the farm enterprise holds the entitlement volume equal to the crop demand, then P_1 might correspond to the expected price when announced allocations are 100%.

If an on-farm water savings project can double the water use efficiency, then half the water can support the same production. As part of the project, the farmer could transfer half of the entitlement to the CEWH. If allocations are 100%, then the full production can be supported by the farm inputs of land, reduced entitlement and enhanced capital.

²⁷ Schirmer, J. and Peel, D. 2016, The Murray-Darling Basin Plan and farm business performance, Report prepared for the Murray Darling Basin Authority, May

However, if the on-farm project means that only half the water is required for the same production with the original set of inputs, then the irrigation farm enterprises willingness to pay for water will double to P_2 .

If the water price is below P_1 (and allocations are $>100\%$):

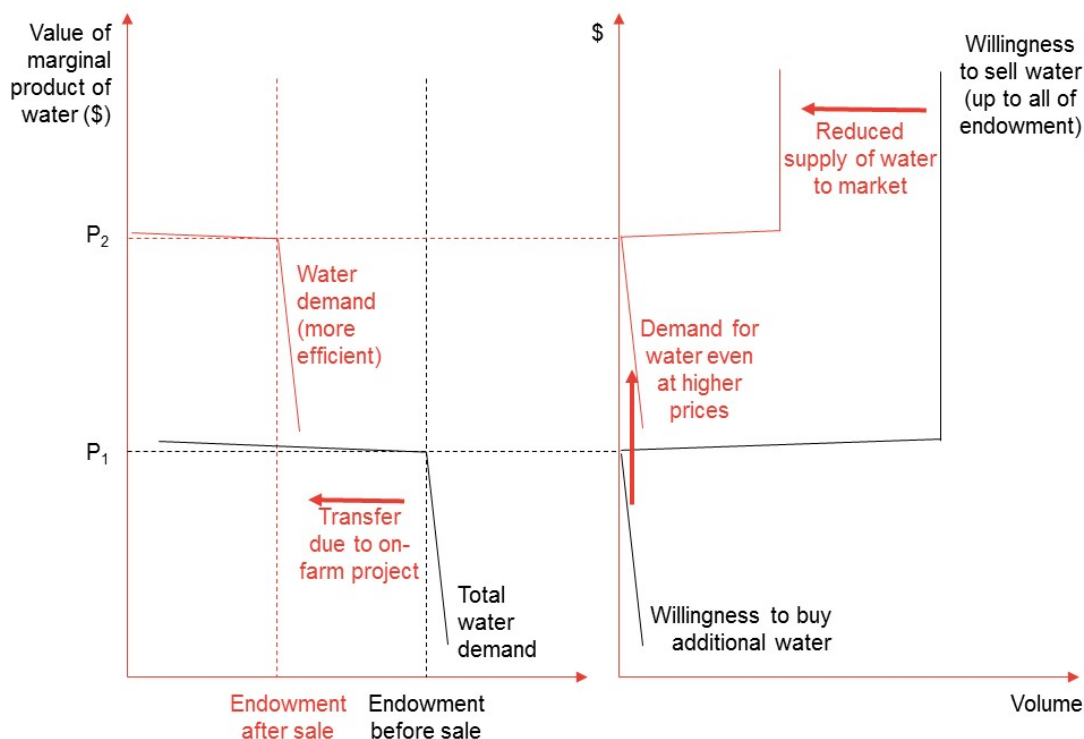
- The farm enterprises water demand is met in both cases (before and after the on-farm water savings project)

If the water price is between P_1 and P_2 (and allocations are $<100\%$):

- Before the on-farm water savings project, the allocations would have been sold (since the water can be sold for higher than the marginal value of water in production).
- After the on-farm water savings project, the increased water efficiency means that the farm enterprise will purchase the water shortfall (since the water can be bought for less than the marginal value of water in production)

If the water price is above P_2 :

- The farm enterprise will sell all water allocations. However, the volume of water allocations sold is greater before the on-farm water savings project than after.

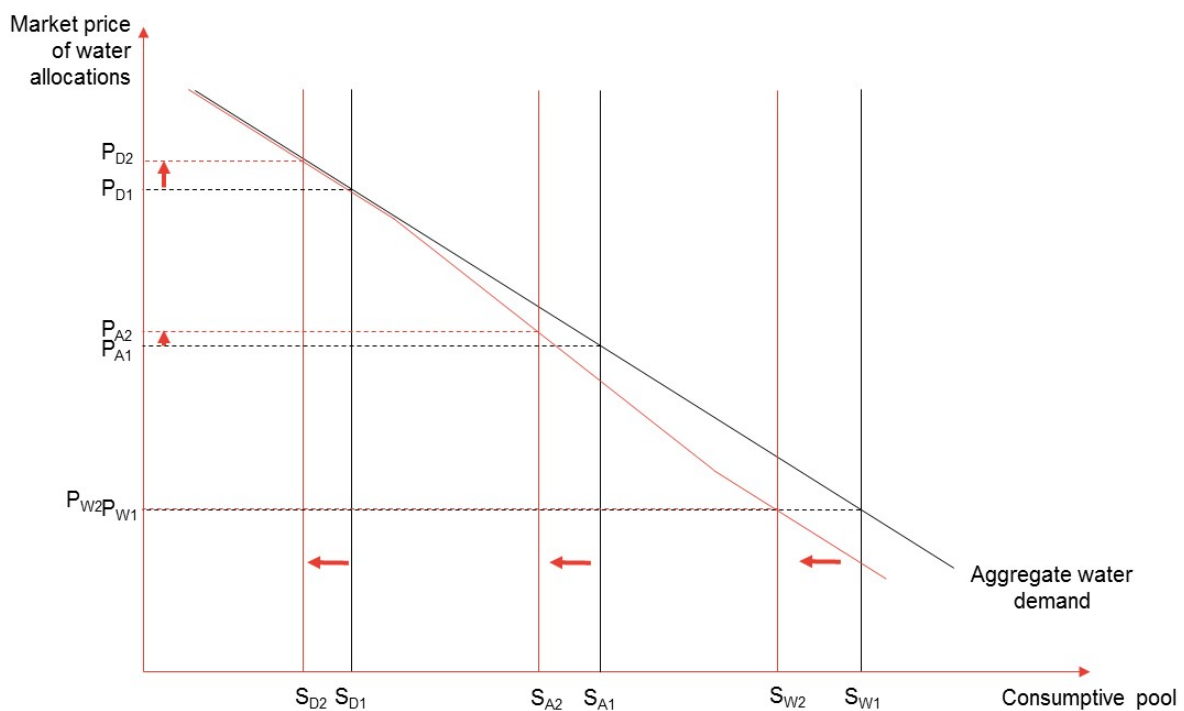


The effect of this is to reduce aggregate demand for water when water availability is at levels where the unimproved farm would have been in production. The water efficiencies of the upgraded farm and the reduction in the consumptive pool are matched, with the resultant effect on water allocation prices being insignificant. However, at higher prices (as during drier seasonal conditions) there is increased demand from upgraded farms (as compared to their willingness to use water before the upgrades). If the price reaches a level when water allocations would be sold from the upgraded farms

rather than used, then the water efficiencies are not utilised. At these levels, aggregate demand consists only of higher marginal value uses, and the water available to these uses is reduced by the quantum of the water allocations received by the 'on-farm water savings' entitlements transferred to the CEWH.

This outcome is consistent with the current focus of on-farm efficiency projects occurring on farms with interruptible or semi-interruptible production systems.

In these circumstances, on-farm water savings are expected to have price effects similar to delivery system water savings in wet-to-average years, but the price effects of on-farm water savings projects are closer to that of buyback when conditions are drier. In aggregate, these price effects influence the outcomes for those farm enterprises that did not participate in on-farm program, or may temper the direct benefits enjoyed by program participants.



If land is not a limiting constraint in production, then the more water efficient farm enterprise may find it more profitable to source additional water to increase production (rather than reduce water use and keep production equal to historical levels) — see box.

Box 1: Example of on-farm water recovery increasing water use

Vignette 1 in MDBA (2016a) reports on a farmer that received two rounds of infrastructure upgrades from the Commonwealth in 2011 and 2014, which has allowed him to upgrade parts of the property from furrow to trickle and in exchange he returned 270ML of water to the environment. The farmer stated:

With all this infrastructure that's gone in it's also created more demand for the water. We're saving water but we're being more intense and more productive. Because we're using it more efficiently and being more profitable that drives us to want more water to do more things. It has that driving effect. We gave water back but we went straight back to the market and bought it again. We were getting two for one really. It is a lot more production but as I say it's made us a lot more intense. A lot of other people are the same all these people are getting better irrigation systems [and the demand for water is going up].

Source: MDBA 2016a, Insights into how the Murray-Darling Basin Plan water reforms are affecting irrigators: A preliminary report, Unpublished MDBA Report, February

4 WATER PRICE EFFECTS OF WATER RECOVERY

ABARES, Aither and RMCG have each considered the price impacts of water recovery. ABARES undertook modelling of the southern MDB allocation market (ABARES 2016) and found that water recovery was an important explanatory of allocation price movements. The ABARES economic model of that market estimated that the Commonwealth entitlement purchases increased annual water allocation prices by an average of around \$25 per ML (or 39 per cent) between 2012/13 and 2014/15. ABARES contrast the increase in market prices for allocations that buyback have with infrastructure upgrades:

The story is more complicated in the case of infrastructure upgrades. Investments in on- or off-farm infrastructure reduce losses (to evaporation, seepage and so on). Under the Murray–Darling Basin Plan programmes, at least 50 per cent of these water savings are returned to the Commonwealth, with the remainder returned to entitlement holders. As such, the net effect of infrastructure projects should be to increase the volume of water available for use and/or to improve farm water use efficiency (by an amount greater than any environmental water recovery)—both of which would lead to lower water prices.

However, infrastructure projects can also help farmers achieve improvements in productivity. General improvements in irrigation farm productivity and profitability may result in increased demand for water. Thus, the precise effect of infrastructure projects on the water allocation price is difficult to measure, although the overall effect on the allocation price is likely to be downward because of the water savings achieved. (p.20)

This statement does not differentiate the discussion of on- and off-farm infrastructure projects, and does not differentiate the effects between the seasonal conditions in which they occur. The ABARES report does not attempt to predict future price impacts of water recovery.

Aither (2016a) analysed supply-side drivers of water allocation prices and found that the buyback had the effect of raising allocation prices for given seasonal conditions.

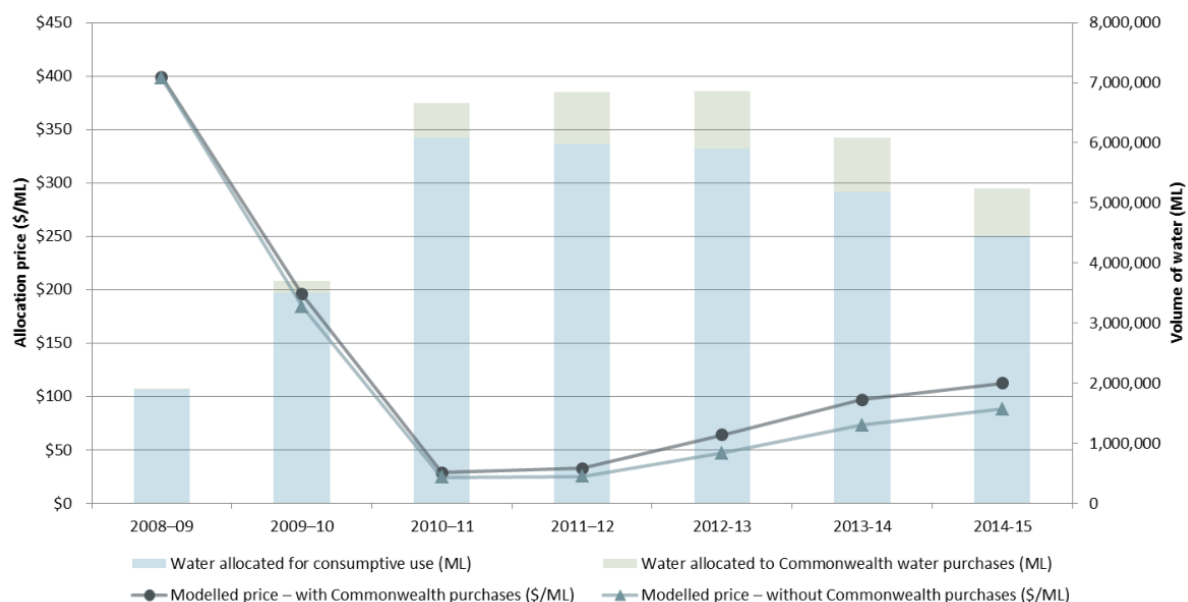


Figure 67 Water allocation prices with and without Commonwealth purchases

The price differences expected in 2013/14 and 2014/15 were associated with 15% reductions in the consumptive pool as a result of buyback. In both years a difference of \$24 dollars was calculated, which was equivalent to a 33% and 27% price rise attributable to the buyback water recovery, respectively.

Aither (2016a) found proportional price rise (that would be attributable to water recovery through buyback) in the event of a repeat of extremely dry conditions such as 2008/09 would be 8%, whereas the proportional increase is expected to be greater in wet years (see table).

Table 30: Water price rises attributable to buyback (Aither, 2016a)

Scenario	Modelled price - without buyback (\$/ML)	Modelled price - with buyback (\$/ML)	Potential price impact of buyback (\$/ML)	Proportional change in allocation price due to buyback
Expected 2015/16	127	157	30	24%
Repeat of extreme dry (2008/09)	398	429	31	8%
Repeat of average (2005/06)	71	92	21	30%
Repeat of wet year (2011/12)	25	34	9	36%

Source: adapted from Aither 2016a

This provides significant insight into the function form of the water allocation price relationship found by Aither's water market model. Aither (2016a) found the added price impact of an additional 200GL of environmental purchases is relatively small – 2% in a repeat of a dry year, 4% in an average year and 6% in a wet year.

Aither (2016b) builds on the above supply-side impact analysis and includes changes in demand by irrigation industries and urban water authorities. Aither (2016b) first revisits the case of historical buyback holding industry structure constant. The proportion change attributable to water recovery of 15% of the consumptive pool is more consistent across water availability scenarios in Aither 2016b than was found in Aither 2016a, suggesting some change in the underlying assumptions of the model. In fact, the highest proportion change is found in dry conditions (low allocation seasons) at 14%.

Table 31: Water price rises attributable to buyback in dry conditions (Aither, 2016a)

Scenario	Modelled price - without buyback (\$/ML)	Modelled price - with buyback (\$/ML)	Potential price impact of buyback (\$/ML)	Proportional change in allocation price due to buyback
Low allocation seasons	172	196	24	14%
Medium allocation seasons	101	114	13	13%
High allocation seasons	32	36	4	12%

Source: adapted from Aither 2016b, scenario 1.

When the historical change in irrigation demand and urban authorities is added in, the price impacts of buyback are found to be higher.

Table 32: Water price rises attributable to buyback in dry conditions after allowing for historical changes in demand for irrigation and urban demands (Aither, 2016a)

Scenario	Modelled price - without buyback (\$/ML)	Modelled price - with buyback (\$/ML)	Potential price impact of buyback (\$/ML)	Proportional change in allocation price due to buyback
Low allocation seasons	172	207	35	20%
Medium allocation seasons	101	118	17	17%
High allocation seasons	32	37	5	16%

Source: adapted from Aither 2016b, scenario 3.

Aither (2016b) also considered the expected price impacts of compounding future changes to irrigation (significant growth for cotton and nuts, and a contraction for grapes) and urban demand as well as 200GL of additional water recovery. Again, the impacts are expected to be greatest under drier conditions.

Table 33: Water price rises attributable to buyback after allowing for future changes to irrigation demand (Aither, 2016a)

Scenario	Modelled price - without (\$/ML)	Modelled price - with (\$/ML)	Potential price impact (\$/ML)	Proportional change in allocation price due to buyback
Extreme dry	603	702	99	16%
Low allocation seasons	207	231	24	12%
Medium allocation seasons	118	131	13	10%
High allocation seasons	37	41	4	9%

RMCG (2016) also examined the correlation between water recovery and prices in water markets. The analysis built of water market data that shows a strong inverse correlation between the level of total available allocation and price in the temporary market.

RMCG found that the water allocation price in the southern MDB could be described in relation to the total volume of announced allocations by season across the southern connected basin.

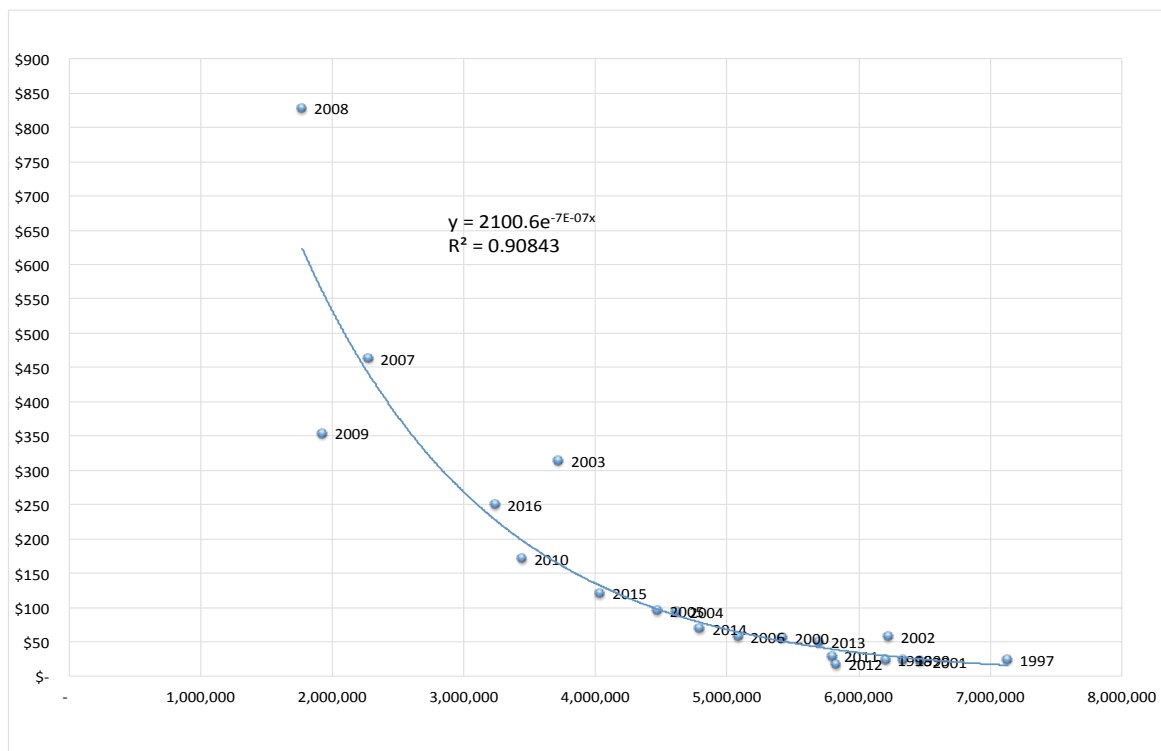


Figure 68 Water allocation price relationship with water availability

Source: RMCG 2016

RMCG use this relationship to consider the impact of water recovery of 20% of the consumptive pool.

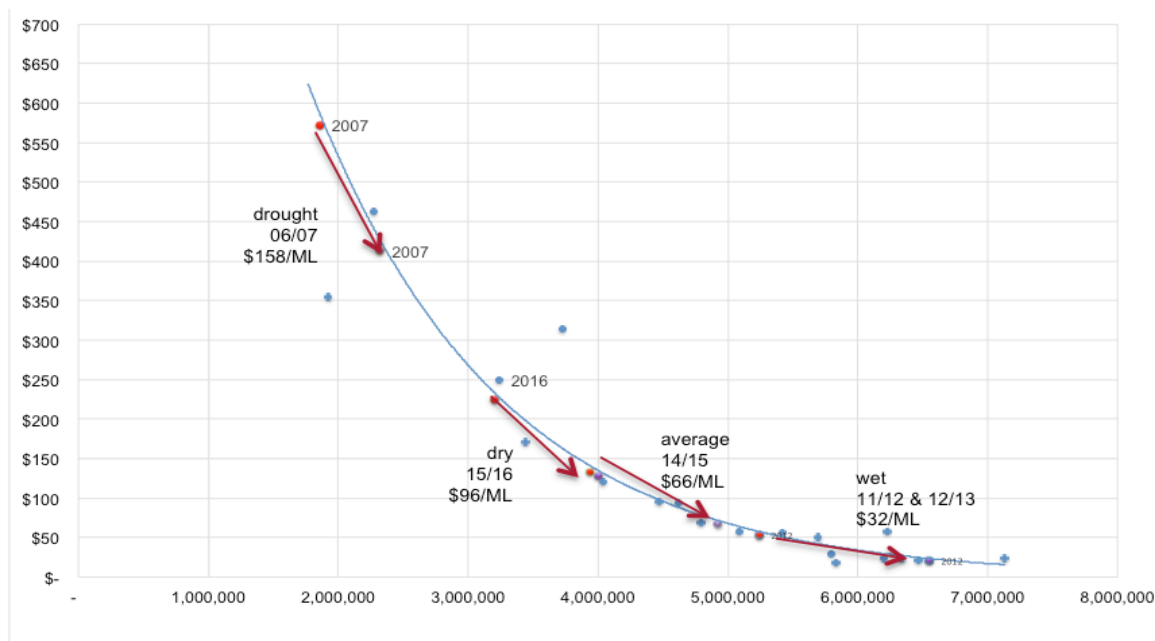


Figure 69 Water allocation price response to water recovery

Source: RMCG 2016

The expected price impacts are significantly greater than the differences reported by Aither (2016a and 2016b), even after adjustments are made to consider a buyback of 15% of the consumptive pool (see table).

Scenario	Potential price impact due to 20% buyback (\$/ML)	Proportional change in allocation price due to 20% buyback	Potential price impact due to 15% buyback (\$/ML)	Proportional change in allocation price due to 15% buyback
Drought scenario	158	38%	115	27%
Dry scenario	96	75%	67	52%
Average scenario	66	95%	47	66%
Wet scenario	32	145%	22	98%

Source: Analysis based on RMCG (2016) function form.

The function form estimated by RMCG can also be used to demonstrate how the compounding effect of water recovery and increasing horticultural investment manifests to impact water allocation prices.

The chart below shifts the RMCG function based on the fixed water demands being added into the Mallee region. A base case (blue), aligning with the original RMCG curve, would be when there was 326GL of relatively fixed horticultural demand (a la 2008/09). If investment grew this horticultural demand to 526GL (a la 2015/16), and these enterprises would be expected to be willing to secure their full required water volumes (for prices up to at least \$800/ML) then the new price function would be the orange curve. Maturation of existing plantings and further new investment would be expected to shift the curve further.

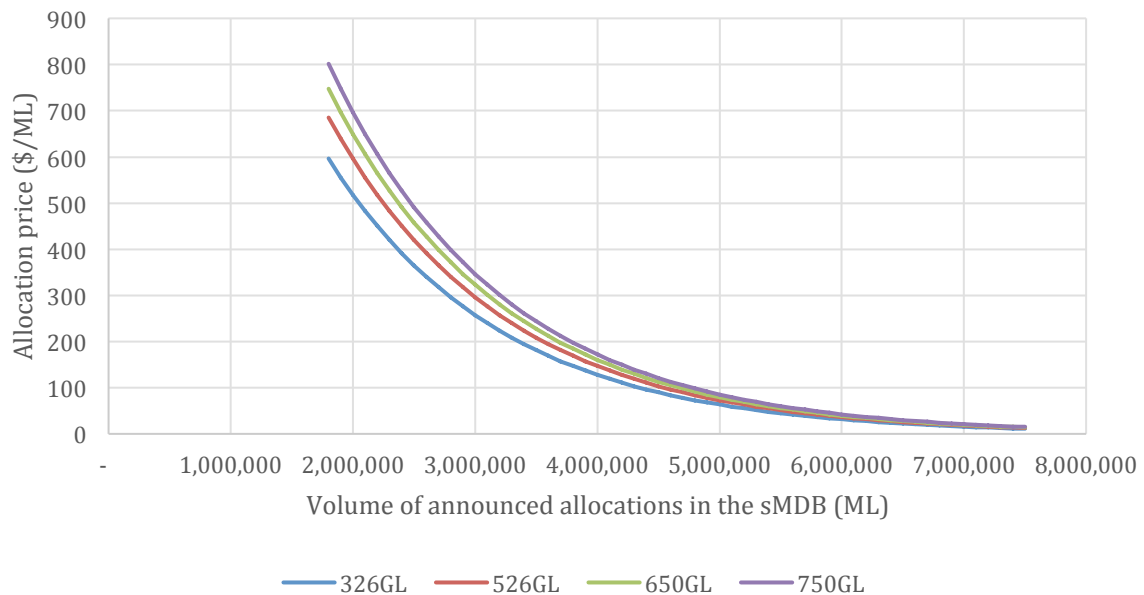


Figure 70: Water allocation price relationship under different levels of horticultural investment

Source: Analysis based on RMCG (2016) functional form.

This means that the water recovery and new horticultural investment are expected to have reinforcing additive effects on water allocation prices. The horticultural volumes are not sufficient to significantly change the price relationship in average and wet year (because they are a fixed volume rather than the proportional change associated with buyback). However, the additional volumes required to support these horticultural investments do become significant under dry to extreme dry conditions and therefore have a greater effect on the water allocation price relationship.

It should be noted that price increases are not a categorically negative effect. It depends on the individual circumstances. However, if a farm enterprise had sold off water entitlement with the expectation of ongoing purchases of water allocations to maintain water use, then they are in a position that would be negatively affected by the expected impacts of the water allocation price.

5 EXPECTED FUTURE HORTICULTURAL DEMANDS FOR WATER

Grapevines are the main irrigated horticultural crop in the southern-connected Basin, but there has been a recent decline in vineyard area. By contrast there has been a steady increase in the total area of tree crops, particularly almonds, since the Basin Plan commenced. The total area of irrigated grapevines peaked around 2006, before the Plan commenced, with the end of the wine boom.

In 1995/96, pears were the Goulburn Broken region's main pome fruit, but declining market demand for pears and comparatively higher prices for other crops meant plantings were not replaced and production steadily declined. As pear production declined, apple production increased by 58% between 1995/96 to 2012/13 when the Goulburn Broken region accounted for 70% of the value of Victorian apple production and 96 per cent of the value of Victorian pear production. Victorian stone fruit production grew strongly between 1995/96 and 2005/06, but production declined by 21% for nectarines and 39% for peaches between 2005/06 and 2012/13 due to shortages in water allocations, drought, hail and frost, coupled with shrinking margins and reduced market demand for stone fruit, particularly for processing and canning. The Goulburn Broken region accounted for 55% and the North Central region 13% of the value of Victorian peach production (DEDTJR, 2014).

Revenue from fruit growing in the Goulburn Valley has increased over time although production volumes have reduced. For example, Goulburn Valley growers have planted trees at a faster rate due to the increase in density of plantings, and value of production increased by 120% from 2001 to 2011, which is faster than the rest of Victoria or Australia (APCG, 2013, cited by RMCg, 2013).

Nut tree plantings in the Victorian Mallee went from 1,900 ha in 1997 to 20,900 in 2015. By contrast grapevines went from 20,500 ha in 1997 to a peak of 25,600 in 2006 (shortly before the Basin Plan commenced) before declining, as a result of low wine prices, low water availability and high water prices, to 20,500 ha in 2015. Those same factors resulted in a vacant land peak of 20% in 2009 (Argus, 2016).

The grapevine story is better understood as a decline in dried grape plantings from 6,300 ha in 1997 to 3,000 ha in 2015, an increase in table grape plantings from 4,100 ha to 7,300 ha in the same period and an oscillation in wine grape plantings from 9,900 ha in 1997, through 15,600 ha in 2006 returning to 10,100 ha in 2015 (Argus, 2016). In effect, table grapes have replaced dried grapes, while the post 1997 increase in wine grape plantings has been reversed.

It is important to note that total water use per hectare for grapevines varies markedly with varieties and production systems. Many varieties of red wine grapes, in particular, were produced with small canopies with total irrigation requirements around 5 ML/ha. Traditional dried vine fruit production involved volumes up to 9 ML/ha while many table grape varieties are grown with large canopies with irrigation requirements in the order of 12 to 15 ML/ha. Almonds are being developed in growing systems using more than 14 ML/ha. Consequently, while the area of irrigated horticulture has grown significantly, irrigation intensity, in terms of ML/ha, has grown even more significantly since 1997.

In Table 35 we multiply the area for each horticultural crop (Argus, 2016) by the maximum irrigation application rates outlined in DSE (2007), to arrive at total annual average horticultural irrigation demands in the Victorian Mallee of 587.4 GL. Applying the same approach to crop area data for South Australia, the Lower Darling and the NSW Murray (MDBA, 2015b) we arrive at a total there of 548.9 GL (workings available on request from Tim.Cummins@bigpond.com). As shown in Table 34, when we combine this with RMCG's (2016) estimate for average annual water use by horticulture in the GMID and the data recorded for Murrumbidgee horticulture in Chapter 7, we arrive at a grand total for average horticultural demand of 1,393.3 GL.

Using a different approach, RMCG (2016) arrive at a total of 1400 GL. Our figures therefore help to triangulate theirs.

Table 34: Estimated future annual average irrigation demand from mature existing horticultural plantings in the southern-connected Basin

Category	irrigation requirement at maturity for 2015 horticultural plantings GL
Total perennial and annual horticultural irrigation requirements in the Victorian Mallee	587.4
Total in the Lower Murray-Darling excluding the Victorian Mallee	548.9
Total GMID horticultural requirements (RMCG, 2016)	97
Total Murrumbidgee horticultural use (from Murrumbidgee Irrigation Annual Report – see Chapter 7)	160
Grand total	1,393.3

Table 35: An initial assessment of mature irrigation requirements of existing crops in the Victorian Mallee and some projections of future possible demand

Category	2009 area (ha)	2015 area (ha)	% change	Maximum application rate ML/ha	2009 Mature irrigation requirement ML	2015 mature irrigation requirement ML	2015 irrigation water requirement plus 75% restoration of vacant land ML	2015 mature irrigation requirement plus 75% restoration of vacant land plus NID proposals ML	2015 mature irrigation requirement plus 75% restoration of vacant land plus NID proposals plus due diligence ML
Almond	19,905	20,620	4%	14	278,670	288,680	288,680	316,400	365,640
Other nut tree		285		12	0	3,420	3,420	3,420	6,255
Wine grape	13,050	10,130	-22%	8	104,400	81,040	81,040	81,040	95,740
Table grape	5,730	7,295	27%	12	68,760	87,540	87,540	87,540	88,260
Dried grape	2,905	3,040	5%	8	23,240	24,320	24,320	24,320	57,320
Other grape	35	45	29%	8	280	360	360	360	360
Citrus	3,655	3,720	2%	12	43,860	44,640	44,640	44,640	45,840
Olive		3,625		12	0	43,500	43,500	43,500	43,500
Avocado		560		13	0	7,280	7,280	7,280	7,280
Stone fruit		580		12	0	6,960	6,960	6,960	6,960
Other fruit tree	565	155		12	6,780	1,860	1,860	1,860	1,860
unspecified fruit tree	4,980	60		12	59,760	720	720	720	720
Nursery		180		12	0	2,160	2,160	2,160	2,160
Woodlot		250		0	0	0	0	0	0

Category	2009 area (ha)	2015 area (ha)	% change	Maximum application rate ML/ha	2009 Mature irrigation requirement ML	2015 mature irrigation requirement ML	2015 irrigation water requirement plus 75% restoration of vacant land ML	2015 mature irrigation requirement plus 75% restoration of vacant land plus NID proposals ML	2015 mature irrigation requirement plus 75% restoration of vacant land plus NID proposals plus due diligence ML
Vacant > 10 years perennial horticultural land		475							
Total area perennial crop land	57,505	58,255	1%						
Maximum perennial horticultural irrigation requirements					585,750	592,480	641,181	668,901	770,596
Long-term perennial horticulture irrigation requirement allowing for continuous renewal (90% of maximum)					527,175	533,232	577,063	602,011	693,537

unspecified vegetables 2009	4,755			12	58,086	0	0	0	0
unspecified vegetables 2015		345		8.0	0	2,760	2,760	2,760	2,760
Asparagus		405		13	0	5,265	5,265	5,265	5,265
Carrot		2,590		12	0	31,080	31,080	31,080	31,080
Cucurbit		535		9	0	4,815	4,815	4,815	4,815
Potato		940		8	0	7,520	7,520	7,520	7,520
Other vegetable		455		6	0	2,730	2,730	2,730	2,730
Total vegetable irrigation requirements					58,086	54,170	54,170	54,170	54,170

Category	2009 area (ha)	2015 area (ha)	% change	Maximum application rate ML/ha	2009 Mature irrigation requirement ML	2015 mature irrigation requirement ML	2015 irrigation water requirement plus 75% restoration of vacant land ML	2015 mature irrigation requirement plus 75% restoration of vacant land plus NID proposals ML	2015 mature irrigation requirement plus 75% restoration of vacant land plus NID proposals plus due diligence ML
Total long-term annual and perennial horticultural irrigation requirements					585,261	587,402	631,233	656,181	747,707

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