**Glossary and abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABARE</td>
<td>Australian Bureau of Agricultural and Resource Economics</td>
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<td>ABARES</td>
<td>Australian Bureau of Agricultural and Resource Economics and Sciences</td>
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<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
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<tr>
<td>allocation (water)</td>
<td>The specific volume of water allocated to water access entitlements in a given season, given accounting period, defined according to rules established in the relevant water plan.</td>
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<tr>
<td>[The] Authority</td>
<td>The Murray-Darling Basin Authority</td>
</tr>
<tr>
<td>broadacre</td>
<td>Large-scale cropping (rice, cotton, grain etc.) In this report, the term refers to grain and fodder crops excluding cotton and rice.</td>
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<tr>
<td>BRS</td>
<td>Bureau of Rural Sciences</td>
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<tr>
<td>Buyback</td>
<td>Purchase of water entitlements for the environment from voluntary sellers.</td>
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<tr>
<td>CD</td>
<td>Census district</td>
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<tr>
<td>CEWH</td>
<td>Commonwealth Environmental Water Holder: The CEWH is the independent statutory position created by the Water Act 2007 to manage the Australian Government’s portfolio of water assets. The Water Act 2007 provides for the CEWH to trade entitlements and seasonal allocations to improve the capacity of the Commonwealth environmental water portfolio to meet environmental objectives.</td>
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<tr>
<td>CGE modelling</td>
<td>Computable General Equilibrium modelling</td>
</tr>
<tr>
<td>COAG</td>
<td>Council of Australian Governments</td>
</tr>
<tr>
<td>CSIRO</td>
<td>Commonwealth Scientific and Industrial Research Organisation</td>
</tr>
<tr>
<td>Cth</td>
<td>Commonwealth (Australian) Government</td>
</tr>
<tr>
<td>dryland</td>
<td>Agricultural production or farming that is dependent on natural rainfall</td>
</tr>
<tr>
<td>EBC</td>
<td>Environment and Behaviour Consultants</td>
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| EC [1]       | Exceptional Circumstances: rare and severe climate events that are outside those that a farmer could normally be expected to manage using responsible farm management strategies. To be classified as an EC event, the event:  
  - must be rare, that is it must not have occurred more than once on average in every 20 to 25 years  
  - must result in a rare and severe downturn in farm income over prolonged period of time (e.g. greater than 12 months)  
  - must be a discrete event that is not part of long-term structural adjustment processes or normal fluctuations in commodity prices. |
Electrical conductivity: a scale providing a measure of the level of salinity

**entitlement (water)**
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.

**GMID**
Goulburn Murray Irrigation District (Victoria)

**The Guide**
*Guide to the proposed Basin Plan*

**GVAP**
Gross Value of Agricultural Production

**GVIAP**
Gross Value of Irrigated Agricultural Production

**ha**
Hectare

**LGA**
Local government area

**MDB**
Murray-Darling Basin

**MDBA**
Murray-Darling Basin Authority

**MDBC**
Murray-Darling Basin Commission (now defunct)

**Millennium drought**
Between 1997 and 2009, south-eastern Australia experienced the most persistent rainfall deficit since the start of the 20th century. Annual rainfall during the so-called 'Millennium Drought' was 73 mm below average (or 12.4% below the 20th century mean) for the years 1997–2009 inclusive *(CSIRO 2011)*.

**MLDRIN**
The Murray Lower Darling Rivers Indigenous Nations

**MJA**
Marsden Jacob Associates

**NBAN**
Northern Murray-Darling Basin Aboriginal Nations

**NSW**
New South Wales

**NVIRP**
Northern Victoria Irrigation Renewal Program

**Qld**
Queensland

**RMCG**
RM Consulting Group

**SA**
South Australia

**SDL**
Sustainable Diversion Limit

**SEWPAC**
Department of Sustainability, Environment, Water, Population and Communities of the Commonwealth Government

**SLA**
Statistical local area

**TLM**
The Living Murray river restoration and buyback program

**Vic**
Victoria
**Volumes of water**

Volumes of water referred to in this document are expressed as either megalitres (ML) or gigalitres (GL) where:

<table>
<thead>
<tr>
<th>Volume Description</th>
<th>1 litre</th>
<th>1 litre</th>
<th>1 L</th>
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<tr>
<td>One litre</td>
<td>1 litre</td>
<td>1 litre</td>
<td>1 L</td>
</tr>
<tr>
<td>One thousand litres</td>
<td>1,000 litres</td>
<td>1 kilolitre</td>
<td>1 KL</td>
</tr>
<tr>
<td>One million litres</td>
<td>1,000,000 litres</td>
<td>1 megalitre</td>
<td>1 ML</td>
</tr>
<tr>
<td>One billion litres</td>
<td>1,000,000,000 litres</td>
<td>1 gigalitre</td>
<td>1 GL</td>
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Overview

• The Murray–Darling Basin Authority has a vision, of a healthy, working Murray–Darling Basin that supports strong and vibrant communities, resilient industries, including food and fibre production, and a healthy environment.

• Achieving that vision means making substantial changes to the way we allocate and manage the Basin’s water resources. One role of the Authority is to determine the appropriate scale of change required to achieve an optimal balance between competing demands for water.

• The development of the Basin’s water resources over the last century has been a critical driving factor behind the development of the Basin’s economy and social characteristics, and a significant contributor to Australia’s prosperity.

• Rebalancing the system to the degree that is required will result in both challenges and opportunities for Basin communities.

• Although it is difficult to quantify, and provided that implementation options are carefully managed and coordinated, the evidence indicates that the long-run social, economic and environmental benefits of the Basin Plan are likely to outweigh the long-run costs.

• At the Basin level, the costs are expected to be relatively small. Models have estimated that the level of total production in the Basin (gross regional product) will be reduced by less than 1 per cent and that this is expected to be more than offset by broader economic growth over the transition period to 2019–20.

• However some towns in the Basin may face more significant adjustment as a result of the Basin Plan.

• Given the potential impacts, it is imperative that implementation of the Basin Plan is managed carefully. To aid the transition, the Authority has proposed a review point in 2015 where progress towards sustainable diversion limits will be assessed. Central to this review will be consideration of how revised river management arrangements and new environmental works and measures could improve the efficiency and effectiveness of water management, and reduce the social and economic impacts.

• The Authority has identified policy opportunities which have the potential to mitigate the social and economic costs of the Basin Plan, while still achieving the environmental benefits. Pursuing these policy opportunities is a key undertaking for the three years leading up to the 2015 review.

• Government policies and programs also provide support to mitigate the extent of the costs borne by those irrigators and local communities likely to be most affected. The Australian Government’s Water for the Future initiative has committed over $9 billion in the Murray–Darling Basin to 2019.

• The Authority considers that governments could particularly focus their efforts on support for adjustment and change.

• Local knowledge must join with scientific expertise to create targeted, flexible and effective solutions to the complex problems facing the Basin. This includes involving communities in developing and implementing reforms so that they have ownership of decisions and actions. It also allows local knowledge and solutions to be drawn on to meet local needs, while recognising those that fit within Basin and catchment scale strategies and actions.
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Summary

1 Australia’s social and economic progress owes much to the development of the Murray–Darling Basin’s water resources. The major rivers of the Basin are also an integral part of the culture of Australia’s Indigenous peoples.

2 Since before Federation, successive governments have championed the use of water for agriculture to encourage economic and social development within the Basin. There has been considerable investment in water storage and delivery infrastructure by Commonwealth and state governments, and through private investment, for more than 100 years. Over time, these efforts have created one of Australia’s most efficient and productive food growing regions, and many communities across the Basin.

3 However, such development is increasingly recognised as having had unintended consequences. The construction of dams, locks and weirs to control water flow has altered the natural flow regimes, changed river temperature and changed sediment and nutrient loads.

4 In turn these have caused changes to riverine ecosystems that have resulted in the decline of species diversity of native fish, birds and invertebrates; facilitated the invasion of exotic species such as European carp; resulted in the loss of wetlands and riparian forests; and caused widespread toxic algal blooms.

5 Increased seepage and run-off (combined with land clearing) has caused mobilisation of salt within the soil profile. Complex salt interception schemes are now required not only to rehabilitate the health of the rivers (particularly the Murray River) but also to ensure that one of Australia’s largest cities, Adelaide, continues to be supplied with potable water.

6 In order to maintain both ecological health and productive capacity from the Basin’s rivers, a rebalancing of the system is required.

7 The Authority has a vision for the Murray–Darling Basin, of a healthy, working Basin that supports strong and vibrant communities, resilient industries, including food and fibre production, and a healthy environment. However, achieving that vision means making substantial changes to the way we allocate and manage the Basin’s water resources. One role of the Authority is to determine the appropriate scale of change required to achieve a better balance between competing demands for water.

8 Rebalancing the system to the degree that is required will result in both challenges and opportunities for Basin communities. For most communities, this is nothing new. Basin communities have been adapting to their physical, political and regulatory environment since European settlement. The Basin Plan is just one more of many factors which will influence the social and economic situation for communities in the Basin.

9 Other factors such as ongoing climate variability, technological innovation, market fluctuations and developments, and demographic and cultural changes will continue to affect rural and regional communities, as they have always done. The ability of farmers, industries, and their supporting communities to adapt to these fluctuations is evident in the ongoing
productivity improvements in agriculture. It is also evident in their ability to cope with
drought, although the Authority recognises that this resilience was sorely tested during the
most recent drought. The fact that many Basin communities are still recovering from the
drought (and subsequent floods) is one of the reasons that the Authority has proposed a
long transition period between introducing the draft Basin Plan now and fully implementing it
in 2019 (see Chapter 7).

10 Following the release of the Guide to the proposed Basin Plan in 2010, the Authority
asked for the views of the community and stakeholders about the proposals in the Guide. In
the five months to the end of February 2011, the MDBA received feedback from over 3,100
individuals and organisations. The Authority has considered this feedback, and the
submissions and recommendations made to the Windsor Inquiry, in preparing the draft Basin
Plan.

11 Part A of this social and economic analysis report presents an overview of the
findings from consultations and the extensive program of research into the social and
economic implications of the draft Basin Plan, which has been undertaken by the MDBA
since 2009. This program of work drew on the best available social and economic evidence
and techniques to analyse those implications. The MDBA’s work has included:

- community consultation to identify flow-on social and economic effects of changes in
  water management on irrigation communities
- macroeconomic modelling and analyses of those changes in water management
- quantitative analyses of community vulnerability and adaptive capacity
- a series of local case studies, which estimated potential economic changes to a selection
  of small and medium irrigation communities as a result of changes in water availability
  and infrastructure investment
- studies of the potential benefits of the draft Basin Plan
- assessment of the implications of the Basin Plan for Indigenous communities
- studies which considered the effects of the Basin Plan on the financial capacity of Basin
  communities.

12 The overall approach and methodologies for this work are outlined in Appendix A to
this document. Part B of this report (Commissioned and non-commissioned reports which
informed the MDBA’s socioeconomic analysis) presents summaries of the projects
undertaken by the MDBA, as well as selected other literature that informed the MDBA’s
analysis.

13 The Authority has used this evidence, gathered from consultation and social and
economic studies, to inform its judgement about the scale of change required to achieve a
healthy working Basin. This evidence has also helped the Authority to identify the
substantial policy opportunities that are available, through which environmental benefits
could be achieved while minimising the social and economic costs and smoothing the
transition process. This report sets out the MDBA’s social and economic analysis as a basis
for further discussion with communities, Indigenous groups and governments through the
consultation period. Such discussions have proved crucial to successful water reform in the past, and will continue to be sought and valued by the MDBA.

14 The evidence and analysis presented in this report tells us that, although it is difficult to quantify, and provided that implementation options are carefully managed and coordinated, the long-run social, economic and environmental benefits of the Basin Plan are likely to outweigh the long-run costs. At the Basin scale, those costs are expected to be small: the Basin Plan is estimated to reduce the level of gross regional product by less than 1 per cent and this will likely be more than offset by broader economic growth over the transition period to 2019–20.

15 However, the evidence also identifies that, at the local level, some towns in the Basin may face more significant adjustment as a result of the Basin Plan. These communities are regarded as more vulnerable because they are more sensitive to changes in water available for consumptive use, while being exposed to a greater degree of change and, in some cases, having a diminished capacity to adapt because of the Millennium Drought. The Authority is also well aware that, while water entitlement holders will be paid for their water, they should decide to sell it during the water recovery process, other businesses and organisations in communities do not have similar opportunities to offset impacts on them. Changes in irrigated agricultural productive capacity could result in flow-on economic impacts (such as to the associated supply chain, agricultural processing, and freight and transport businesses) and social impacts (such as on social services and community well-being).

16 Communities that have been identified as being more likely to experience significant changes include:

- towns in the cotton growing areas of the Lower Balonne
- smaller towns in the NSW Murray which could be affected by reductions in rice production
- the central and western parts of the Murrumbidgee region which are highly reliant on irrigated horticulture and rice production, and already struggling with the continuing impacts of the drought and low commodity prices
- smaller dairying communities in the Goulburn–Broken and Victorian Murray catchments, which have a high dependence on irrigated agriculture, and less capacity to adapt to reductions in water availability
- communities in the Victorian Murray and South Australian Riverland that are reliant on horticulture, particularly if the profitability of irrigated permanent horticulture remains low.

17 Given these potential effects, it is imperative that the Basin Plan implementation is managed carefully. The Authority proposes that a volume of 2,750 GL needs to be recovered to achieve balance in the system. Work towards this has already begun. Already, almost half that that volume has been recovered through buyback and infrastructure, which means 1,468 GL remains to be recovered over the next seven years. To aid the transition, the Authority has proposed a review point in 2015 where progress towards the proposed sustainable diversion limits (SDLs) will be assessed. Central to this review will be
consideration of how revised river management arrangements and new environmental works and measures could improve the efficiency and effectiveness of water management. Between now and 2015, the MDBA will work with partner governments and the community to review new knowledge and information gained from community consultation, new modelling and scientific research, and early results of the monitoring and evaluation of environmental water use, to inform any revisions of SDLs that may be required. The extended transition period to 2019 will also allow communities time to adjust to the new arrangements, by reorganising their production processes and resources for a future with less water available for irrigation.

18 But the social, economic and environmental benefits and costs of the Basin Plan will be determined not only by how water is allocated between the environment and consumptive uses—by the SDLs. The benefits and costs of the Basin Plan will also be influenced by how water is managed—and improvements in water management have the potential to reduce the amount of water that needs to be reallocated.

- Recommendation 1 from the Windsor Inquiry stated that ‘the Committee recommends that the Commonwealth Government commission a study to identify all regulations that inhibit the efficient management of water in the Murray–Darling Basin and, where appropriate, work with states to remove those regulations’ (House of Representatives Standing Committee on Regional Australia 2011). This recommendation has been adopted in section 7.5.1 of the draft Basin Plan.

19 In considering the social and economic impacts of the Basin Plan, the Authority has identified policy opportunities which have the potential to mitigate the costs of the Plan, while still achieving the environmental benefits (see Chapter 7). Some of these are the responsibility of the MDBA, while others are the responsibility of other areas of the Australian Government, or of state governments. For this reason, better coordination between the Commonwealth and state governments, as well as local organisations is a key area of policy which has the potential to enhance outcomes. These policy opportunities include:

- the timeframe over which the transition process will take place
- approaches to environmental watering, including how water is used, the type of water is that is acquired for the environment, and the methods used to acquire that water (e.g. buybacks, infrastructure programs, or other mechanisms)
- productivity improvements and improved water use efficiency
- approaches to river management and operations
- how governments and communities work together to manage the transition process.

20 Pursuing these policy opportunities is a key undertaking for the three years leading up to the 2015 review. The MDBA will identify measures that governments and communities could take to ease the transition to new SDLs and improve the management of Basin water resources. While many of those opportunities are the responsibility of organisations other than the MDBA, the MDBA will work with those organisations to pursue them. The Authority considers that governments could particularly focus their efforts on support for adjustment and change.
21 Current Government policies and programs already provide support to mitigate the extent of the costs borne by those irrigators and local communities likely to be most affected. The Australian Government, through its Water for the Future initiative, has committed more than $9 billion in the Murray–Darling Basin to 2019.

- The Australian Government’s ‘bridging the gap’ commitment means that the gap between current diversions and SDLs will be met through water savings generated by infrastructure investments and voluntary water purchases. This means that there will be no impact on the production of irrigators who do not sell their entitlements.

- As part of this commitment, the Commonwealth is investing $4.8 billion in projects with irrigators to upgrade their infrastructure, in return for a share of the water savings. This reduces the net amount of water that must be recovered from irrigation use, provides a temporary boost to local economies through increased construction activity, and provides a permanent increase in irrigators’ water use efficiency.

22 The vision of a healthy working Murray–Darling Basin cannot be achieved by governments alone. Local knowledge must join with scientific expertise to create targeted, flexible and effective solutions to the complex problems facing the Basin. In other words, the vision will only be achieved by taking a ‘localism’ approach.

23 Localism in water management is about governments partnering with local and regional communities to manage water and other natural resources in an integrated way. Localism includes involving communities in developing and implementing reforms so that they have ownership of decisions and actions. It also allows local knowledge and solutions to be drawn on to meet local needs, while recognising those that fit within Basin and catchment scale strategies and actions.

24 This document, which constitutes Part A of the MDBA’s report on how social and economic analyses have informed the draft Basin Plan, includes the following chapters:

- Chapter 1 outlines why we need a Basin Plan, and proposes an approach to conceptualising the re-balancing of the use and management of the Basin’s water resources.

- Chapter 2 sets the scene for assessing the potential costs of implementing the draft Basin Plan, by outlining the historical, social and economic characteristics of the Basin and its communities.

- Chapter 3 describes the methodology used by the MDBA to assess the social and economic impacts of the Basin Plan.

- In Chapters 4 and 5, those impacts are considered in more detail. Chapter 4 discusses the economic impacts at a Basin-wide scale. Chapter 5 considers specific communities and industries that are more likely to be affected.

- Chapter 6 describes how the MDBA has assessed the benefits of achieving a healthy working Basin.
Finally, Chapter 7 outlines the Authority’s position on the many opportunities available for improved management of the Basin’s water resources, to help ensure that the Basin Plan delivers a healthy and productive Murray–Darling Basin.

25 The accompanying Part B of this report presents summaries of studies commissioned by the MDBA to inform its social and economic analyses. It also presents summaries of selected non-commissioned studies which also informed the MDBA’s social and economic analyses.

26 Both parts of this report have been released alongside the draft Basin Plan, to help the community better understand how the Plan was developed and what it means. The draft Basin Plan has been released for a consultation period closing on 16 April 2012. The Authority invites submissions on the draft Basin Plan and on the technical documents which have informed it, including Parts A and B of this report. The MDBA will take into account these submissions in revising the Basin Plan and in further developing its future social and economic work program.

27 During the consultation period on the draft Basin Plan, the MDBA will prepare a Regulation Impact Statement. The Regulation Impact Statement will describe in detail the benefits and costs of the Basin Plan, including the social and economic benefits and costs outlined in this report. It will also draw on analysis that the MDBA undertakes during the consultation period, including analysis of submissions received, as well as ongoing work by the CSIRO, mentioned in Chapter 6 of this report, to assess the likely multiple benefits of the Basin Plan.

28 The Regulation Impact Statement will accompany the Basin Plan when it is submitted for comment to the Legislative and Governance Forum (formerly Ministerial Council), before the Authority gives the Basin Plan to the Commonwealth Minister for Water for adoption, and before the Minister presents the Basin Plan to Parliament.
Chapter 1: Introduction

Why we need a Basin Plan

1.1 The Basin Plan provides a platform for an integrated and adaptive approach to water management that balances social, economic and environmental needs in the Basin.

1.2 Consultation with Basin communities has revealed that there is an extraordinary consensus across most of the community that a rebalancing of the allocation of water resources between social, economic and environmental uses, is required. There is much less agreement on the scale of rebalancing required.

1.3 The Murray–Darling Basin is an interconnected system of 21 river basins that span four states and a territory. It is home to more than two million people and provides drinking water for more than three million people. It represents 20 per cent of Australia’s total agricultural land area, approximately 40 per cent of Australia’s farms and agricultural production, and 65 per cent of the total irrigated land area. The three longest rivers in Australia, the Murray, the Murrumbidgee and the Darling, all lie within the Basin. There are over 30,000 wetlands, 16 of which are recognised under the Ramsar Convention (United Nations 1987) as being internationally important.

1.4 Indigenous people lived sustainably in the Australian landscape for thousands of years. There are over 40 Indigenous groups in the Basin which continue to have a strong spiritual and cultural connection to its lands and waters. However, in a little over one hundred and fifty years, the Murray–Darling Basin has seen major changes. Forests have been cleared, dams, weirs and flood levies have been built, and new animals and plants have been introduced. The transformation of the Basin has brought great economic benefit to Australia, but also put pressure on the sustainability of the Basin’s natural resources.

1.5 Throughout the last century, the Basin’s water resources were largely managed to provide for agricultural, industrial and town/urban use. This changed how the rivers flow. While we still see very large floods, the small to medium floods are now captured in order to store the water in readiness for agricultural and urban use in the summer. In the southern Basin, this has also seen some rivers change from predominantly winter and spring flowing to summer and autumn flowing. In the northern Basin, large-scale development of irrigation occurred more recently, mainly involving the development of on-farm storages or ‘ring tanks’.

1.6 Changes in the volume and seasonality of river flows have contributed to long-term declines in the health of many wetlands, floodplains, river red gum forests, native fish and waterbird populations. In addition, the system has been less able to perform its natural function of flushing salts and nutrients out. To manage salinity in the Basin, the past 20 years have seen the building of salt interception schemes to keep salt out of the Murray as well as the reform of irrigation and land management practices to help reduce salt loads entering the rivers.

Impact of increasing water use in the Basin on ecosystem health

1.7 Without adequate flows for the environment, not only will the environment continue to decline, but the agricultural prosperity of the Basin will be threatened.
To increase the security and reliability of water resources for domestic use and agricultural production in the Basin, natural flows have been regulated through the construction of large reservoirs in the upper catchments and irrigation infrastructure such as canals, locks and weirs in the lower reaches of river systems. Between the mid-1950s and 1980 there was a seven-fold increase in water storage capacity in the Basin. The total storage capacity now exceeds the average annual flow of all rivers and is more than double the average natural flow to the sea. Furthermore, strong growth in licenses for extracting water between the mid-1950s and 2000 facilitated a three-fold increase in surface water diversions over this period. By the late 1990s total water use in the Basin was approximately equal to the long-term natural flow to the sea. Consequently, it has been estimated that the total flow at the Murray Mouth has been reduced by 61 per cent with the river now ceasing to flow through the mouth 40 per cent of the time, compared to 1 per cent of the time (or once in 100 years) prior to development (Crossman, Rustomji et al. 2011).

In combination with a range of other major ecological stresses such as changes in land use and climate variability, increases in flow regulation, dam capacity and water consumption over the past century have led to a long-term decline in freshwater ecosystems across the Basin (Crossman, Rustomji et al. 2011; Davies, Harris et al. 2008; Davies, Harris et al. 2010; Gawne, Butcher et al. 2011).

In particular, the size, frequency and duration of flood events have been greatly reduced over this period. The size of a flood event—specifically the peak, volume and duration of the event—is a major influence on the spatial extent of inundation and the type of ecological communities that are reached. For example, small to medium flooding events that may have occurred once every ten years or so prior to the development of water resources, have been substantially reduced in size or even completely eliminated across both the northern and southern Basins. The regulation and consequent evening out of stream flow has not only significantly altered these characteristics of flood events, but also the annual seasonality of flow peaks (Crossman, Rustomji et al. 2011; Davies, Harris et al. 2008).

Freshwater ecosystems of the Basin have evolved over thousands and millions of years to withstand long-term fluctuations in wetting and drying. Because these freshwater ecosystems are dependent on natural fluctuations in climatic conditions and flow regimes, changes in patterns of flow have resulted in a general decline in the condition of freshwater ecosystems across most of the Basin.

Status and long-term trend of ecological condition

Water resource development has caused major changes to flooding regimes that support nationally and internationally significant floodplain wetland systems in the Basin. An interim report of a CSIRO study commissioned by the MDBA to assess the potential multiple benefits of the Basin Plan reported that, from 57 long-term studies of ecological condition that were reviewed, the overall picture was one of consistent, long-term decline in condition of freshwater ecosystems in the Basin over many decades and across a broad range of response variables (Crossman, Rustomji et al. 2011).

For example, the Sustainable Rivers Audit undertaken in 2008 by a panel of independent ecologists was the first systematic assessment of the health of river
ecosystems in the Murray–Darling Basin (Davies, Harris et al. 2008). The report assessed ecosystem health for each of 23 major river valleys, using data gathered from 2004 to 2007. Only the Paroo Valley was rated as being in good health. The Border Rivers and Condamine Valleys were found to be in moderate health. Seven other valleys were in poor health and 13 were in very poor health (Davies, Harris et al. 2008). The valleys in very poor health were predominantly in the south eastern part of the Basin; they included (in order of decline): the upper Murray, Wimmera, Avoca, Broken, Campaspe, Kiewa, Lachlan, Loddon, Goulburn and Murrumbidgee.

Acid sulphate soils

1.14 Acid sulphate soils are one of four key water quality indicators. The other three are freshwater salt loads, risk of cyanobacteria outbreaks, and the risk of blackwater events (with low dissolved oxygen content). Acid sulphate soils are prominent in the southern Basin, particularly the Lower Lakes, and appear when the water levels of surface water bodies drop below a critical threshold. Reductions in within-year flow variability, plus the construction of weirs and locks along the River Murray, have led to water levels in the river being maintained at a level more constant than under natural conditions, contributing to the formation of acid sulphate soils (MDBA 2011a).

1.15 Acid sulphate soils pose a number of significant risks to the environment. When an acid sulphate soil is exposed to oxygen, it undergoes a complex series of reactions that ultimately result in acidification and deoxygenation processes. In extreme cases these impacts result in the death of aquatic organisms including fish. Oxidation of acid sulphate soils can also lead to the release of metals (such as cadmium and lead) and metalloids (such as arsenic) into the environment. Once released, these metals may be incorporated into animal or plant tissue, with subsequent impacts on both aquatic and terrestrial food webs and the health of associated ecosystems (MDBA 2011a).

Rising groundwater salinity and salinity of riverine water

1.16 High salinity levels of groundwater and surface water are in part a natural consequence of Australia’s dry climate and weathered and ancient landscapes. However, clearing of native vegetation and dryland and irrigated agriculture have led to increased mobilisation of salt from saline soil profiles and aquifers into streams and groundwater (Crossman, Rustomji et al. 2011). Surface water salinity can be highly variable, due to existing salt loads and fluctuations in river flow and groundwater flows, resulting from variations in water use and climatic conditions. High levels of salinity can affect the suitability of water for drinking, irrigation and recreation. For example, human drinking water should have a salinity that measures less than 800 on the electrical conductivity scale (EC) while damage to irrigated crops may occur with levels as low as 300 EC. High levels of in-stream salinity can also affect the health of aquatic and riparian ecosystems.

1.17 Studies during the 1990s found that riverine salinity trends have been rising in the south-eastern dryland and irrigation zones of the Basin, where mean annual rainfall was less than 800 mm per year (Crossman, Rustomji et al. 2011). In 1999 the Salinity Audit of the Basin predicted that riverine EC levels would increase in the period to 2100 for most locations that were examined (MDBMC 1999). Some of the predicted rises were quite
substantial, exceeding the acceptable levels for human drinking water and some irrigated crops (800 EC) by 2100.

Cyanobacterial blooms

1.18 When low-flow conditions are associated with warmer climatic conditions and higher nutrient loads, there is a greater risk of cyanobacterial blooms (or blue-green algae), which affect the quality and safety of water supplies. Blooms not only cause undesirable tastes and odours, but may also cause health problems in human populations, such as digestive and skin disorders (Crossman, Rustomji et al. 2011). Health risks associated with blooms affect water-based leisure such as fishing and swimming. The decay of a bloom can also generate low oxygen levels in the water body, leading to stress or death of aquatic organisms such as fish.

1.19 The Interim Report notes that during the 2000s there was an increase in the duration of individual algal blooms compared to the 1980s. This increase was associated with ever-increasing concentrations of Anabaena, Aphanizomenon, Microcystis and other Cyanophyceae (Crossman, Rustomji et al. 2011).

A vision for the Basin

1.20 The Authority has a vision of a healthy working Basin that supports strong and vibrant communities, resilient industries, and a healthy environment. As part of that vision, the Basin Plan will provide for the long-term social, economic and environmental wellbeing and sustainability of the Basin. This involves rebalancing water use between social, economic and environmental purposes.

1.21 The Authority considers that the Basin Plan will help ensure:

- improvements in the extent and diversity of healthy wetland habitat, including river reaches, billabongs, floodplains and red gum forests—and improvement in the health of key wetland assets listed under the Ramsar Convention
- improvements in hydrological connectivity between rivers and floodplains and between hydrologically connected valleys, and improved diversity of habitat for drought refuges, migration and recolonisation by plants and animals
- improved conditions for native water-dependent species including vegetation, birds, fish and macroinvertebrates—including migratory waterbirds protected under various international agreements, and threatened species protected under state and federal laws
- flows that enable salts and nutrients to be flushed from the Basin and keep the Murray mouth open occur in nine out of ten years on average
- increased environmental flows that maintain water quality, reduce in-stream salinity and the risk of blue-green algae outbreaks, particularly in the southern Basin, and reduce outbreaks of acid sulphate soils
- that water quality for human use, agricultural production and other industries is maintained and where possible improved
• that sufficient water is available for human use in times of drought
• that an efficient water market is in place, so water can get to where it is most needed and valued
• that Basin water resources continue to support a strong primary production sector into the future.

Balancing social, economic and environmental outcomes

1.22 The Authority believes that the Basin Plan should balance social, economic and environmental outcomes. Rebalancing the Basin’s water resources between social, economic and environmental uses will not be easy. Some environmental outcomes may not be achievable without social or economic costs. Conversely, some social and economic benefits may not be achievable without some cost to the environment.

1.23 The Water Act 2007 aims to promote the use and management of the Basin water resources in a way that optimises social, economic and environmental outcomes (Commonwealth of Australia 2007). The Authority has considered the question of how to balance social, economic and environmental outcomes in the context of this optimisation objective.

1.24 The Authority considers that a balanced social, economic and environmental outcome will not be determined purely by a particular SDL. A balanced outcome will also be determined by other aspects of how governments and communities manage water resources. There are substantial policy opportunities available to governments to improve these approaches to management, to achieve an overall balanced social, economic and environmentally balanced outcome. Some of these policy opportunities reflect approaches that could be taken by the MDBA, others fall within the responsibility of other Commonwealth or State agencies.

Environmental benefits

1.25 The Basin Plan will result in benefits to the environment. The benefits to the environment that would flow from the draft Plan are described in detail in a separate document (The proposed ‘environmentally sustainable level of take’ for surface water of the Murray–Darling Basin: method and outcomes).

1.26 The MDBA has determined the environmental water requirements in the Basin through an iterative process, drawing on the best available science, and assessed through a hydrological indicator sites approach.

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1 Refer to section 3 of the Water Act 2007 (Cth). The requirement that social, economic and environmental outcomes be optimised is also recognised in the National Water Initiative and the 2008 Murray–Darling Basin Intergovernmental Agreement (COAG 2004a; b; Commonwealth of Australia 2008).

2 The Water Act 2007 (Cth) requires that optimisation be pursued in terms of both how water is used and how it is managed (Commonwealth of Australia 2007).
1.27 End of system flows analysis, which was undertaken to inform the *Guide to the proposed Basin Plan*, indicated that a further 3,000 to 4,000 GL would be required for the environment (MDBA 2010). However, the end-of-system analysis did not take account of physical system constraints (e.g. channel capacity, flood risk to infrastructure), the rules that constrain the use of environmental water (e.g. capacity to call water from storages), nor did it involve assessment of specific environmental water requirements for environmental assets or ecosystem functions.

1.28 Since that time, the MDBA has completed further, more detailed, analyses of key environmental sites and the flow requirements at those sites. Through a hydrological indicator sites method, these analyses have examined environmental outcomes in a more robust way.

1.29 Provided that arrangements are in place to ensure successful implementation of environmental watering, significant environmental benefits will be achieved through the Basin Plan.

Social and economic benefits

1.30 *Improvements* to the environment as a result of the Basin Plan will not only benefit the environment for its own sake, but will also result in considerable social and economic benefits.

1.31 The concepts of ‘ecosystem services’ and ‘ecosystem functions’ provide a link between the improvements to environmental assets that may result from a Basin Plan and the social and economic benefits that would accrue from those environmental improvements. While the economics and science in this area are still being developed, it is possible, drawing on existing data, to *estimate* in monetary terms the broad costs and benefits that would result from a Basin Plan (for a more detailed description of methods used, refer to Appendix A to this document). The MDBA’s preliminary analyses have found that the magnitude of the long run social and economic benefits of the Basin Plan is likely to exceed the long run costs associated with the Basin Plan. The MDBA has also commissioned further work to assess in more detail the social and economic benefits of the Basin Plan (refer to Chapter 6).

Social and economic costs

1.32 The social, economic and environmental benefits of the Basin Plan need to be compared with the social and economic costs. These costs would arise largely because reductions in water availability for irrigated agriculture will result in changes to patterns of agricultural production. This will lead to impacts on irrigated agricultural producers and have flow-on effects in their communities.

1.33 The MDBA has assessed the potential social and economic costs of the draft Basin Plan through a *comprehensive* range of social and economic analyses, which make use of the best available scientific knowledge and socio-economic analysis as of November 2011.
Box 1: Context for assessing the social and economic impacts of the Basin Plan

When the MDBA released the Guide to the proposed Basin Plan there was widespread concern about the social and economic effects expressed by Basin communities. Feedback received from the public consultation meetings and submissions, and through commissioned reports, included concerns about:

- Employment impacts resulting from proposed SDLs
- Flow-on effects to local economies from loss of irrigation income
- Decline in population in rural/regional communities
- Decline in services and facilities in rural/regional communities.

Much of the social and economic analysis undertaken by the MDBA and reported on here has investigated these issues in order to gain a better understanding of how they might play out in Basin communities.

More broadly, the EBC consortium (2011a) reported that a number of themes dominated most of the discussions they held across the Basin:

- ‘Don’t understand it – don’t accept it’. There was a profound lack of trust about the basis for proposals;
- ‘Nobody asked my opinion’. There was serious criticism of the way the Guide had been developed and publicised, and that it had ignored local people and communities;
- ‘It will have devastating impacts and you are not listening’. Communities felt that they had been abandoned by government; and
- ‘Government can’t get its act together’. Communities saw no coordination between different initiatives of government.

Many of the submissions to the MDBA in response to the Guide to the proposed Basin Plan from communities, individuals and stakeholder groups echoed these concerns.

This report presents the technical work that has underpinned MDBA’s efforts to understand the concerns raised by Basin communities since the Guide to the proposed Basin Plan.

Proposed sustainable diversion limits

1.34 In the draft Basin Plan, the MDBA is proposing a Basin-wide long-term average sustainable diversion limit of 10,873 GL for surface water. This consists of 3,468 GL in the northern Basin and 7,405 GL in the southern Basin. The MDBA is also proposing a Basin-wide long-term average limit of 4,340 GL on groundwater use.

1.35 The SDL proposed in the draft Basin Plan represents the MDBA’s judgement, based on the best available scientific knowledge and socio-economic analysis, of the allocation of water between consumptive use and the environment that best balances social, economic and environmental outcomes.

Environmental water recovery to date

1.36 The SDL proposed in the draft Basin Plan will mean that, by 2019, a total of 3,573 GL of water will have been recovered for environmental use in the Murray–Darling Basin.
1.37 Around 823 GL of this water was recovered prior to 2009, through the Living Murray initiative, Water for Rivers program and state water sharing plans.

1.38 As of 30 September 2011, a further 1,068 GL of water has been recovered (or is contracted to be recovered) for the environment. This includes water to be recovered through the Australian Government’s Water for the Future program, the New South Wales RiverBank program and stage one of the Northern Victoria Irrigation Renewal Project. The recently announced stage two of the Northern Victoria Irrigation Renewal Project (NVIRP 2) is estimated to see another 214 GL of environmental water recovered.

1.39 This leaves 1,468 GL to be found across the Basin by 2019.

Future water recovery

1.40 In addition to environmental water contracted through the Sustainable Rural Water Use and Infrastructure Program to date (including NVIRP 2), the Australian Government currently estimates that around 400 GL could be recovered through future investment in water-saving infrastructure (including works at the Menindee Lakes).

1.41 This would leave about 1,050 GL to be recovered Basin-wide through other measures. If this was met through water purchases alone, over the next seven years, this could be recovered at a rate of about 150 GL each year. However, the volume of water purchases could be reduced further should environmental water needs be able to be met more efficiently—for example, though changes to river operation management and rules, or through environmental works and measures. Refer to Figure 1.

Figure 1: Environmental water recovery

3 Under the Water for Rivers program, around 191 GL/y of water has been recovered in the Basin for the environment. However, of this, 136 GL/y has been returned to the Snowy River, which is not included in the 2009 baseline.
Modelled reductions to sustainable diversion limits

1.42 For modelling purposes, the MDBA has considered SDLs in terms of reductions in diversion limits from a 2009 baseline. This baseline already takes account of around 823 GL on a long-term average basis that was returned to the Basin environment prior to 2009.

1.43 Relative to the 2009 baseline, the MDBA’s view is that a further reduction of 2,750 GL is necessary to achieve environmentally sustainable levels of water use.

1.44 To inform the setting of the proposed SDL, the MDBA assessed the social and economic impacts of a range of alternative water recovery scenarios. Work by the MDBA undertaken before mid-2011 considered water recovery scenarios from 3,000 to 4,000 GL, this being the range considered in the Guide to the Proposed Basin Plan. More recent work centred on a water recovery scenario of 2,800 GL, with analysis of the sensitivity of impacts to changes of 2,400 GL or 3,200 GL.

1.45 The specific water recovery scenarios considered by key elements of the MDBA’s social and economic work are summarised in Table 1. Through the breadth of work undertaken, the MDBA has gained a detailed understanding of the social and economic impacts across a range of water recovery scenarios, and the sensitivity of those impacts to variations in the proposed SDL.
Table 1: Specific water recovery scenarios considered by key social and economic studies commissioned by the MDBA

<table>
<thead>
<tr>
<th>Social and/or economic study (refer to full summary list in Appendix A)</th>
<th>Water recovery scenario (GL)</th>
<th>2,400</th>
<th>2,800</th>
<th>3,200</th>
<th>3,000</th>
<th>3,500</th>
<th>4,000</th>
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<tr>
<td>Assessment of benefits by Morrison, M. and D. Hatton MacDonald (2010)</td>
<td>Assessed impacts of marginal changes rather than for a specific water recovery scenario</td>
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<td>Assessment of benefits and costs by Centre for International Economics (CIE 2011)</td>
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<tr>
<td>Economic modelling, ABARE–BRS (2010c)</td>
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<td>Economic modelling, ABARES (2011d)</td>
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<td>Economic modelling, University of Queensland (Mallawaarachchi, Adamson et al. 2010)</td>
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<td>Economic modelling, University of Queensland (Adamson, Quiggin et al. 2011)</td>
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<td>Economic modelling, Monash University Centre of Policy Studies (Wittwer 2010)</td>
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<td>✓</td>
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<tr>
<td>Economic modelling, Monash University Centre of Policy Studies (Wittwer 2011a)</td>
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<td>✓</td>
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<tr>
<td>Vulnerability analysis, ABARE-BRS (2010d)</td>
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<tr>
<td>Vulnerability analysis, ABARES (forthcoming)</td>
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<tr>
<td>Economic and social profiles and impact assessments, Marsden Jacob Associates et al. (MJA, RMCG et al. 2010)</td>
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<tr>
<td>Assessment of community impacts of the Guide to the proposed Basin Plan, Environmental Behaviour Consultants et al. (EBC, RMCG et al. 2011a)</td>
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<tr>
<td>Assessment of local impacts, Arche Consulting (2011)</td>
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<td>Assessment of impacts on Indigenous people, Jackson, Moggridge et al. (2010)</td>
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</table>

Assessment of benefits and costs by Centre for International Economics (CIE 2011) assessed impacts of marginal changes rather than for a specific water recovery scenario.

Economic and social profiles and impact assessments, Marsden Jacob Associates et al. (MJA, RMCG et al. 2010) did not assess implications of a specific water recovery scenario, but of changes in water availability of on the order of 20, 40 or 60 percent reductions in long-term cap equivalent.

Assessment of local impacts, Arche Consulting (2011) did not assess implications of a specific water recovery scenario.
An adaptive plan

1.46 The manner in which the remaining 1,468 GL is obtained will influence the social and economic impacts of the Basin Plan. Over the next seven years, the MDBA will work with stakeholders to ensure that water for the environment is recovered in ways which minimise the social and economic impacts.

Opportunity for review

1.47 The MDBA has undertaken extensive analysis to arrive at the proposed SDLs in the draft Basin Plan. However, the Authority recognises that the scientific knowledge and socio-economic analysis which has informed the draft Basin Plan, while currently ‘best available’, could be improved in the future. There will be scope in the future to refine the Basin Plan, and revise the SDLs, in light of new knowledge.

1.48 The draft Basin Plan makes clear that the proposals in the draft Plan, including the proposed SDLs, will be reviewed in 2015 and not enforced until 2019. Equally, the ‘Rules Review’ by 2015 as recommended by the Parliamentary Inquiry chaired by Tony Windsor MP, has been ‘hardwired’ as a Plan requirement (House of Representatives Standing Committee on Regional Australia 2011).

- Recommendation 1 from the Windsor Inquiry stated that ‘the Committee recommends that the Commonwealth Government commission a study to identify all regulations that inhibit the efficient management of water in the Murray–Darling Basin and, where appropriate, work with states to remove those regulations’. This recommendation has been adopted in section 7.5.1 of the draft Basin Plan.

- Section 6.06 of the draft Basin Plan provides that the MDBA may express its view in relation to which changes arising from matters including works or measures, river management and river operational practices, methods of delivering water, new knowledge, proposals which serve to advance the objectives and outcomes of the Basin Plan, including optimising economic, social and environmental outcomes and any other matter that may result in a need to adjust the sustainable diversion limits. Section 6.07 stipulates that the Authority must undertake a review of the long-term average sustainable diversion limits in 2015 and prepare a written report of the review.

1.49 Between now and 2015, the MDBA will work with partner governments and the community to review new knowledge and information gained from community input, new modelling and scientific research, and the early results of the monitoring and evaluation of environmental water use, to further develop understanding of the social and economic impacts of the Basin Plan and how they might best be managed. The MDBA is developing a research and work program which will contribute to the 2015 review and beyond the transition period.

Governance arrangements

1.50 The draft Basin Plan explicitly recognises that the management objective and outcomes for the Basin Plan as a whole is to achieve a healthy working Basin, including a healthy environment, strong communities and a productive economy, through the integrated
and cost effective management of Basin water resources, and that Basin water resources should be used in a way that optimises social, economic and environmental outcomes.4

1.51 The Authority is committed to the principles of ‘localism’ (refer to more detailed discussion in Chapter 7 of this document) and has ensured that the draft Basin Plan explicitly makes provision for arrangements which will promote localism.

1.52 Recognising the importance of giving local communities a real say in how to better manage their part of the system, a commitment by all Basin governments (New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Commonwealth) and the MDBA to either establish or strengthen existing local entities to localise involvement in ongoing environmental watering programs has now been built into the draft Basin Plan.5

1.53 Two new entities will also be created under Water Act 2007 (Cth) to: (i) oversee the ongoing science and economic and social research program for the overall Basin Plan (the Science and Research Committee); and (ii) assist the MDBA in assessing and forming a view about possible changes and adjustments under section 6.06 of the Plan (the Adjustment Advisory Committee). In addition, the MDBA will collaborate with the New South Wales and Queensland Governments to initiate a Northern Basin Committee, comprising New South Wales and Queensland community representatives, to ensure the unique needs of the northern Basin are addressed.

Policy opportunities

1.54 The social, economic and environmental benefits and costs of the Basin Plan will not be determined only by how water is allocated between the environment and consumptive uses—i.e. by the SDLs. The benefits and costs of the Basin Plan will also be influenced by how water is managed—and improvements in water management have the potential to reduce the amount of water that needs to be reallocated.

1.55 There are significant policy opportunities for achieving an optimal social, economic and environmental outcome for water management in the Basin, including:

- the timeframe over which the transition process will take place
- approaches to environmental watering, including how water is used, the type of water that is acquired for the environment, and the methods used to acquire that water (e.g. buybacks, infrastructure programs, or other mechanisms)
- productivity improvements and improved water use efficiency
- approaches to river management and operations
- how governments and communities work together to manage the transition process.

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4 Refer to the draft Basin Plan, section 5.02.
5 Refer to the draft Basin Plan, Part 4 Division 2.
1.56 Pursuing these policy opportunities is a key undertaking for the three years leading up to the 2015 review. The MDBA will identify measures that governments and communities could take to ease the transition to new SDLs and improve the management of Basin water resources. While many of those opportunities are the responsibility of organisations other than the MDBA, the MDBA will work with those organisations to pursue them.

1.57 The Authority considers that governments could particularly focus their efforts on support for adjustment and change. Where social and economic impacts are likely, non-water economic development initiatives will need to be considered.

1.58 Clear efforts by the Commonwealth, state and territory governments to consider infrastructure, environmental works and measures, more efficient water management and rules will be critical.

1.59 The Australian Government currently estimates that a further 400–500 GL could be recovered through investment in water-saving infrastructure (including works at the Menindee Lakes). At the more conservative estimate of 400 GL, this would leave around 1,050 GL to be recovered Basin-wide through other measures. If this were met through water purchases alone, over the next seven years, this could be recovered at a rate of about 150 GL a year to 2019. These measures are discussed in more detail in Chapter 7.

The Basin Plan and Indigenous communities

1.60 The Authority recognises the need to consider Indigenous interests in waters of the Basin, and to assess the potential impacts of the Basin Plan on the Basin’s Indigenous communities.

1.61 Studies have found that there is a need to better define Indigenous water requirements, as market-based approaches do not work in the Indigenous context, and environmental flows (while meeting many Indigenous water requirements) would not address the full range of Indigenous water requirements (Jackson, Moggridge et al. 2010). A great diversity of Indigenous interests in water exists, reflecting patterns of Indigenous land use, population and social priorities, as well as forms of social organisation and resource management institutions. Traditional systems of land tenure and the nature of customary rights and interests in land and waters are complex and vary from region to region (Behrendt and Thompson 2004).

1.62 Furthermore, despite the importance of water resources to Indigenous culture, there is a severe lack of quantitative data on Indigenous uses, values and commercial interests in the waters of the Basin. The lack of quantitative data on Indigenous water use and sensitivity to change constrains water planning and, in particular, the ability to measure the impacts of reducing current diversion limits. Water plans need to better address Indigenous water requirements, recognising the desire of Indigenous people to ‘retain their identity, a belief in their right to their land, a desire to control their own affairs, and a desire to remove economic and social disadvantages’, recognising that the strategies employed to achieve these aims vary (Horton 1994).

1.63 There are many accounts of detrimental social and economic impacts on Indigenous people arising from the environmental and socio-political changes that have occurred with
Basin water resource development. Modifications to Basin stream flow through river regulation, over allocation of water, salinity and land-use change are all cited as causes of significant environmental degradation and subsequent loss of access and enjoyment of water for Indigenous people (see, for example, Forward NRM and Arrilla – Aboriginal Training & Development (2003), McFarlane (2004) and Weir (2009)). Further negative effects can be attributed to the loss of control by Indigenous landowners who consistently express distress over their inability to manage their country holistically, exercise custodial responsibility and authority, and to prevent further ecological degradation (Weir 2009).

1.64 While further investigation is required, the MDBA’s work in this area has determined the Basin Plan could result in impacts on Indigenous communities such as:

- enhanced environmental flows are highly likely to generate positive impacts for Indigenous people
- changes to regional industries as a result of implementation of SDLs may provide new opportunities for Indigenous people in emerging natural-resource-based industries (e.g. payment for environmental services, stewardship arrangements, small-scale bush tucker businesses and tourism)
- long-term community adjustment programs could enhance positive impacts of the Basin Plan, and benefit both Indigenous and non-Indigenous residents.

1.65 There is a continuing need to engage with Indigenous communities in the development and implementation of the Basin Plan. This engagement will help inform more effective water planning (discussed above) and help ensure that Indigenous values are not excluded from environmental water management.

1.66 To aid this process, the MDBA currently facilitates the Murray Lower Darling Rivers Indigenous Nations (MLDRIN) and the Northern Murray–Darling Basin Aboriginal Nations (NBAN).

1.67 The MDBA is also developing further research that will enhance understanding of Indigenous communities of the Basin and their interests in water. These include:

- a social and economic survey that will help develop a baseline of social and economic information that can be utilised in the future for monitoring the impact and the effectiveness of the Basin Plan on Indigenous people
- a project to further develop understanding of aspects of the concept of ‘cultural flows’, which will cover the following areas:
  - cultural water values—describe the current Indigenous cultural water values, knowledge and needs
  - quantification—develop methodologies to articulate the cultural water values and needs of Indigenous communities in the Basin and to quantify water volumes of cultural flows
  - benefits—measure the multiple, ongoing and overlapping benefits of cultural flows for the Aboriginal nations and the wider community
- relationship with environmental flows—identify the relationship between the cultural outcomes derived from a cultural flow and the ecological benefits
- policy and institutional—management and Indigenous governance options for implementing cultural flows.
Chapter 2: The social and economic context

Key points

- The Murray-Darling Basin is home to over 2 million people. Agriculture is a defining feature for many communities, and is relatively more important in smaller communities. Together, dryland and irrigated agriculture represent 84 per cent of Basin land use, 32 per cent of businesses and 11 per cent of jobs.

- Agriculture and rural communities have been undergoing significant change for many decades. Particularly since the 1980s, economic reforms and market changes have exerted pressure on agricultural producers. In response, agricultural producers have increased their productivity, farms have grown larger and labour intensity has declined. This has led to significant demographic and social change for Basin communities.
  - Many smaller agricultural-based communities are concerned about population decline. Population ageing is a particular issue in small or remote communities.

- The Millennium Drought has had significant impacts on many communities in the Basin. It has affected the financial viability of many enterprises, eroded business and consumer confidence, and had negative impacts on mental health, family relationships, and community stability and cohesion.
  - The impacts of the drought do not provide an accurate indication of the likely long-term impacts of the Basin Plan. However, the effects of the drought form an important part of the social and economic context for Basin communities, and consequently their capacity to adapt to long-term changes in water availability.

- The Basin’s water resources are of critical importance to Indigenous communities. Approximately 70,000 of the Basin’s population identify as Indigenous. Indigenous populations exhibit greater socio-economic disadvantage than the general population.

- Irrigated agriculture is the biggest user of consumptive water in the Basin, and therefore most affected by changes in water availability.
  - Irrigated agricultural development has occurred differently in the northern and southern parts of the Basin. In the north, cotton is dominant, and is planted as a highly adaptable annual crop in areas of high climatic variability. In the south, rice is grown as an adaptable annual crop in the central Murray and Murrumbidgee. The dairy industry is centred in the Goulburn–Murray. Horticulture occurs throughout the Basin, but particularly in southern regions.
  - Many factors influence irrigated agricultural output, other than changes in water availability. Irrigated agricultural output has a history of adjusting significantly from year to year, reflecting changes in water availability, commodity prices, water use efficiency and broad productivity growth. Increasingly efficient water markets play a significant role in facilitating these adjustments.

- Ultimately, the greatest influence on social and economic outcomes in the Basin will be conditions in the wider economy. The main drivers will include long-term changes in commodity prices, driven largely by growth in emerging Asian economies, and anticipated continuing growth in Australia’s GDP and productivity. Any impacts of the Basin Plan need to be considered in the context of these likely trends.
Communities in the Murray–Darling Basin

2.1 The Murray–Darling Basin is home to over 2 million people, who rely directly on the water resources of the Basin. A further 1.3 million people outside the Basin rely, either fully or partially, on the Basin water resource. The majority of the Basin population (over 70 per cent) live in either Canberra or the inner regional areas in the south-east and east of the Basin. The population becomes increasingly remote towards the north and west of the Basin (Figure 2). The social and economic characteristics of the people of the Basin have been described in detail in a report undertaken by the Australian Bureau of Statistics (ABS), Australian Bureau of Agricultural and Resource Economics (ABARE) and Bureau of Rural Sciences (BRS) for the MDBA in 2009 (ABS, ABARE et al. 2009). This report presents detailed data on population trends, patterns of water use, industry profiles, and measures of economic and community wellbeing for the Basin.6

2.2 Agriculture is a defining feature for many of the Basin’s communities. Many residents have a strong connection with the land, which forms part of their identity. The intimate connection between the farm as a place of work, as a residence, as part of family tradition, and in defining identity, reflects a way of life for many farmers and their families (Drought Policy Review Social Panel 2008).

2.3 A total of 921,600 persons aged over 15 years were employed in the Basin at the time of the 2006 census. The agriculture, forestry and fishing sector was a significant employer, with 11 percent of employed persons and 32 per cent of businesses. This employment proportion is much higher in smaller regional communities (ABS, ABARE et al. 2009).

2.4 The Basin’s agricultural communities have been affected by a range of social and economic developments and trends. These developments and trends have been described in more detail by a recent report commissioned by the MDBA (see EBC, RMCG et al. 2011a) as well as in many other recent documents (for example, by the Productivity Commission (2005b)).

2.5 Until the 1980s, agricultural activity in Australia was undertaken within the terms of the so-called ‘Australia settlement’ (Kelly 1992), under which the government played an active role in the economy. Governments intervened to encourage development of agricultural production, for example through schemes to stabilise and improve prices received by producers (an example of such a scheme was the establishment of the Australian Wheat Board in 1948). Until recently, governments also provided direct support to agriculture during difficult times, notably during drought (Aslin and Russell 2008; Gray and Lawrence 2001; Productivity Commission 2009).

6 To inform understanding of the historical, political, economic and social context for the Basin Plan, the MDBA drew on an extensive body of other work, including commissioned studies (ABS, ABARE et al. 2009; EBC, RMCG et al. 2011a; Frontier Economics 2010; MJA, RMCG et al. 2010), and a large number of non-commissioned reports and studies. In particular, the MDBA drew on data collected by the Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and Sciences, and the Productivity Commission, and studies of agricultural change and adjustment, such as those by Barr (2000), McColl and Young (2005), and the Productivity Commission (Productivity Commission 1999b; 2001). Many other reports identified in Part B of this document also informed the MDBA’s understanding of the social and economic context.
2.6 Beginning in the 1980s, economic and financial reforms have been implemented, through which trade barriers have been removed, the Australian dollar floated, public utilities privatised, markets created for water and power, and the banking sector deregulated. The consequences for rural and regional communities and agricultural producers have been profound. Improvements in communication technology and transport, together with changes in the organisation of production, have allowed sectors such as tourism and services to re-locate or grow in regional areas. Private capital has also become increasingly mobile, and farmers have enjoyed increased access to credit to expand their operations and gain access to international markets.

Box 2: Tourism in the Basin

Tourism in the Basin is widespread and diverse, and includes experiential and eco-tourism, boating and recreational fishing. Experiential tourism often relies on a vibrant food and wine sector, and as such has a close cultural association with irrigated agriculture. Activities such as boating, water sports and fishing depend to an extent on infrastructure developed to support the river regulation that maintains weir pools, while eco-tourism, boating, house boating and fishing in some places also rely on the natural attraction of aquatic ecosystems and water for the environment.

Drawing on data from state tourism departments, the total value of tourism associated with the River Murray alone has been estimated (in 2005) at $1.6 billion (Howard 2008).

While tourism is undoubtedly an important activity in the Basin, there has been little research to date on the nexus between water and tourism in the Australian context, particularly in a form that is relevant to policy (Crase, O'Keefe et al. 2010).

The potential importance of increased environmental flows to the tourism industry can be partly illustrated through the impacts of the recent drought. A destination visitor survey commissioned by (Tourism Research Australia 2010) evaluated the impacts of drought on the Murray region between 1999 and 2008. The region is a notable tourism destination in South Australia, representing 17 per cent of direct regional tourism expenditure, while in Victoria it is 12 per cent and in New South Wales 3 per cent.

The research found that overnight visits to the entire Murray region, which were estimated to be 2.8 million in 2008, had fallen by more than 2 per cent per year over the period. Had the drought not occurred, tourism expenditure would have been about 5 per cent, or $70 million, higher than actual levels in 2008. Over 1999–2008, there was an estimated fall in direct spending of $350 million, leading to a reduction in gross regional product over the entire period of around $460 million, and about 600 fewer full-time equivalent jobs. These losses through tourism alone during the drought are equivalent to the total number of jobs that are estimated to be lost from the Basin Plan overall.
Figure 2: Population by remoteness area, 2006

Source: Analysis of data from ABS (2008c).
2.7 Yet at the same time, the agricultural sector has had to contend with a wide range of other pressures, including changes in the costs of factors of production (e.g. water, feed, fuel, fertiliser), consumer demand, technological advances and innovation, emerging environmental concerns, continuing variability in seasonal conditions, and declining terms of trade (ABARE-BRS 2010a; Beilharz 1994; Hughes 1998; Kelly 1992; Melleuish 1997; Tonts 2000).

2.8 Irrigators and other agriculturalists have had to increase productivity and manage input costs to remain competitive (Frontier Economics 2010). Australian agricultural producers have been very successful at increasing their productivity. Thanks to rapid productivity growth, agricultural output more than doubled over the four decades to 2003–04 (Productivity Commission 2005b). Between 1974–75 and 2007–08, total factor productivity (the value of output relative to the value of inputs used) in Australia's agriculture, forestry and fisheries sector increased at an average annual rate of 2.2 per cent, substantially higher than in the manufacturing sector (1.2 per cent a year), the retail trade sector (0.9 per cent a year) and the mining sector (0.8 per cent a year) (ABARE-BRS 2010a). Refer also to the discussion on productivity growth beginning on page 42.

‘The only thing that keeps us going is productivity improvement – increased productivity from new varieties, research and development ‘ [respondent in the Namoi, EBC, RMCG et al. (2011a)]

2.9 Long-term changes in the economic prospects for agriculture have led to changes in the Basin’s social and economic makeup and outlook.

2.10 Over the longer-term, the proportion of those employed in agriculture has declined. For example, recent Census figures show that between 1996 and 2006, the number of people identifying themselves as ‘farmer’ or ‘farm manager’ in the Murray–Darling Basin declined by 10 per cent—from 74,000 to 67,000 (ABS Various years-b)—Refer to Table 2.

2.11 Many larger communities in the Basin have grown significantly. Analysis by the ABS has shown that 10 major urban centres in the Basin grew by more than 30 per cent over the period 1976–2001 (refer to Figure 3). However, some smaller rural communities have grown relatively slowly, or experienced population decline. This reflects a continuation of the trend, since the beginning of the twentieth century, for the percentage of the population living in rural areas of the Basin to decline (ABS, ABARE et al. 2009). Refer also to Appendix B.

7 See ABS, ABARE et al. (2009:13). The ten urban centres cited in this report were Mount Barker, Mildura, Canberra–Queanbeyan, Dubbo, Murray Bridge, Bathurst, Albury-Wodonga, Toowoomba, Echuca–Moama (Echuca part) and Shepparton-Mooroopna.
Table 2: Employed persons (farmers and farm managers), Basin Plan regions

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Barwon–Darling</td>
<td>249</td>
<td>190</td>
<td>166</td>
<td>154</td>
</tr>
<tr>
<td>Border Rivers</td>
<td>3,434</td>
<td>3,103</td>
<td>3,016</td>
<td>2,790</td>
</tr>
<tr>
<td>Campaspe</td>
<td>1,511</td>
<td>1,382</td>
<td>1,433</td>
<td>1,377</td>
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<tr>
<td>Condamine–Balonne</td>
<td>8,044</td>
<td>7,256</td>
<td>7,058</td>
<td>6,437</td>
</tr>
<tr>
<td>Eastern Mt Lofty Ranges</td>
<td>1,323</td>
<td>1,242</td>
<td>1,261</td>
<td>1,076</td>
</tr>
<tr>
<td>Goulburn–Broken</td>
<td>6,556</td>
<td>6,063</td>
<td>5,871</td>
<td>5,301</td>
</tr>
<tr>
<td>Gwydir</td>
<td>2,384</td>
<td>2,225</td>
<td>2,148</td>
<td>2,079</td>
</tr>
<tr>
<td>Lachlan</td>
<td>6,944</td>
<td>6,373</td>
<td>6,468</td>
<td>6,210</td>
</tr>
<tr>
<td>Loddon</td>
<td>2,906</td>
<td>2,825</td>
<td>2,802</td>
<td>2,638</td>
</tr>
<tr>
<td>Lower Darling</td>
<td>1,134</td>
<td>1,024</td>
<td>861</td>
<td>781</td>
</tr>
<tr>
<td>Macquarie–Castlereagh</td>
<td>7,262</td>
<td>6,442</td>
<td>6,549</td>
<td>6,399</td>
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<tr>
<td>Moonie</td>
<td>530</td>
<td>480</td>
<td>537</td>
<td>510</td>
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<td>Murray</td>
<td>15,228</td>
<td>14,306</td>
<td>14,123</td>
<td>12,340</td>
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<td>Murrumbidgee</td>
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<td>9,273</td>
<td>9,189</td>
<td>8,628</td>
</tr>
<tr>
<td>Namoi</td>
<td>4,200</td>
<td>3,809</td>
<td>3,831</td>
<td>3,766</td>
</tr>
<tr>
<td>Ovens</td>
<td>1,738</td>
<td>1,415</td>
<td>1,545</td>
<td>1,570</td>
</tr>
<tr>
<td>Paroo</td>
<td>248</td>
<td>181</td>
<td>219</td>
<td>180</td>
</tr>
<tr>
<td>Warrego</td>
<td>589</td>
<td>498</td>
<td>491</td>
<td>494</td>
</tr>
<tr>
<td>Wimmera–Avoca</td>
<td>6,778</td>
<td>6,242</td>
<td>5,516</td>
<td>4,901</td>
</tr>
<tr>
<td><strong>Total Murray–Darling Basin</strong></td>
<td>80,947</td>
<td>74,329</td>
<td>73,084</td>
<td>67,631</td>
</tr>
</tbody>
</table>

2.12 Labour intensity in the agriculture sector has declined significantly over time. Figure 4 demonstrates how labour intensity has declined from around 9,000 people per unit of output in 1966–67 to around 3,000 people per unit of output in 2006–07. This increase in labour intensity has been a significant influence on demographic trends over the last century.

2.13 Many agricultural based towns, which were established when numbers of farm labourers were significant compared to the agricultural output they produced, have increasingly struggled as the use of agricultural labour has been replaced by more capital intensive methods of farming. Even in towns where populations have not declined greatly, the underlying trend in demand for farm labour has inhibited growth in population and economy, such that there is a sense of being left behind somewhat compared with other parts of Australia that are growing strongly.
Figure 4: Ratio of rural agricultural employment to output, 1966-67 to 2006-07

Note: Estimate of labour intensity was derived by dividing the total number of people employed in rural industries by the index of total rural output (measured in volume terms). ABARES revised the method for calculating farm production indexes in October 1999. The indexes for the different groups of farm commodities are now calculated on a chained weight basis using Fishers’ ideal index with a reference year of 1997–98 = 100.

Source: ABARES (2010)

2.14 The declining use of labour per volume of agricultural output has been offset by the increase in overall agricultural production. The consequence is that the overall size of the agricultural labour force has been relatively flat for much of the last century (refer to Figure 5), but has been steadily declining as a proportion of the total labour force (refer to Figure 6).
In conjunction with these trends in agricultural labour, the average age of labour in the industry—reflected in the age profiles of many Basin communities—has been steadily increasing. The agriculture industry has the highest proportion of workers aged over 45 years (56.8 per cent) and over 65 years (15.2 per cent) compared with any other industries. Across the Basin as a whole, the proportion of persons aged over 65 has increased from 10.8 per cent in 1991 to 14.5 per cent in 2006. This ageing trend has been particularly pronounced in some Basin Plan regions (refer to Figure 7).

Figure 5: National employment by industry, 1966-67 to 2006-07

Source: ABS (2011c)

Figure 6: Agricultural employment as a share of national employment, 1966-67 to 2006-07

Source: ABS (2011c)

Figure 7: Percentage of persons aged over 65 years, Basin Plan regions, 1991 to 2006

2.16 The pressure to increase productivity has resulted in ongoing expansion of the size of farms, to spread fixed costs over a larger productive base.⁸ A relatively small number of large commercial farms now produce a significant proportion of agricultural output (Productivity Commission 2005b). The expansion of farm size has affected succession planning in farming families. Significant numbers of younger people from rural and regional Australia have migrated away from smaller towns to larger regional centres and cities, for education, careers and expanded social possibilities. While some young people may return to the farm, they tend to be older (typically around 40), have fewer children than previous generations, and don’t necessarily expect those children to take up the farm themselves (Barr 2009).

2.17 Furthermore, some farmers are increasingly competing with ‘amenity buyers’ when expanding their land holdings. These amenity buyers often value the land from quite a different perspective (i.e. for the lifestyle pleasure of living on a rural block rather than the business return it might make) and are willing to pay higher prices. While these high prices can provide financial benefits for those wishing to exit farming, such sales contribute to the changing demographics and culture of previously agriculturally based towns (Barr 2009). Some regional and rural communities may suffer from these demographic forces if they lose the farming base that is required to sustain many businesses, services and social outlets.

2.18 In the first half of the 20th century, agriculture accounted for around a quarter of Australia’s output and between 70 and 80 per cent of exports. Since the early 1960s, agriculture’s share of GDP has fallen from around 14 per cent in the early 1960s to 6 per cent in the early 1980s, and ranged from between around 4 and 6 per cent since that time. Agriculture’s share of national employment has more than halved since the late 1960s, when it accounted for around 9 per cent of the workforce (Productivity Commission 2005b).

2.19 As a result of these, and other pressures, many agricultural communities feel that their place in society has changed (refer to Box 3). Yet despite the ongoing social and economic pressures facing the agricultural sector—and the recent drought—the outlook for Basin communities is positive. The Basin’s people are generally optimistic, and have strong connections to place and community (Drought Policy Review Social Panel 2008). Perhaps because of their connection with the land, and with their communities, rural families generally express higher levels of satisfaction with their family, community and life circumstances than urban people (MJA, RMCG et al. 2010).

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⁸ Irrigation towns have been shielded from these impacts to a certain extent, especially those that rely on horticultural industries (i.e. fruit and vegetable production), as horticulture is a high value industry that requires more labour intensity than other agricultural enterprises. However, technological changes (which make it cheaper to invest in greater amounts of more efficient infrastructure) and the need to increase water use efficiency (both to increase productivity and to deal with reduced water availability) have created pressures for irrigation enterprises to increase in size.
Agriculture and rural and regional communities have been dealing with a changing identity within Australian society. One hundred and fifty years ago, the small farmer was a symbol of the ‘common man’ seeking freedom from repression of a class-bound Europe. Through to the 1960s, agriculture was seen as the engine that drove Australia’s economy—we ‘rode on the sheep’s back’. But as agriculture’s share of the national economy has decreased over time, and as environmental issues have come to the forefront of the national consciousness, challenging previously accepted notions of how natural resources should be shared and used, so too has farming’s status in society changed.

The perception now is that the ‘social contract’ between farmers, government and society—where farmers will supply food at reasonable prices and, in return, society will support them in financial, political, and, most crucially, social terms—has been evolving. Increasing urbanisation has meant that fewer Australian families have personal contact with agriculture either through work or through relatives. Increasing affluence has meant that many people now have enough income to satisfy their basic needs for food and shelter with very little physical effort on their part, and so tend to turn their energies to satisfying more esoteric needs for ‘beauty, justice, goodness and environmental richness’ (Barr 2009).

As many farmers and their communities would report, shifts have been occurring at the policy level too, partly in response to these changing societal attitudes and partly due to changing political philosophies. The deregulation of the Australian economy in the 1980s and early 1990s was not only a response to the prevailing economic circumstances but also a shift in understanding of the role of government in society. Rather than being actively involved in the market via government instrumentalities (for instance water utilities and telecommunication bodies), government’s role is now seen to be to set the parameters for the efficient operation of a competitive market. The guiding principle is of ‘steering, not rowing’ the economy—hence the emphasis on deregulation of industries, privatisation or corporatisation of government businesses, the removal of cross-subsidies in prices and the separation of the service and regulatory roles of institutions. The withdrawal of governments from the more direct support mechanisms to agriculture (e.g. in the form of subsidies and stabilisation of prices) reflects this shift in thinking.

### Indigenous communities in the Basin

2.20 The Basin’s river systems are of critical importance to the social, cultural and economic life of Indigenous people (refer to Box 4). In Indigenous belief systems, water is a sacred and elemental source and symbol of life. Aquatic resources also constitute a vital part of the customary economy. The pursuit of livelihoods derived from water-based enterprises on Indigenous lands, such as pastoralism, horticulture and sport fishing, expand the range of interests Indigenous people have in water to include a commercial element (Jackson 2008; Jackson and Altman 2009).

2.21 Approximately 70,000 of the Basin’s population of around 2 million people identify as Indigenous, constituting 15 per cent of the national Indigenous population. Reflecting in part their much younger age profile, the region’s Indigenous population grew by 17 per cent between 2001 and 2006, faster than the non-Indigenous population by a factor of five
(Taylor and Biddle 2004). Taylor and Biddle (2004) conclude that the likelihood that the Indigenous share of the Basin population will continue to rise appears high.

2.22 The largest share of the Basin’s total Indigenous population is resident within New South Wales (40 per cent) followed by Victoria (29 per cent). A number of large centres have a relatively high proportion of Indigenous people, including Moree, Bourke, Lightning Ridge, Condobolin and Wellington. As with the Basin population more broadly, the Indigenous population has recently exhibited a trend towards regional urbanisation, with a shift in population from rural areas to larger urban centres. A pattern of youthful outmigration of Indigenous population to towns and cities in response to employment opportunities has been observed, with a corresponding movement back again in later years in response to lower housing costs (Taylor and Biddle 2004). However, despite these trends, compared with non-Indigenous people, Indigenous people are far less likely to reside in large regional centres, such as Albury and Queanbeyan, and instead tend to be more widely scattered in smaller localities across the Basin (Taylor and Biddle 2004).

2.23 In the Basin, Indigenous labour force and income indicators remain relatively poor compared with the general population. Indigenous unemployment rates have generally been much higher than that experienced by non-Indigenous people. In 2006, Indigenous unemployment rates were over four times higher than for non-Indigenous people (20.1 per cent compared with 4.7 per cent) (ABARE, BRS et al. 2009). Agriculture is a relatively less important employment sector for the Indigenous population than for the non-Indigenous population. Only one area of agricultural employment (sheep farming) was listed in the Indigenous top 20 sectors (although meat processing might also be added). Meanwhile, Indigenous workers were more represented in government administration, education, health and community services, and personal and other services, but generally absent from professional and managerial positions (Taylor and Biddle 2004).

2.24 Taylor and Biddle (2004) also emphasise another dimension to Indigenous people’s socio-economic disadvantage—economic dependency. They found a substantial difference between the proportions of the adult Indigenous population that lie outside of the labour force (50 per cent of Indigenous adults), compared with the general population (for whom the equivalent figure was 37 per cent).

2.25 The Census data around work and income highlighted above is collected in part to inform governments about the mainstream economy. It does not necessarily reflect alternative economies or values that Indigenous people may participate in and hold. Aboriginal people not only view water as inextricably connected to the land and rivers, but also view themselves as an integral part of the river system. It is because of this holistic understanding and connection that Indigenous people feel a deep responsibility for the health of rivers. Customary practices are still carried out today and many of these have environmental benefits. These customary practices may be defined as legitimate forms of work in Indigenous communities (Taylor and Biddle 2004).
Box 4: Indigenous interests in the Murray–Darling Basin

More than 40 major Aboriginal nations maintain their traditional lands within the Murray–Darling Basin, and many of the Basin’s waters, waterways and wetlands continue to be culturally significant places to those nations.

The Murray–Darling Basin includes all or portions of the territory of the Indigenous ‘nations’ of the: Barapa Barapa; Barkindji (Paakantyi); Barunggam; Bidjara; Bigambul; Budjiti; Dhudhuroa (Dhadaroa); Dja Dja Wurrung; Euahlayi; Gamilaroi; Githabul; Gunggari; Gwamu (Kooma); Jarowair; Kunja; Kwiambul; Latji Latji; Maljangapa; Mandandanji; Maraura; Mardigan; Murrawarri; Muthi Muthi (Mutti Mutti); Nari Nari; Ngarrindjeri; Ngemba; Ngintait; Ngiyampaa; Ngunnawal; Nyeri Nyeri; Tati Tati (Tatti Tatti); Taungurung; Wadi Wadi; Wallwan; Wakka Wakka; Wamba Wamba; Wajjobaluk; Waywurru; Wergaia; Whurung; Wiradjuri; Wotjobaluk; Yaltmathang; Yita Yita and Yorta Yorta peoples.

Twenty-one nations in the north of the Basin are represented by the Northern Murray–Darling Basin Aboriginal Nations, and 21 in the south of the Basin are represented by the Murray Lower Darling Rivers Indigenous Nations. These self-determining groups are supported by the Murray–Darling Basin Authority.

Water interests

Indigenous bodies hold a total of 81 water licences in the Basin. Under the four State licensing regimes, not all licences include a designated water allocation. Water that is allocated within the 81 licences totals some 8,237 ML. Of this, 2,601 ML is classified as ‘High Security’ or ‘Reliable’. Most licences are in the regions of Macquarie-Castlereagh, Lower Darling, Lachlan, Murrumbidgee, Murray and Goulburn–Broken.

Two water licences held in the Victorian portion of the Basin are associated with properties held by the Indigenous Land Corporation (ILC).

Land interests

Indigenous groups hold an estimated 75 parcels of land in the Basin totalling 3,445 sq km, representing less than 1 per cent of the whole Basin. The majority of this land has been obtained through the ILC on behalf of Indigenous groups and is inalienable freehold title.

Native Title matters

The extent to which Indigenous groups may obtain control or influence over land that is subject to native title determination or to Indigenous Land Use Agreements is variable ranging from agreements for access, hunting and fishing to particular commercial arrangements. They rarely provide for exclusive control of land.

Approximately 339,236 sq km (33 per cent) of the Basin is subject to Native Title Application.

Native title has been found to exist over some 8,307 sq km of the Basin principally in the regions of Murray and Wimmera-Avoca.

Some 101,457 sq km (10 per cent) of the Basin is subject to Indigenous Land Use Agreements under Native Title. Agreements have been established mostly in parts of the regions of Paroo; Condamine-Balonne; Murrumbidgee; Murray; Wimmera-Avoca; and Loddon.

Indigenous Protected Areas

There are seven Indigenous Protected Areas in the Basin. These lie in the regions of Warrego; Condamine-Balonne; Border Rivers; Macquarie-Castlereagh; Murrumbidgee; and Murray.

Jointly-managed national parks

There are six jointly-managed national parks in the Basin. These lie fully or partly in the regions of Paroo; Barwon-Darling; Lower-darling; Murray; and Namoi.

Source: Arthur (2010)
Irrigated agriculture in the Murray–Darling Basin

2.26 While systematic irrigation began in Victoria in the 1880s, notably after 1886 when the Chaffey brothers were granted 100,000 hectares of land and water rights to develop irrigation near Mildura (Pigram 2006) significant growth did not occur until after the Second World War (Smith 1998).

2.27 Over the past 100 years, the Murray–Darling Basin’s agricultural base has been transformed from a low intensity, volatile dryland sector to a more intensive, mixed irrigation and dryland system. Today, the Murray–Darling Basin is Australia’s principal irrigation area. In 2005-06, it produced 45 per cent ($5.5 billion) of Australia’s total irrigated agricultural production ($12.2 billion) from 65 per cent of Australia’s irrigated agricultural land. Irrigated agriculture in the Basin represents around 37 per cent of Basin agricultural production and 15 per cent of national agricultural production (ABS, ABARE et al. 2009). Refer to Table 3.

2.28 All of Australia’s irrigated rice is produced in the Murrumbidgee and NSW Murray irrigation regions. The Basin also produces a majority of Australia’s cotton, sorghum, stone fruit, pome fruit and grape production. (ABS, ABARE et al. 2009).

Table 3: Selected indicators, Australia and the Murray–Darling Basin

<table>
<thead>
<tr>
<th>Region</th>
<th>Total</th>
<th>Agriculture</th>
<th>Irrigated agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Population (million)</td>
<td>Land area (million km²)</td>
<td>GDP/GRP</td>
</tr>
<tr>
<td>Australia</td>
<td>21</td>
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<td>$934b</td>
</tr>
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<td>MDB</td>
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<td>$54b</td>
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<td>MDB as a proportion of Australia</td>
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<td>14%</td>
<td>6%</td>
</tr>
<tr>
<td>Year</td>
<td>2006</td>
<td>N/A</td>
<td>2006</td>
</tr>
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</table>


2.29 The figures relating to irrigated agricultural production do not include the substantial activity and employment in the processing of food and fibre, nor the major sectors that service both primary production and secondary processing, such as transport, light engineering, wholesale supplies and machinery sales. If these sectors are also included, they represent a far greater proportion of the total Basin economy, particularly within some regional communities.

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9 It is important to recognise that the gross value of irrigated agricultural production (GVIAP), as measured and reported by the Australian Bureau of Statistics, refers to the gross value of agricultural commodities that are produced with the assistance of irrigation, where the gross value of commodities produced is the value placed on recorded production at the wholesale prices realised in the marketplace. Note that this definition of GVIAP does not refer to the value that irrigation adds to production, or the ‘net effect’ that irrigation has on production—rather, it simply describes the gross value of agricultural commodities produced with the assistance of irrigation. Refer to ABS (2010a).
2.30 On the other hand, it should not be assumed that most rural households earn most of their income from farming. Over the last decade or so, an important farm adjustment strategy has been the increasing linkage between farm households and rural towns through involvement in ‘off-farm’ work (Gow and Stayner 1995; McColl and Young 2005; Peterson and Moon 1994). This trend predates the onset of the Millennium Drought.

2.31 Irrigated agriculture has developed in different ways in the northern and southern parts of the Basin. In the southern Basin, there was significant government involvement in irrigation development. Irrigation infrastructure is generally shared, with larger schemes managed by irrigation supply businesses. Many irrigation communities were established as soldier-settlement schemes after the first and second World Wars.

2.32 The southern Basin tends to have winter-dominated rainfall and greater historical reliability of rainfall year to year, facilitating the development of farming systems that depend on continuity of water supply, such as perennial horticulture (EBC, RMCG et al. 2011a). The southern Basin is interconnected between valleys. This allows trading of entitlements and allocations of water, subject to hydrological and policy-based limitations.

2.33 In the northern Basin, development was been led by private interests. Some irrigation communities make significant direct contributions to agricultural production, while others rely more on services, manufacturing, education or government administration for their economic viability.

2.34 The northern Basin is characterised by unregulated flows, off-river diversions, and privately owned storages, some of which are extremely large. Rainfall is greater in summer, and is highly variable. As a result, irrigators rely more on opportunistic annual crops and depend on a few good seasons to generate the return required to offset years with lower water availability. The northern rivers are not interconnected, but comprise separate, terminal systems that only connect in high-rainfall years. Water trade is less well-developed than in the south, and tends to occur only within valleys.

2.35 Reflecting these differences, patterns of irrigated agricultural production vary across the Basin.

- Around two-thirds of Australia’s cotton is grown in the northern valleys of NSW and southern Queensland. Cotton is the dominant crop in the Queensland regions of Lower Balonne and Border Rivers and in the northern New South Wales regions of Gwydir, Namoi and the Lachlan. In these regions, there is considerable variation between seasons, in rainfall and water available for irrigation. Consequently, the cotton sector has been established on a business model built around a few very good years in each climate cycle. The area planted is readily reduced in response to lower water availability, and production consequently varies significantly from year to year. The crop is experiencing significant ongoing improvements in yields, quality and productivity.

- Rice is the predominant crop in the Central Murray and Murrumbidgee irrigation regions of New South Wales. Rice farmers irrigate more than half their land and have the highest holdings of general security entitlements of any sector. Like cotton, rice is an adaptable annual crop, although the level of rice production tends to decline at a greater rate than the respective decline in water availability. If crop profitability is high enough and water is affordable, rice-growers tend to buy water to supplement allocations;
however, if the price of water is higher (often in response to low allocations) and/or crop profitability is lower, they tend to sell their water (often to horticulture or dairy farmers).

- **The dairy** industry of the Basin is centred on the Victorian Goulburn–Murray Irrigation District, but farms are also clustered in the New South Wales Murray and other valleys in New South Wales, the lower Murray and lakes in South Australia, and the Darling Downs in Queensland. Dairy farmers irrigate over 70 per cent of their land and hold more high reliability than low reliability entitlements, reflecting the importance of reliability of supply, particularly to sustain herds in dry years. The recent drought years have seen declining farm numbers, increasing average farm size, low milk prices and high water prices (in response to low allocations). This has led to increased farmer debt levels, decreased milk production, and rationalised processing capacity. However, irrigation efficiency and fodder productivity have increased as farmers have balanced the cost of growing feed themselves with the cost of buying it from mixed farmers.

- **Horticultural** production is located throughout the Murray–Darling Basin, but is particularly important in southern Basin regions. Horticultural farmers irrigate more than half their land and predominantly hold high reliability entitlements, reflecting the importance of a reliable water supply particularly to maintain trees and vines in dry years. A distinction can be drawn between annual horticulture, which uses water on a year-to-year basis, and for which water represents a small component of input costs; and perennial horticulture, for which water costs can be more significant, particularly during drought periods when horticulturalists buy water from other users to keep permanent plantings alive.

2.36 The characteristics of the Basin’s irrigated agricultural industries have been described in detail in reports undertaken for the MDBA by EBC, RMCG et al. (2011a) and MJA, RMCG et al. (2010). Detailed data on regional variations in irrigated agricultural production are also collected by ABS and ABARES.

**Water use by the irrigated agricultural sector**

2.37 Irrigated agriculture in the Basin is the most significant user of water (refer to Figure 8). The volume of water used varies significantly from year to year. For example, between 2000–01 and 2007–08, total water consumption by irrigated agriculture varied from over 10,500 GL in 2000–01 to only 3,142 GL in 2007–08 (ABS Various years-a). In 2008–09, irrigated agriculture in the Basin consumed approximately 3,500 GL (ABS 2010b).
2.38 Of the water used by irrigated agriculture in the Basin, approximately 30 per cent is applied to pastures, 30 per cent is applied to other crops (including rice), 20 per cent is applied to cotton, and 20 per cent is used for horticulture (grapes, fruits, nuts, vegetables). These proportions vary from year to year (2010a; Various years-a). Refer to Figure 9.

2.39 Changing patterns of water use reflect the changing nature of the many factors that influence irrigators’ production decisions. Irrigators tend to use water when, and to the extent that, it makes economic sense for them to do so. In simple terms, they take into account the cost of water, the cost of other fixed and variable inputs, the yield of a commodity per unit of water, and the value of that commodity, when deciding whether or not to use water for the purposes of producing a specific commodity. In a general sense, irrigators use water where it has the highest value per ML applied—that is, where the value of production relative to the cost of the water is maximised. When water is scarce (and
expensive) it will tend to be used first by high-value producers (e.g. perennial horticulture), and only by lower-value producers (e.g. rice) when there is sufficient water available. For lower-value producers, it will often make more economic sense for them to sell their water allocations to higher-value producers when water is relatively scarce (and water prices are high), rather than use their allocations to produce a crop.

2.40 Commodity prices and patterns of water trade have a particularly material impact on patterns of water use. Producers also take into account other factors, such as the extent to which inputs can be substituted, the extent to which production of a given commodity is associated with fixed capital (e.g. horticultural plantings), overheads (e.g. annual access charges for irrigation infrastructure) and their financial position. Furthermore, like the agricultural sector more broadly, irrigated agriculture has demonstrated sustained growth in productivity, at a rate that is greater than the rest of the national economy (ABS 2007).

2.41 These multiple factors have a significant influence on the value of irrigated production—sometimes far greater than the amount of water available. By changing their production methods and factor inputs, in combination with generally increased commodity prices, many irrigators were able to maintain the value of their production during the protracted Millennium Drought—notwithstanding low levels of water availability.

- For example, dairy farmers were able to maintain the value of their production in the period to 2007-08 by purchasing fodder or agisting herds to compensate for shortfalls in irrigation water (Box 5) and because dairy prices improved. However, dairy prices deteriorated in 2008-09, coinciding with very low water allocations, resulting in a substantial decline in the value of dairy production. Dairy profits also suffered as a result of significantly higher costs during the drought.

- Many farmers increased their water use efficiency through substituting other factors for water—for example, by increasing investment in water efficient irrigation or higher levels of labour costs to improve the efficiency of water application.

2.42 Consequently, across the Basin, a reduction in water availability of close to 70 per cent between 2000–01 and 2008–09 saw the gross value of irrigated agricultural production decline only slightly in nominal terms (refer to Figure 10 and Figure 11).

2.43 If estimated in real terms (2009–10 dollars) by deflating nominal GVIAP by the consumer price index, real GVIAP was reduced by approximately 30 per cent over the same period (from approximately $6.4 billion to $4.4 billion). In practice, a number of other factors will have contributed to changes in GVIAP over this period, including changes in key commodity prices (relative to the consumer price index) and potential changes in productivity (ABARES 2011d: 68). It is also important to note that much of this period was affected by drought, and that the observed relationship between reduced water availability and GVIAP for this period is not indicative of changes that may occur as a result of the Basin Plan. Refer to the discussion on the differences between drought and the Basin Plan beginning on page 48.
Box 5: Changes in dairy production during the drought

Around a third of Australia’s dairy cattle are located in the Murray-Darling Basin, and most of these are in Victoria. Approximately 90 per cent of dairy farmers in the Basin use irrigation to assist in pasture production. Pasture tends to be used in conjunction with grain feeding and it can be substituted with purchased fodder.

The 2006–07 drought severely affected pasture availability in the Basin. Even where dairy producers had been able to use irrigation to supplement local rainfall, pasture growth was below average because of lower than average water allocations. Results from ABARE’s Australian dairy industry survey for 2006–07 indicate that dairy farmers responded to the drought in a variety of ways, including increasing their use of purchased feed and reducing herd size. As the drought worsened and pasture production proved to be considerably below average, some dairy farmers increased the amount of concentrated rations (including grain, supplements and hay) fed to their milking herds in order to maintain milk production.

Water usage by the dairy industry between 2005–06 and 2007–08 declined by 64.4 per cent, but the value of dairy production reduced by only 26.5 per cent. This was largely because farmers adjusted their production in response to low water allocations and much more expensive water by selling part of their water allocations, reducing or suspending irrigated grazing, and using the income from their water allocations to purchase fodder. While dairy farmers were able to maintain production by altering the mix of inputs into production, substitution from lower cost inputs (i.e. water) into higher cost inputs (e.g. fodder, agistment, more water efficient irrigation methods) significantly affected their profitability—refer to page 49 for a discussion of profitability and debt during the drought.

Sources: Goesch, Hafi et al. (2007), Wittwer (2011b) and Wittwer and Griffith (2011).
2.44 Of course, irrigators didn’t just adjust their production methods or improve their technology costlessly. Farmers use the levels of water they do because it optimises their production and profitability. Readjusting their production methods—in response to lower levels of water availability and higher water prices during the drought—increased their costs and reduced their profitability—refer to Box 5 and Figure 18.

Productivity growth in the agricultural sector

2.45 Productivity growth measures the increases in output over and above additional input use. Historically, productivity growth has been a major driver of growth in Australia’s agricultural sector, and has typically exceeded productivity growth in the rest of the economy—refer to Figure 12. Productivity growth has helped maintain competitiveness in export markets and is the main driver of increases in the total value of global agricultural production over time—Figure 13.

![Figure 12: Productivity growth by industry, selected sectors, index, 1976-77 to 2007-08](source: Productivity Commission (2011))

![Figure 13: Contribution of total factor productivity growth to gross value of agricultural production](source: Gray, Sheng et al. (2011))

2.46 The broadacre and dairy industries, which collectively account for 65 per cent of agricultural gross value of production, achieved long-term productivity growth of 1.9 per cent and 0.8 per cent a year respectively for the period 1977–78 to 2007–08. Within the broadacre sector, the cropping industry has consistently achieved the highest long-term growth rates, followed by beef at 1.3 per cent and sheep at 0.4 per cent. Within the dairy sector, productivity gains were small prior to deregulation but higher milk yields and labour productivity improvements enabled some overall gains during the early 2000s, although the effect of these improvements has been less pronounced in recent years due to the drought. Average annual total factor productivity growth for dryland cropping over the same period has been higher still, at 2.1 per cent (Gray, Sheng et al. 2011).
2.47 **Figure 14** shows total factor productivity for selected agricultural sectors over the period 1977–78 to 2008–09. Note that cropping growth rates are from surveys that exclude irrigated cropping activities.

![Figure 14: Total factor productivity in selected agricultural sectors, index, 1977–78 to 2008–09](image)

(a) Figures reflects dryland production except for combined irrigated and dryland production for the dairy sector.

Source: Unpublished analysis by ABARES, 2011

2.48 Over time, further gains in agricultural productivity will allow the industry to offset the effect of reduced water availability on the total value of production. For example, **Figure 15** illustrates the substantial gains in rice and cotton yields over the past 40 years.

![Figure 15: Cotton and rice yields, 1965–66 to 2009–10](image)

Source: ABARES (2011d)

2.49 Innovation is an important element of productivity growth and recent results from the ABARES survey, *Farm innovation in the broadacre and dairy industries, 2006–07 to 2007–08*, found that more than 80 per cent of broadacre farms and more than 90 per cent of dairy farms made at least one innovative change to farm management practices or farm
technologies over this period (Liao and Martin 2009). The report found that cropping farms were more likely to report innovative changes in irrigation and water management practices than livestock farms and there were significant differences in the adoption of irrigation and water management practices between large family farms (45 per cent) and small family farms (17 per cent). The report also suggested a correlation between levels of innovation and financial capacity, implying that farmers who were financially constrained as a result of the drought are likely to require time to recover before innovation and productivity levels improve.

2.50 A slowdown in the rate of productivity growth has been observed in some agricultural industries, most notably the cropping and dairy industries. Recent drought conditions are estimated to be at least partially responsible, as drought conditions have led to short term downturns in output at a faster rate than reductions in input use. These changes have commonly led to inputs being either over- or under-committed, both with negative consequences for productivity growth. Drought conditions have also reduced overall confidence and investment in new technologies, although many growers have improved their risk management and water use efficiency in response (Nossal and Sheng 2010).

2.51 Under the more recent wetter climate conditions, agricultural productivity growth is expected to recover, but will be reliant on targeting the well-known drivers of farm productivity in the past: the development of new innovations; the wide scale adoption of existing innovations; and overall successful structural adjustment (Nossal and Sheng 2010).

- For example, precision farming—the use of spatially accurate and real-time knowledge made possible through the use of global positioning systems (GPS) and wireless technologies—is an emerging field of innovation which has the potential to increase productivity in the agricultural sector (Smith, Baillie et al. 2010).

- Precision agriculture in dryland cropping systems is widespread, but is in the early stages of adoption for precision irrigation to date. However, a recent review of case studies of the economic benefits of precision irrigation showed water savings in individual years ranging up to 50 per cent and savings averaged over a number of years up to 20 per cent (Smith, Baillie et al. 2010).

2.52 Recent work by ABARES suggests that farms with greater capacity to innovate—based on factors such as higher education, greater labour availability, larger farm sizes and more intense land use—have greater potential to deliver productivity gains. ABARES also suggests that well-formed business and investment plans will help facilitate the best profitability and productivity outcomes by ensuring appropriate management and technology options (Liao and Martin 2009; Nossal and Lim 2011).
Box 6: The Basin Plan, food security and food prices

A growing world population, with an expanding middle class, will contribute to growing global demand for food. Questions regarding the capacity of the world’s agricultural systems to meet the growing demand, together with potential environmental constraints on production—such as the limitations on water availability, soil degradation, the loss of agricultural land to urban development, and climate change—have heightened concerns about issues of food affordability and food security.

Australia makes a positive contribution to global food supply, being one of only a small number of countries exporting more food than it imports. Total Australian farm production, representing the integrated production of food and fibre, continues to rise. Of $40 billion in Australian farm production in 2009–10, over $28 billion was exported, with $22 billion representing food exports. Food imports totalled $10 billion, with the breakdown of imports and exports varying across the sectors (Figure 16).

The Basin contributes around 38 per cent of agricultural production (indicated by the sectoral contribution described in Figure 17). Of that, irrigated agriculture in the Basin contributes around 14 per cent of national farm production—ABARE-BRS (2010c).

Given the significant role that international markets have in determining the prices for many of the Basin’s outputs, and that a significant proportion of its agricultural product is for export, the Basin Plan is unlikely to have much effect on national food prices—ABARES estimates a 1.7 per cent reduction in Basin GVAP as a result of the Basin Plan, which translates to just a 0.5 per cent reduction in national GVAP.

Furthermore, the real value of agricultural production, after abstracting for productivity growth, has been in long term decline since 1950—indicating long term downward pressure on prices for agricultural produce. Globally, farmers rely substantially on productivity improvements to generate increasing value of production.

Basin farmers are well-placed to continue leveraging productivity enhancements to capitalise on the increased global demand for food.

Figure 16: Australian food imports and exports ($b), 2009–10
Source: ABS (2010c).

Figure 17: Value of production ($b), 2007–08
Source: ABS (2009; 2010a)

Note: There was very little rice produced in 2007-08 due to low water allocations and high water prices.
Water markets and trading in the Murray–Darling Basin

2.53 The Basin states have a large range of different categories of water entitlements across different systems. These categories of water entitlement confer varying levels of security (reliability) on annual allocations made under those entitlements. Generally, a much higher proportion of high reliability entitlements (60 per cent or more of the total volume on offer) has been issued in Victorian catchments than in NSW catchments. In contrast, in some NSW systems, the majority of entitlements are low reliability or supplementary—however, note that general security entitlements in the Murrumbidgee have reliability that makes them comparable with Victorian high security.

2.54 The growth of the water market has played a significant role in helping the irrigated agricultural sector adjust to seasonal variations in water availability. Trading allows for resources to move to higher value uses, maximising the productive capacity of available water. Trading increases the flexibility and responsiveness of farmers, as they are able to buy or sell water in response to changing climate conditions, commodity prices or other factors when previously their access to water would have been fixed (NWC 2011).

2.55 Water trades are recorded in state water registers. Since 2007–08, the National Water Commission has reported on water market trends, through its annual Water Markets Reports (NWC 2008; 2009a; 2010) and a recent report on water markets trends and drivers (NWC 2011).

2.56 Recent patterns of trade in water allocations demonstrate how there has been considerable variation in inflows and outflows from different trading zones. These trading patterns are driven mainly by the interactions of three main sectors (rice, horticulture and dairy) with the water market. Rice growers have lower gross margins per megalitre of water applied, compared with the other sectors, and typically sells water to other users when the price of water rises. Horticulturalists have relatively inelastic demand for water, reflecting the significant cost in losing permanent plantings. Dairy farming is sensitive to water prices; such that at lower prices farmers purchase additional water, while at higher prices they sell water and increase fodder purchases (NWC 2011:34-36). Refer also to Table 4.
Table 4: Net water allocation trade between trading zones, southern Murray–Darling Basin, 1998–99 to 2009–10 (ML)

<table>
<thead>
<tr>
<th>Year</th>
<th>Lower Darling</th>
<th>NSW Murray</th>
<th>Murrum-bidgee</th>
<th>SA Murray</th>
<th>Vic Goulburn</th>
<th>Vic Loddon and Campaspe</th>
<th>Vic Murray above Barmah</th>
<th>Vic Murray below Barmah</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999–00</td>
<td>8,986</td>
<td>111,654</td>
<td>-113,650</td>
<td>-1,696</td>
<td>1,117</td>
<td>-3,319</td>
<td>-2,718</td>
<td>-2,908</td>
</tr>
<tr>
<td>2000–01</td>
<td>20,009</td>
<td>3,021</td>
<td>-30,177</td>
<td>3,255</td>
<td>8,557</td>
<td>-2,718</td>
<td>-18,428</td>
<td>-16,428</td>
</tr>
<tr>
<td>2001–02</td>
<td>7,816</td>
<td>-29,983</td>
<td>31,487</td>
<td>-7,261</td>
<td>18,151</td>
<td>-2,718</td>
<td>-13,859</td>
<td>-13,859</td>
</tr>
<tr>
<td>2002–03</td>
<td>-</td>
<td>36,086</td>
<td>-14,489</td>
<td>-9,001</td>
<td>27,547</td>
<td>-2,718</td>
<td>-19,072</td>
<td>-16,428</td>
</tr>
<tr>
<td>2003–04</td>
<td>-</td>
<td>38,927</td>
<td>-34,708</td>
<td>6,010</td>
<td>-27,273</td>
<td>-1,766</td>
<td>12,939</td>
<td>12,939</td>
</tr>
<tr>
<td>2004–05</td>
<td>-1,139</td>
<td>2,705</td>
<td>8,026</td>
<td>-1,630</td>
<td>-26,186</td>
<td>-2,718</td>
<td>20,871</td>
<td>20,871</td>
</tr>
<tr>
<td>2005–06</td>
<td>-</td>
<td>2,645</td>
<td>-5,896</td>
<td>-24,290</td>
<td>47,244</td>
<td>36,763</td>
<td>-56,263</td>
<td>-56,263</td>
</tr>
<tr>
<td>2007–08</td>
<td>-</td>
<td>-17,506</td>
<td>-139,096</td>
<td>144,375</td>
<td>-66,908</td>
<td>-17,722</td>
<td>95,023</td>
<td>95,023</td>
</tr>
<tr>
<td>2008–09</td>
<td>-27,948</td>
<td>-134,701</td>
<td>-390,147</td>
<td>336,263</td>
<td>172,343</td>
<td>2,206</td>
<td>17,736</td>
<td>24,248</td>
</tr>
</tbody>
</table>

Source: NWC (2011:66)

Drought

2.57 Australia’s recorded rainfall history features several distinctly dry periods of a decade or longer. Periods of prolonged drought included the Federation Drought of the 1890s; the mid to late 1920s and the 1930s, continuing over the eastern states through most of the 1940s; and the 1960s in central and eastern Australia. During these low rainfall periods, not every year is dry; however, rainfall in most years is below the long-term average, and there are often runs of years with recurrent dryness.

2.58 Between 1997 and 2009, south-eastern Australia experienced the most persistent rainfall deficits since the start of the 20th century. Annual rainfall during the Millennium Drought was 73 mm below average (or 12.4 per cent below the 20th century mean) for the years 1997–2009 inclusive. Some key features made this drought different to others.

- It was largely limited to south-eastern and south-western Australia while national rainfall was above average.
- It was distinctive with regards to its seasonality—the rainfall deficit occurred between March and October, with around two thirds of the deficit in autumn, and smaller reductions in the rest of the year (CSIRO 2011).
- The drought had profound effects on irrigation allocations. Unprecedented rainfall deficits in the alpine regions of Victoria and NSW meant that inflows into the Murray River in the ten years to 2009 were about half of the historic average. Inflows in 2006 were considerably less than the previous historic minimum, being less than 10 per cent
of the long-term mean during the main inflow period from June to October. Irrigation allocations were cut significantly; for example, Goulburn-Murray Water (which aims to provide 100 per cent of allocations in 97 years out of 100) was unable to do so in five out of eight irrigation seasons starting in 2002–03 (Wittwer and Griffith 2011).

2.59 The drought had significant economic and social impacts on irrigation communities. In some sectors, particularly the dairy, rice and cotton sectors, levels of irrigated agricultural production fell. At the same time, some producers (generally higher value industries) maintained production, through purchasing water in the market or altering their production methods. The financial viability of many farming enterprises fell, with average returns low to negative, reflecting reduced returns and raised costs from having to buy water or other inputs at premium rates. The closure or mothballing of processing plants in rice and cotton communities led to loss of jobs and investment. Businesses in irrigation communities also suffered. Socially, the drought had negative impacts on many farm families, rural business and communities, and on mental health, family relationships and community stability and cohesion (Alston and Witney-Soanes 2008; EBC, RMCG et al. 2011a; Edwards, Gray et al. 2008; MJA, RMCG et al. 2010).

Differences between drought and the Basin Plan

2.60 While the drought has contributed significantly to the social and economic context for the Basin Plan, it is important to recognise the differences between the impacts of the Basin Plan compared to those of the drought. It is not possible, or appropriate, to compare adjustment in response to drought conditions with the adjustment required in response to the Basin Plan.

2.61 The Basin Plan will reduce the water that is available for irrigation, but will not affect dryland production, the contribution of rainfall to irrigated production, or rates of evaporation. Rainfall is the most important source of water for most forms of Basin agriculture—of total Basin rainfall, only around 4 per cent on average finds its way into the Basin’s rivers (CSIRO 2008a; b). For most forms of agricultural production, applying irrigation is a cost-effective method of increasing yields and profitability.

2.62 For every 100mm of rainfall deficit during drought, the irrigation water requirement grows by around one megalitre per hectare (Wittwer 2010:11). For example, in very general terms an irrigated cotton crop grown in the Basin could be expected to have an average irrigation requirement of around 6 ML/ha (ABS 2005: 5; 2011a: 18). This could be expected to be increased by 1 ML/ha should there be rainfall of 100 mm less than average.

2.63 Unlike drought, dryland productivity will not be affected under the Basin Plan, and in some areas irrigators will have scope to move factors of production to dryland activities. Furthermore, irrigators will receive full monetary compensation should they sell their water to the Australian Government.

2.64 The drought and the Basin Plan will also likely result in very different longer-term production and investment decisions. During drought, producers typically expect that future climatic conditions and water availability will return to average, and consequently they implement coping strategies during droughts which assume an upturn in conditions. In contrast, reductions in water availability under the Basin Plan will be permanent rather than
temporary. Producers will make production and investment decisions on the basis of these long-term changes in the availability of water for consumptive use.

2.65 While the drought does not provide an accurate indication of the likely impacts of the Basin Plan, it has still affected the way in which individuals and communities will deal with the Plan. During the drought, Exceptional Circumstances assistance and off-farm income provided a significant contribution to farmers’ coping strategies. Others ran down their capital or accumulated debt. As a consequence, many farmers will have reduced financial capacity to allow them to adjust to the Plan. Other farmers, particularly those that are older or have lower wellbeing or optimism, have already exited the agricultural sector, or may well do so if faced by further pressures (Drought Policy Review Social Panel 2008).

Financial capacity and adjustment

2.66 The recent severe and prolonged drought has resulted in many farmers in the Basin being under financial stress. Many farms survived the drought on a combination of exceptional circumstances payments and off-farm income, and by running down farm equity (MJA, RMCG et al. 2010).

2.67 In the dairy sector, the drought led to changes in the feeding systems used. Previously, farms irrigated perennial pastures. During the drought, there was a move away from irrigated pastures to more flexible feeding systems, with increased production of annual crops, lucerne and annual pastures. Farmers purchased more feed, and increased their debt levels in doing so. Dairy Australia analysis of ABARES farm survey data for the period from 1999–00 to 2007–08 shows that the total debt of farms in the Goulburn-Murray Irrigation District grew by 41 per cent, from $367,000 to $518,000 (analysis based on ABARES various years). The biggest driver was the increased requirement for working capital, which grew by 200 per cent from $84,000 to $255,000. Interest payments became the second largest farm expense item for dairy farmers (EBC, RMCG et al. 2011d:73).

2.68 Rice production was severely affected by drought, and many rice growers experienced a dramatic reduction in their on-farm revenue. Horticultural producers faced a critical need to ensure they had water for permanent plantings, and bought large quantities of temporary allocations to obtain water. Some horticulturalists even sold permanent water entitlements to keep debt levels down at the same time as they bought allocations (Dairy Australia 2011; MJA, RMCG et al. 2010).

2.69 In a survey undertaken for the MDBA, MJA, RMCG et al. (2010) found that the average gross margin return on farm assets over five years to 2010 for horticulture, broadacre, livestock, dairy, and mixed farms was in the range of 2 to 3 per cent. When debt and interest costs are added, the average annual return on assets during that period was negative for the majority of farms surveyed.

2.70 As shown in Figure 18 and Figure 19, since 1996 levels of farm average cash income have fallen, and levels of average farm debt have increased significantly in the Riverina, Central North Victoria, Darling Downs and Riverland areas.
Figure 18: Average farm income ($), selected regions, 1996–2010  
Source: ABARES (2011b)

Figure 19: Average farm debt ($), selected regions, 1996–2010  
Source: ABARES (2011b)

Economic outlook

2.71 Ultimately, the greatest driver of social and economic outcomes in the Basin will be conditions in the wider Australian economy, including exposure to international conditions.

2.72 As at the May 2011 Budget the Australian economy was forecast to grow at an above-trend rate over the next two years, with real GDP growth forecast to be 4 per cent in 2011–12 and 3¾ per cent in 2012–13 (Australian Government 2011: section 1, p 7). Since May, several of the downside risks identified in the 2011–12 Budget have become more prominent, especially those relating to international economic conditions. However, prospects for the Australian economy remain positive, with an underlying profile over the next year of solid growth, low unemployment, moderate inflation and a surge in business investment. This solid economic growth will assist in smoothing the transition to a more water-constrained future under the Basin Plan.
2.73 Australia’s economic growth will be supported by robust growth in China, India, and other emerging economies of Asia. This growth has pushed Australia’s terms of trade towards historical highs (Australian Government 2011: section 2, p 4). As well as continued demand for mineral resources, it is anticipated that demand will increase for higher order goods and services, including many of the food and fibre products that are produced in the Murray–Darling Basin (Australian Government 2011: Section 4, p3; Swan 2011).

2.74 Over the past several months, there has been significant volatility in the value of the Australian dollar, especially against the US dollar. The Australian dollar appreciated significantly from around parity against the US dollar in early March 2011 to a post-float high of US 110c in late July, before depreciating to around US 95c in early October, and then recovering to above parity later in the month. To a large extent, the recent volatility reflects financial market concerns over high levels of public debt in the United States and Europe, and the possible implications for global economic activity. At this stage, the main international economic forecasters are not predicting a sharp slowdown in global economic growth (ABARES 2011a). The short-term economic outlook for Australia’s agricultural sector is positive. Rural exports are expected to remain at a high level over the next two years. A bumper summer crop is expected in 2011–12, with recent rainfall increasing the availability of irrigation water and improving subsoil moisture. In 2012–13, farm production is expected to decline slightly, assuming a return to average seasonal conditions (Australian Government 2011: section 2, p 26).

2.75 In the September 2011 Agricultural Commodities Report, ABARES forecasts the total volume of farm production to increase by 2.5 per cent in 2011–12, following an increase of 6 per cent in 2010–11 (ABARES 2011a). Generally favourable growing conditions are expected to lead to a large 2011–12 national winter crop. Of the major winter grains, wheat and barley production are forecast to fall slightly while canola production is forecast to rise. For summer crops, production is forecast to increase by 2 per cent in 2011–12. The volume of livestock production is also forecast to increase by around 1 per cent in 2011–12, reflecting higher lamb and sheep turn-off rates and increased wool and milk production. In total, the value of Australian agricultural, fisheries and forestry exports is forecast to be around $38.6 billion in 2011–12, an increase of 6.6 per cent from $36.2 billion in 2010–11 (ABARES 2011a).

2.76 The rise of China, India and other emerging economies, along with an appreciation in the Australian dollar suggest a change in the long-term economic and financial conditions facing the agricultural sector, although it is not clear how these changes will play out.

2.77 The appreciation of the Australian dollar has been driven by several factors, including high export prices for our non-rural commodities, strong economic growth relative to other advanced economies and tightened macroeconomic policy settings. The appreciation is putting pressure on the export producing components of the agricultural sector (Australian Government 2011: section 2, p 4). While the Australian dollar is expected to retreat from recent highs in the long-term, the currency changes likely indicate a long-run reduction in comparative advantage of the Australian agriculture sector in global markets. To continue to compete on world markets, it will be important that Australian exporters continue to adapt and adjust to changes in demand, use scarce resources more efficiently, adopt new technologies, and seek opportunities to value-add, innovate and produce niche products.
2.78 On the other hand, strong population growth and wealth creation in the emerging economies will put pressure on the volumes and prices of many basic commodities in international markets, including food and fibre. Rising incomes in emerging economies are likely to stimulate demand for food products, especially those foods with relatively high value added, and this will likely continue to be combined with growing demand for agricultural products in energy production. The emergence of carbon farming in response to the adoption of carbon pricing is also likely to influence agricultural production. In contrast, global supply of agricultural products has been expanding only modestly, partly due to low levels of research into improving yields and little growth in the land area devoted to agricultural production (Lowe 2011).

2.79 On balance, these conditions are likely to offer Australian agricultural producers a range of new opportunities and markets, including for those producers in the Murray–Darling Basin.
Chapter 3: Methodology for assessing the impacts of the Basin Plan

Key points

- The Authority recognises that the Basin Plan may have significant social and economic impacts on some Basin communities. The MDBA has assessed these impacts by taking into account information from multiple sources including:
  - Findings from consultations with communities.
  - Economic modelling and analyses of impacts on irrigated agricultural production and regional economies.
  - Analyses of community vulnerability and adaptive capacity.

- The MDBA commissioned extensive community consultations, to build a better understanding of the potential social and economic impacts using first-hand experiences and knowledge, and to ground-truth the data and analysis.
  - The EBC consortium (EBC, RMCG et al. 2011a) consulted with nearly 700 community representatives, from 119 towns and regional centres.

- The MDBA also drew on work from:
  - an earlier study led by Marsden Jacob Associates (MJA, RMCG et al. 2010)
  - the outcomes of consultations following the release of the Guide to the proposed Basin Plan, and the findings of studies
  - reports undertaken or commissioned by organisations or individuals outside the MDBA.

- The MDBA has commissioned extensive modelling of the macroeconomic impacts of the Basin Plan. This modelling represents the best available understanding of the likely Basin scale impacts of the Plan, but is subject to standard modelling limitations and will continue to be developed to take advantage of new knowledge.
  - The modelling considers the dynamic changes that might be expected to occur in the Basin economy as a result of three consumptive water recovery scenarios of 2,400, 2,800 and 3,200 GL, and the sensitivity of these changes to climate variability, patterns of water trade, and varying commodity prices.
  - The modelling also considers the impacts of the Australian Government’s infrastructure investments and buyback program under the Water for the Future initiative.

- To assess community vulnerability and adaptive capacity, the MDBA commissioned analyses by MJA, RMCG et al. (2010), EBC, RMCG et al. (2011a), ABARE-BRS (2010d) and ABARES (forthcoming) which developed quantitative indicators of community sensitivity, adaptive capacity and vulnerability, drawing on data from the population census, and agricultural censuses and surveys.

- The MDBA also commissioned KPMG (2011) to undertake an independent review of the economic modelling. The review confirmed that the modelling represents the best available analysis, but suggested some areas for future improvement going forward.
Introduction

3.1 The Authority recognises that the Basin Plan may have significant impacts on some Basin communities. Many communities have expressed concerns deep expressed concerns about these potential impacts (refer to Box 1 on page 13). Community consultations have been critical for the Authority to gain a better understanding of the local, regional and sectoral level impacts. The MDBA has also assessed the impacts of the Basin Plan through multiple methods.

- Economic modelling has informed understanding of Basin scale and regional impacts, and the factors that affect these impacts at a regional level.

- Because macroeconomic modelling is not well suited to capturing impacts at a very localised scale, and may underestimate the cost of adjustment in the short term, the Authority also considered the impacts using 12 local government area (LGA) scale case studies across the Basin (Arche Consulting 2011). The Authority considers that this analysis provides an alternative view of the direct impacts on the agriculture sector. However, this type of analysis may also tend to overstate potential impacts because it does not capture the substitution of factor inputs, and cannot estimate the extent to which changes outside of the sector or area under consideration—for example, dynamic adjustment through substitution between other sectors of the economy, responses to changes in prices, and labour market adjustments—could assist in mitigating local impacts.

- Extensive community consultations were used to understand the potential impacts using first-hand experiences and knowledge, and to ground-truth data and analysis. Through the study by the EBC consortium (EBC, RMCG et al. 2011a), nearly 700 community representatives from 119 towns and regional centres were consulted. The Authority also considered the feedback from surveyed communities through the earlier study led by Marsden Jacob Associates (MJA, RMCG et al. 2010). These consultations helped identify flow-on social and economic effects on irrigation communities—including flow-on economic impacts (for example, associated with the supply chain, processing, freight and transport, and local businesses) and social impacts (for example, on social services and community well-being) (EBC, RMCG et al. 2011a; MJA, RMCG et al. 2010).

- Following the release of the Guide to the proposed Basin Plan, the MDBA asked for the views of the community and stakeholders about the proposals in the Guide. In the five months to the end of February 2011, the MDBA received feedback from over 3,100 individuals and organisations. The MDBA has considered this feedback in further preparing the Basin Plan.

- Assessments of community vulnerability informed the Authority’s assessment of impacts at a local level and incorporated, not just changes in the agricultural sector, but a range of social indicators about resilience, diversity and adaptive capacity to provide an

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10 Communities can be conceptualised in a range of ways. Refer to the section beginning on page 68 of this document.
indication of vulnerability (ABARE-BRS 2010d; ABARES forthcoming; EBC, RMCG et al. 2011a; MJA, RMCG et al. 2010).

- Through a report on the impacts of the Basin Plan on Indigenous communities (Jackson, Moggridge et al. 2010), the Authority considered the potential impacts of the Basin Plan on Indigenous rights, responsibilities and interests in the Basin’s water resources.

- The Authority also took into account the findings of a wide range of other studies and reports, undertaken or commissioned by organisations or individuals outside the MDBA. A selection of these studies and reports are summarised in Part B to this report. Part B also presents a bibliography of studies and reports considered by the MDBA.

3.2 These multiple methods were necessary because it is not possible to assess, through any single methodology, all of the definitive impacts of the Basin Plan. No one line of evidence can be considered exhaustive or definitive—yet collectively, they provide an indication of what local impacts may be expected, and an indication of the potential range of the impacts that communities could experience.

3.3 The Authority also acknowledges that several communities have commissioned their own work to assess how the Basin Plan might affect them (refer to Box 7).

**Economic modelling**

3.4 The MDBA commissioned a series of economic modelling studies to assess the impacts of the draft Basin Plan on agricultural production and other economic indicators, at a Basin and regional scale. These studies included work by ABARES, the Monash University Centre of Policy Studies, the University of Queensland and Arche Consulting.

3.5 Economic modelling studies have considered a range of scenarios with a focus on a 2800 GL water recovery volume, and sensitivity analyses of 2400 GL and 3200 GL scenarios. Consistency was ensured between the MDBA’s hydrological modelling and the economic modelling, and between the macroeconomic modelling, vulnerability analysis and the local scale analysis.

3.6 The methods used for the economic modelling are further detailed in the summaries of relevant reports in the document *Part B—Commissioned and non-commissioned reports which informed the MDBA’s socioeconomic analysis*.

3.7 The MDBA intends to continue to refine and improve its economic modelling as new knowledge becomes available, and expects that improved modelling will constitute a key input into the proposed 2015 review of the Basin Plan.

**Macroeconomic modelling process**

3.8 The macroeconomic modelling commissioned by the MDBA operates by imposing an external shock to a baseline and measuring the changes in economic variables for the agricultural sector and broader economy, taking into account the dynamic relationships between these variables. For the Basin Plan, economic modelling was used to estimate the impacts of a reduction in irrigation water availability on other variables in the economy, in either a static (single point in time) or dynamic (changing over time) state.
Box 7: Studies commissioned by communities to assess the local impacts of changes in water availability in the Basin

The Australian Government has committed $200 million under the Water for the Future initiative to establish the Strengthening Basin Communities program. Under the planning component of the program, grants are provided for local governments in the Murray–Darling Basin, to help them systematically assess the risks and implications associated with climate change, with a particular focus on water availability, and then to review existing plans or develop new plans to take account of these risks and implications. These projects include:

- A study commissioned by the Riverina and Murray Regional Organisation of Councils, which assessed impacts of a range of water availability scenarios, through land use and CGE modelling (Hyder Consulting 2011)
- A study by Narromine and Warren Shires on the impact of water reductions in the Lower Macquarie Valley (Psi Delta, forthcoming)
- A study by four Victorian shire councils (Moira Shire Council, Shire of Campaspe, Swan Hill Rural City Council and the Mildura City Council) of the potential impacts of the Basin Plan and climate related water availability (Psi Delta 2011)
- A study of the likely impact of reductions in water availability on irrigators in the Lachlan Valley (Western Research Institute 2011)
- A series of studies prepared as part of a science review of the implications for South Australia of the Guide to the proposed Basin Plan (Connor 2011; Connor, Banerjee et al. 2011)
- A study by eleven South Australian Councils to plan for an uncertain climate future, with a particular focus on water availability (SAMDBNRMB 2011).

The Authority also recognises that some industry groups have also commissioned studies to assess the impacts of the Basin Plan. For example, one study for the Cotton CRC considered changes in production and employment as a consequence of the Basin Plan (Judith Stubbs and Associates 2010a; b), and estimated that the Basin Plan (assuming it reduces water availability by 25 per cent) would result in the loss of 14,000 jobs across the Basin and annual production losses of $1.4 billion. These estimates are an order of magnitude larger than indicated in modelling commissioned by the MDBA.

The MDBA notes that the methodologies used by some of these other studies are relatively simple and do not involve sophisticated economic modelling or account for the dynamic nature of the economy. They may estimate employment or production losses based implicitly on assumptions that water and land are only used in specific proportions, that water and other factor inputs do not respond to price signals, that a job loss cannot be regained elsewhere, that assets cannot be redeployed, that the full reduction in water availability will occur at a single point in time, or ignoring the significant offsetting effects of the Australian Government’s Water for the Future programs.

Importantly, many of these studies were undertaken before the Guide to the proposed Basin Plan was released and based on anticipated reductions in water availability at levels that are significantly higher than the range proposed in the draft Basin Plan. While there is much useful information in many of these reports, the estimates of reported impacts need to be considered alongside their underlying assumptions and treated with caution.
3.9 The MDBA commissioned macroeconomic modelling from three economic modelling approaches:

- the ABARES Water Trade Model (partial equilibrium) and ABARES AusRegion model (computable general equilibrium)
- the Monash University Centre for Policy Studies TERM-H20 model (computable general equilibrium) (Wittwer 2011a)
- the University of Queensland Risk and Sustainable Management Group Water Allocation Model (optimisation) (Adamson, Quiggin et al. 2011).

3.10 Using these economic models, the MDBA received estimates of changes in irrigated agricultural production, total agricultural production, land use, water use, profit, gross regional product, gross domestic product and employment.

3.11 By using different models, the MDBA was able to test whether the models might be misspecified and to explore how different assumptions affected the results. Importantly, the exercises produced largely similar results, even though there is significant variation in the structure of each model. This convergence provides a degree of confidence in the modelled outcomes, subject to standard limitations about this type of analysis.

**Scenarios**

3.12 The MDBA requested that each modeller estimate the impact of a 2,800 GL water recovery scenario, with sensitivity analysis for 2,400 GL and 3,200 GL water recovery scenarios also undertaken by ABARES (ABARES 2011d) and Monash University (Wittwer 2011a).

3.13 In order to understand better the impacts of different elements of the Basin Plan, the MDBA requested that the scenarios were modelled both including and excluding the elements of the Australian Government’s Water for the Future initiative. This initiative includes $3.1 billion for the Australian Government’s voluntary buyback program and $4.8 billion for infrastructure investment in the Murray–Darling Basin. The scenarios modelled are outlined in Table 5.

3.14 This combination of modelling scenarios effectively means that nine water availability scenarios were modelled. In addition, the MDBA requested that ABARES undertake sensitivity analysis on the impacts of updated commodity prices and changes in water supply variability under the draft Basin Plan.
Table 5: Economic modelling scenarios

<table>
<thead>
<tr>
<th>Scenario 1: Without Commonwealth investment in water saving infrastructure (SDLs no infra). This scenario assumes all water that is to be recovered occurs through the buyback process.</th>
<th>2,400 GL</th>
<th>2,800 GL</th>
<th>3,200 GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABARES</td>
<td>ABARES</td>
<td>ABARES</td>
<td></td>
</tr>
<tr>
<td>Monash University</td>
<td>Monash University</td>
<td>University of Queensland</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 2: With Commonwealth investment in water saving infrastructure (SDLs with infra). This scenario reduces the amount that is to be recovered through the buyback process by including the offsetting water savings achieved through government infrastructure investments via the Commonwealth’s Water for the Future initiative.</th>
<th>2,400 GL</th>
<th>2,800 GL</th>
<th>3,200 GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABARES</td>
<td>ABARES</td>
<td>ABARES</td>
<td></td>
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<tr>
<td>Monash University</td>
<td>Monash University</td>
<td>Monash University</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scenario 3: With Commonwealth investment in water saving infrastructure, after accounting for water entitlement buybacks to date (SDLs with infra, after buybacks to date). This scenario reflects the expected future reduction in water supply remaining, after the progress that has already been made through the buyback and infrastructure investment programs to date is taken into account.</th>
<th>2,400 GL</th>
<th>2,800 GL</th>
<th>3,200 GL</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABARES</td>
<td>ABARES</td>
<td>ABARES</td>
<td></td>
</tr>
</tbody>
</table>

Uses and limitations of economic modelling

3.15 It is important to recognise the scope and limitations of the economic modelling used for this exercise when interpreting modelling results.

- The modelling is not a forecasting tool, and it does not predict actual outcomes. It is best used in conjunction with a range of other policy tools to provide a greater understanding of the likely consequences of a change in policy, and how different policy options or assumptions may affect outcomes.

- The models operate by measuring the consequences of changing a specific variable, holding all other changes constant. Through this approach, it is possible to estimate the effect attributable to the change of that specific variable. In practice, they are unable to take into account the infinite number of linkages and relationships that will exist in reality.

- Economic models are driven by assumptions on the structural relationships between economic variables, and on the data used to calibrate the models. To the extent that these relationships are misspecified, or the data sets are not a good representation, the models will give less accurate results.
• The modelling does not predict any single individual decision. For example, the modelling estimates which areas of the Basin are more likely to use less water, but cannot actually predict which farmers, towns or regions will choose to do so.

• Economic modelling tends not to be well-suited to capturing intangible effects that can also impact on economic outcomes, such as consumer confidence, herd behaviour, community resilience, and irrational decision making.

3.16 Some of the major assumptions in respect of modelling the costs of the draft Basin Plan are shown in Table 6, together with an indication of the likely effect.

3.17 On balance, the MDBA considers that, after taking the factors listed in Table 6 into account, there is potential for the modelling to understate moderately the likely short-term impacts of implementing the Basin Plan, but that the long-term Basin-scale impacts are likely to be indicative of the broad impacts if the assumptions prove to be robust.

3.18 The Authority has taken a long-term perspective in determining sustainable allocations of water between environmental, social and economic purposes, but has been concerned to give sufficient consideration to adjustment paths and possible shorter-term impacts.

3.19 The limitations and assumptions inherent in the models are discussed in more detail in the summaries presented in Part B to this report (Commissioned and non-commissioned reports which informed the MDBA’s socioeconomic analysis).
Table 6: Economic modelling assumptions and limitations

<table>
<thead>
<tr>
<th>Assumption or limitation</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not incorporate productivity/technology improvements</td>
<td>Modelling likely to overstate the extent of impacts by underestimating the capacity of community to adjust</td>
</tr>
<tr>
<td>Towns in each catchment are homogeneous</td>
<td>Modelling market outcomes at catchment scale does not distinguish between how the Basin Plan may affect towns in the same catchment differently</td>
</tr>
<tr>
<td>Assignment of Water for the Future expenditures not yet finalised</td>
<td>May understate or overstate the impacts on particular towns because the assignment of expenditures is not yet finalised</td>
</tr>
<tr>
<td>Assumes labour adjustment costs are small</td>
<td>Modelling may understate the short-term impacts of changes to employment</td>
</tr>
<tr>
<td>Assumes capital adjustment costs are small</td>
<td>Modelling may understate the short-term impacts through overestimating the ability of the agricultural sector to adjust, including the ability to access capital to adjust</td>
</tr>
<tr>
<td>No threshold effects</td>
<td>Modelling may not capture where a series of small adjustments have a more significant threshold impact on a community or industry sector</td>
</tr>
<tr>
<td>Assumes certainty/foresight in decision making</td>
<td>Modelling may underestimate the social and economic effects of uncertainty on communities</td>
</tr>
<tr>
<td>Relies on past data for establishing baseline (e.g. 2005–06 Census data) parameterisation.</td>
<td>Modelling may not be using an ideal baseline of the Basin conditions (e.g. levels of rainfall and water prices, commodity prices, exchange rates) and this could overstate or understate the impacts</td>
</tr>
<tr>
<td>Cannot incorporate consumer behaviour and confidence effects</td>
<td>Modelling may underestimate the potential for negative consumer sentiment and confidence to lead to greater social and economic costs</td>
</tr>
<tr>
<td>Assumes future climate conditions will be broadly similar to past conditions (i.e. similar ‘dry’, ‘wet’ and ‘normal’ years)</td>
<td>Modelling may underestimate impacts if climate conditions turn out to be more extreme in the near future</td>
</tr>
<tr>
<td>Models water use, so does not account for differences in security/reliability between classes of water entitlement, or distinguish between allocations and entitlements.</td>
<td>Modelling may not adequately capture regional variations as a consequence of different classes of entitlement.</td>
</tr>
</tbody>
</table>

How the modelling has improved since the *Guide to the proposed Basin Plan*

**Modelling enhancements**

3.20 The MDBA has been working with the modellers, with input from industry experts, academics and bureaucrats, to refine the inputs and assumptions since the *Guide to the proposed Basin Plan* was released. Some of the key modelling enhancements include:
• a more detailed consideration of water supply variability—for example, given the climate of the Basin is inherently variable, how implementation of the SDLs might affect irrigators across a variety of water availability levels (e.g. in ‘good’, ‘dry’ and ‘very dry’ years)

• converting changes in water diversions to changes in irrigation use—irrigation use is only one component of total water diversions, but as there are limited opportunities to reduce other water uses, the percentage changes in irrigation water use are likely to be greater than percentage changes in water course diversions

• various refinements to the baseline data—in particular, the baseline irrigation water use now accounts for pre–Basin Plan environmental water recovery, including The Living Murray

• testing assumptions and baseline data with Commonwealth and State agencies, academics and industry experts

• a focus on both short- and long-run employment effects under a range of scenarios

• taking into account the effects of other government policies—specifically Water for the Future, incorporating assumptions on water entitlement purchases and infrastructure investment by governments.

Enhancements not yet implemented

3.21 While the approach to the modelling has been improved substantially since the Guide to the proposed Basin Plan, there is still a need for further enhancements to improve the science available for the 2015 review. Key areas for enhancement include:

• working with environmental water managers to model likely environmental watering plans—and exploring the opportunities to optimise the social, economic and environmental outcomes of those plans—and the likely portfolio balances of low security and high security water entitlements

• an improved understanding of the capacity for farmers to substitute current forms of irrigated production with either more efficient forms of irrigated production or alternative forms of dryland production

• an improved understanding and modelling of the interconnections between the agriculture sector and other sectors of the economy—in particular, possible threshold effects that could affect business decisions in upstream and downstream sectors

• incorporating the 2011 Census data into the modelling—there are concerns that the 2006 Census is not an ideal baseline, given the worst effects of the recent drought occurred subsequently and that the structure of irrigated agriculture has changed substantially in response to significant changes in commodity prices and other external factors.
Estimated direct farm impacts

3.22 The Authority also considered estimates of the direct impacts at a local scale, using 12 case studies of local government areas (LGAs), in recognition of the potential limitations associated with macroeconomic modelling (Arche Consulting 2011). The 12 case studies were selected on the basis of their high dependence on agriculture, and an expectation that they could potentially bear more substantial impacts than other areas of the Basin as a result of the Basin Plan. They also provided variety in terms of population size, geographic distribution, and dominant agricultural product.

3.23 The LGAs selected were: Moree, Narromine, Leeton, Greater Shepparton, Berri-Barmera, Balonne; Griffith; Murrumbidgee (Coleambally); Murray (Deniliquin); Gannawarra (Kerang); Mildura; and Murray Bridge.

3.24 For each case study area, Arche Consulting used information about the local enterprise area and mix, gross margins, employment levels, the values of irrigated and non-irrigated agricultural production, and regional profit to establish a baseline.

3.25 Changes in the availability of water for irrigation as a result of the Basin Plan were then imposed, drawing from the results of the ABARES economic modelling, with the relevant CSIRO Sustainable Yield Regions from the ABARES modelling matched to the applicable local government areas.

3.26 The direct impacts on the gross value of irrigated agricultural production, dryland production and agricultural employment, and flow-on impacts in other sectors of the local economy were then estimated using standard multiplier analysis.

- For each community, an assumption was made about the dominant crop that could be expected to bear the majority of the water reductions and a suitable dryland substitute (if any) that could likely replace it.

3.27 This analysis is the first part of a more comprehensive analysis of the potential impacts of the Basin Plan on the 12 case studies that is being conducted jointly by the MDBA and the Department of Sustainability, Environment, Water, Population and Communities, which is expected to be completed shortly in the near future.

Assessments of community impacts

3.28 Communities can be conceptualised in a range of ways. For example, they can be considered in terms of communities of place (people living in a given geographical area); communities of interest (people who share a common interest, such as an industry); or communities of identity (for example, the Indigenous community) (ABARE-BRS 2010d). Many experts have argued that a more meaningful unit of analysis is the 'social catchment', which describes communities with a distinct identity and coherence, and cuts across the concepts of place, interest and identity (Brunckhorst and Reeve 2006; Fenton, Coakes et al. 2003; Hugo, Smailes et al. 2001).

3.29 In assessing the local impacts of the Basin Plan, the MDBA considered communities from all of the above perspectives.
• Assessments of community vulnerability (ABARE-BRS 2010d) focused on communities of place, reflecting the data sources used.

• Economic analyses of impacts on industries implicitly focused on communities of interest.

• Assessments of the implications of the Basin Plan for Indigenous persons focused on communities of identity.
Figure 20: Social catchments used in EBC, RMCG et al. (2011a)
3.30 The MDBA’s major study of community impacts in respect of the *Guide to the proposed Basin Plan* (EBC, RMCG *et al.* 2011a) used a ‘social catchment’ methodology, whereby the Murray–Darling Basin was divided into 48 social catchments (refer to Figure 20).

Assessments of community vulnerability

3.31 To assess how communities will be affected by the Basin Plan, the Authority considered four factors which contribute to community vulnerability:\(^1\)

- sensitivity, which is a measure of how dependent a community is on the factor that is changing—in the case of the Basin Plan, to changes in water availability and any consequent changes in agricultural sector employment
- exposure, being the degree to which communities are affected by an external stress—in the case of the Basin Plan, to reductions in water availability brought about by the Basin Plan
- potential impact, or the consequences of a change, made up of a combination of exposure and sensitivity
- adaptive capacity, this being the inherent capacity of a community to manage or cope with change, and which may mitigate the potential impact on a community.

3.32 The vulnerability of a community reflects the residual effects of an exposure event after coping and adaptation strategies have been implemented. Communities that are less vulnerable to shocks are often described as resilient—that is, their adaptive capacity enables them to minimise the social and economic damage that might result from potential impacts (ABARE-BRS 2010d; Burnside 2007; Ellis 2000; MJA, RMCG *et al.* 2010; Nelson, Kokic *et al.* 2005; Yohe and Tol 2002). This relationship is illustrated graphically in Figure 21.

![Figure 21: Relationship between exposure, sensitivity, adaptive capacity and vulnerability](source: ABARE-BRS (2010d), drawing on Allen Consulting (2005))

3.33 It needs to be emphasised that vulnerability in itself is not an indicator or predictor of a pessimistic future for communities. The changes that occur could be positive or negative,

\(^1\) The MDBA’s methodology drew on work by experts in the areas of vulnerability and adaptive capacity assessment (Fay, Block *et al.* 2009; Herreria, Byron *et al.* 2008; Maguire and Cartwright 2008; Nelson, Kokic *et al.* 2010; Preston and Stafford-Smith 2009; Smit and Wandel 2006).
and will be largely dependent on how the communities themselves respond and what policies are implemented.

Sensitivity

3.34 Communities will be more sensitive to reductions in water if they are more reliant on irrigation water or dependent on associated agricultural and processing employment.

3.35 A 2010 study commissioned by the MDBA (MJA, RMCG et al. 2010) identified four key indicators of farm and farm sector sensitivity, which may make farmers, or farm sectors, more sensitive to changes in water availability:

- the level of dependence on irrigation water of the farm or farm sector
- the level of financial stress (particularly indebtedness) of the farm or farm sector
- the level of personal wellbeing and optimism of the farm or farm sector
- the proportion of middle-aged farmers in the farm or farm sector.

3.36 As the work by MJA, RMCG et al. (2010) was undertaken prior to release of the Guide to the proposed Basin Plan, the study did not take into account the proposed SDLs—rather, it was predicated on notional water recovery scenarios of 20, 40 and 60 per cent—nor did it take into account the financial compensation that would be provided to sellers of entitlements through the government’s water buyback policy.

3.37 The MDBA also commissioned work by ABARE-BRS (2010d) to assess the sensitivity of communities to reductions in water availability, by developing an index which takes into account the extent to which communities are dependent on irrigated agriculture, and employed in agriculture and associated industries. This work drew on data from the 2006 population census and ABS surveys of agricultural water use (ABS 2008e).

Exposure

3.38 Some Basin communities will be more exposed to reductions in water availability as a result of the Basin Plan. The change in water availability for specific communities, regions and industries will, in part, reflect the water recovery scenario proposed for the relevant catchment. Changes in water availability will also be driven by water trade, and associated movement of water between different users. The quantum and extent of this trade will be influenced by commodity prices and by the extent to which there is physical connectivity (or constraints) between catchments.

3.39 For this analysis, a measure of exposure of different communities to the Basin Plan was constructed using estimates of changes in water availability derived from the ABARES Water Trade Model. The Water Trade Model estimated changes in water availability for Basin Plan regions, taking into account specific assumptions with regard to patterns of water use and commodity prices.

3.40 Exposure to the Basin Plan will be low in catchments where there have already been significant reductions and minimal further reductions are required. Exposure will be higher in catchments where there are large proposed reductions in in-catchment SDLs, or where
water trade will result in large amounts of water leaving that catchment to meet downstream requirements.

**Adaptive capacity**

3.41 Some communities have greater capacity than others to adapt to change. Previous studies have found that adaptive capacity is positively related to the resources available to the community, commonly described as various forms of capital—the so-called ‘five capitals’, namely built, human, natural, social or financial capital (Burnside 2007; Ellis 2000; Nelson, Kokic et al. 2005; Yohe and Tol 2002). Communities appear to have greater adaptive capacity where they have a greater amount and diversity of these stocks of capital. It is also desirable that capital be mobile, which increases the flexibility with which it can be applied to new or alternative ends. For example, communities with greater labour mobility have a higher degree of adaptive capacity.

3.42 Capital stocks are a function of recent and past history. Hence, communities which have enjoyed prosperity should have greater capital stocks, and communities which have recently suffered (for example, from drought) have lower stocks of capital—manifested, for example, by higher debt levels, smaller populations, and a shortage of skilled workers.

3.43 To quantitatively assess community adaptive capacity, ABARES (forthcoming) developed an index which takes into account measures such as income, education levels, age structure, mobility, housing and economic diversity, and volunteering rates. These indicators represent proxy measures for local economic diversity, human capital, and social capital. Using these measures, some communities are estimated to have lower adaptive capacity than others. In particular, communities with lower levels of economic diversity, lower levels of education, or which are relatively remote, generally have lower levels of adaptive capacity. Financial capacity is also a particularly important factor in determining a community’s adaptive capacity.

**Vulnerability**

3.44 By synthesising the findings of its analysis of sensitivity, exposure and adaptive capacity, ABARES (forthcoming) identified which communities in the Basin may be relatively more vulnerable to changes in water availability.

3.45 They presented this relative vulnerability as a composite index made up of data from a range of sources at different scales, including catchment level, regional level, statistical local area (SLA) level and Census District (CD) level.

3.46 As vulnerability is a summary indicator, in order to understand the factors contributing to the index, it is necessary to look at the potential impact and adaptive capacity sub-indices and their contributing indicators.

3.47 The EBC Consortium (2011a) also identified communities that are most likely to be vulnerable to the Basin Plan. They proposed that vulnerable communities could be identified on the basis of four ‘risk factors’:

- size: smaller communities are at greater risk than larger ones; a population figure of 10,000 is a threshold for resilience, with higher risks in populations of less than 2,000 people
diversity: social catchments with greater economic diversity tend to be more resilient to change

dependence: communities that are more highly dependent on agriculture (if more than 15 per cent of the population is employed in agriculture or directly related sectors) are more exposed

location: communities towards the eastern edge of the Basin, closer to major population centres, are more robust than more westerly communities in Victoria, Queensland or NSW.

Limitations of quantitative measures of community vulnerability

3.48 It is important to recognise the limitations of quantitative indices of sensitivity, adaptive capacity and vulnerability. Such indices are an indicative tool, not a definitive or predictive measure. They are based on socio-economic and water use data for a single point in time. Moreover, it is simply not possible to quantify all aspects of sensitivity, adaptive capacity or vulnerability. Quantitative indices draw only on data that can be readily quantified, and do not take into account other social or economic characteristics which may be important. For example:

- a community may have particularly capable leaders, with the ability to mobilise groups who can develop alternative industries or training programs that will enable a community to adjust—such factors cannot be reflected in quantitative indices

- community sentiment, outlook and optimism are important, but not reflected in quantitative indices

- adaptive capacity is influenced by individual businesses and industries and their capacity to modify their operations (for example, to embrace new technologies) in light of change—again, not captured in the quantitative indices.

3.49 As there are limitations with the method, the intention is to provide a starting point to guide further analysis. The relative vulnerability score of a region should not be viewed in isolation. It is important to understand the elements of the sensitivity and adaptive capacity indexes that are most influential in determining the relative vulnerability score. It is also important to understand that the indexes are relative—the scores are a ranking and so the difference between scores do not indicate the magnitude of difference between the scores.

3.50 Above all, the indices developed by ABARES (forthcoming), EBC, RMCG et al. (2011a) and MJA, RMCG et al. (2010) should not be seen as predictors of social outcomes following a shock or change but rather ‘short hand’ descriptors of some of the characteristics of communities or regions, which may be material to how easily a community can adapt to change.

3.51 Where appropriate, the MDBA has ensured consistency between the assumptions used in its economic modelling and analysis of community vulnerability, including where improvements have been made since the Guide to the proposed Basin Plan. The Authority has used the findings from both the economic modelling and the community vulnerability analysis to inform its assessment of the impacts of the Basin Plan.
Chapter 4: Basin-scale impacts

Key points

- While the Basin Plan sets the overall level of water recovery required to rebalance the environment’s share of water resources, governments are responsible for determining how this water recovery occurs.

- The social and economic impacts of achieving the SDLs set out in the draft Basin Plan will be influenced, in particular, by:
  - the structure of the Commonwealth’s Water for the Future program—specifically the balance between: purchases of water entitlements (which reduce the amount of water available for economic purposes), offset by the impact of infrastructure investments (which generate water savings from more efficient water use, and these savings are shared between irrigators and the Commonwealth)
  - the implementation by the States of their environmental watering plans
  - how the Commonwealth manages its environmental water entitlements in respect of those watering plans and over variable climatic conditions.

- The MDBA has examined numerous scenarios and found that, overall, the macroeconomic costs of the Basin Plan will be small—much smaller, proportionally, than the corresponding reductions in water availability.
  - At the Basin scale, the Basin Plan is estimated to reduce gross regional product by less than 1 per cent. This reduction in the value of Basin production will be more than offset by underlying economic growth, with the size of the economy estimated to be significantly higher in 2019-20 than in 2011-12 even taking the Basin Plan into account.
  - The total value of irrigated agricultural production in the Basin is estimated to be reduced by 9.0 per cent (after accounting for water savings from infrastructure investment under the Water for the Future program). When considering the proportion of water that has already been recovered, the estimated reduction remaining is 5.0 per cent.

- The modelling also estimates that economic impacts will be more significant in some regions and sectors.
  - Local impacts can be predicted with more certainty in unconnected catchments and in catchments where most of the water required has already been recovered.
  - However, the precise location and magnitude of local impacts will ultimately be determined by patterns of water trading, which will in turn be influenced by commodity prices, exchange rates, lifestyle and business decisions, and a host of other factors, including confidence effects, many of which cannot be estimated with any precision.

- While at an aggregate level the longer-term social and economic implications of the Basin Plan are likely to be small, the Authority recognises that, in the short-term and at the local level, some communities face significantly more adjustment, particularly if they are small, remote, heavily reliant on irrigation, have limited alternatives to diversify, or are already struggling due to financial pressures or long-term demographic changes.

Policy influences on estimating the impacts

4.1 While the Basin Plan sets the overall level of water recovery required to rebalance the environment’s share of water resources, the governments of the Commonwealth and the
Basin states are responsible for determining how this level of water recovery occurs and they are also responsible for other policy settings which will influence the precise nature of the social and economic impacts.

4.2 In particular, the social and economic impacts of achieving the SDLs set out in the draft Basin Plan will be influenced by three key policy settings:

- the structure of the Commonwealth’s Water for the Future program, and specifically the balance between:
  - purchases of water entitlements (which reduce the amount of water available for economic purposes);
  - offset by the impact of infrastructure investments (which generate water savings from more efficient water use, and these savings are shared between irrigators and the Commonwealth);
- the implementation by the States of environmental watering plans that will be accredited under the Basin Plan; and
- how the Commonwealth manages its environmental water entitlements in respect of those watering plans and over variable climatic conditions.

4.3 The modelling incorporates the current structure of the Water for the Future program and updated parameters from the Department of Sustainability, Environment, Water, Population and Communities. Many of the other policy settings (e.g. state environmental watering plans) are yet to be determined. Consequently, the modelling assumes that economic impacts are determined according to the flow regimes underpinning the MDBA’s setting of the long-term average SDLs and, implicitly, that state watering plans and the behaviour of Commonwealth and state environmental water managers are consistent with those flow regimes.

**Impacts on total production in the Basin**

4.4 Gross regional product (GRP) is the value of goods and services produced for a particular region of Australia. In 2010–11, GRP for the Murray–Darling Basin was $63.8 billion. The Basin economy is still expected to continue to grow under the Basin Plan, but the economy is estimated to be slightly smaller than would be the case without the Basin Plan (refer to Figure 22).

4.5 ABARES modelling estimates that GRP for the Basin will be 0.81 per cent lower in 2018–19 than without the Basin Plan (ABARES 2011d). Monash University estimates a slightly smaller reduction, of 0.05 per cent in 2020 (Wittwer 2011a).

4.6 These reductions are relatively small overall when compared with the scale of change required to implement the sustainable diversion limits, because of the wide range of other sectors other than agriculture that make up the Basin economy, and the models’ assumptions about the ability of farmers and other sectors to adjust and redeploy resources in response to reductions in water availability for consumptive purposes. These estimates represent the aggregate impact of the Basin Plan for the Basin as a whole.
The relatively small macroeconomic impact estimated by the modelling can seem counter-intuitive to the expectations of communities, but is more obvious when broken down into its parts:

- The Basin produces a huge and varied range of goods and services. Agriculture makes up 15 per cent of total production in the Basin and irrigated agriculture makes up no more than 40 per cent of total agriculture, or approximately 6 per cent of total Basin production.

- Irrigated production accounts for 2 per cent of agricultural land use in the Basin (ABARE-BRS 2010c:1) and for every hectare of irrigated land, there are more than 40 hectares of dryland farming (Wittwer 2011b:290).

- If the Basin Plan is estimated to reduce the value of irrigated agricultural production by around 10 per cent, this translates to a reduction in total Basin production of less than 1 per cent.

The Authority considers that, in the context of a growing Basin economy, a one per cent reduction in the value of total Basin production, spread over the period to 2019, is a scale of change that Basin communities in aggregate will be able to adjust to.

In addition to estimating a relatively small impact on gross regional product, the economic modelling suggests that effects on household consumption will be small; ABARES estimates a slightly negative impact while Monash University estimates a slightly positive impact.

While percentage reductions in irrigated production are estimated to be larger than the percentage reductions in total Basin production. They are still expected to be smaller than the corresponding reductions in water availability for irrigation, because water is only one input into the production process.
4.11 In the long run, the modelling estimates that the Basin Plan will have relatively small impacts on employment as well, although estimates could be much higher in the short term. The short term employment estimates are discussed in more detail later in this chapter.

Table 7: Key long run economic impacts, 2,800GL water recovery scenario less water savings from Water for the Future infrastructure investments \(^{(a)(b)}\)

<table>
<thead>
<tr>
<th></th>
<th>ABARES</th>
<th>Monash 2019–20</th>
<th>UQ</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Basin irrigated agriculture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water use</td>
<td>-18.84</td>
<td>-21.00</td>
<td>-23.00</td>
</tr>
<tr>
<td>GVIAP</td>
<td>-8.97</td>
<td>-5.00</td>
<td>-11.00</td>
</tr>
<tr>
<td>Profit</td>
<td>-5.59</td>
<td>-</td>
<td>-10.00</td>
</tr>
<tr>
<td><strong>Basin total agriculture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GVAP</td>
<td>-3.09</td>
<td>-4.2</td>
<td></td>
</tr>
<tr>
<td><strong>Basin macroeconomic indicators</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GRP</td>
<td>-0.81</td>
<td>-0.05</td>
<td>-</td>
</tr>
<tr>
<td>Household consumption</td>
<td>-0.28</td>
<td>0.42</td>
<td>-</td>
</tr>
<tr>
<td>Investment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employment</td>
<td>-0.03</td>
<td>0.23</td>
<td>-</td>
</tr>
</tbody>
</table>

(a)All results are presented after the impacts of water trade. More information on the implications of water trade for the modelling is presented in (ABARES 2011d).

(b) Results from University of Queensland are not directly comparable as this scenario excludes infrastructure investments.

Impacts on agricultural production\(^{12}\)

4.12 ABARES economic modelling estimates that the gross value of irrigated agricultural production (GVIAP) will be reduced in the long run by 9.0 per cent or $542 million across the whole Basin, with a 10.9 per cent ($425 million) reduction in the southern Basin and 5.5 per cent ($117 million) reduction in the northern Basin. This includes the offsetting impacts of water savings from infrastructure investment under the Water for the Future program.

4.13 In comparison:

- Monash University estimates irrigated production to contract by 5.0 per cent ($265 million) for the total Basin in 2020, with a 1.3 per cent reduction in the northern Basin and a 4.8 per cent reduction in the southern Basin (Wittwer 2011a).

\(^{12}\) All results are presented after the impacts of water trade. More information on the implications of water trade for the modelling is presented in (ABARES 2011d).
University of Queensland estimates GVIAP to contract by 11 per cent or $1.1 billion for the total Basin, although this estimate does not include the offsetting impacts of the Water for the Future programs (Adamson, Quiggin et al. 2011).

4.14 As irrigated agricultural production accounts for less than half of total agricultural production, the percentage reduction in total agricultural production will be smaller than for irrigated agricultural production. Further, decreases in irrigated production may be offset by some increases in dryland production.

4.15 ABARES (2011d) estimates that the reduction in the gross value of total agricultural production (GVAP) will be 3.1 per cent or $498.2 million, including the offsetting impacts of water savings from infrastructure investment under the Water for the Future program. The offsetting contribution from an increase in dryland agricultural production is estimated to be 0.8 per cent of GVIAP, or $48.8 million, which will partially offset the reductions in GVIAP.

In comparison, Monash University estimates that total agricultural production would decrease by ($92.2 million). Monash University estimates a larger expansion of dryland production than ABARES, which will help to minimise the overall reduction in total agricultural production, estimating an increase in dryland production increase of 2.0 per cent ($173.3 million).

Sectoral impacts

4.16 Sectoral production impacts are likely to be highly influenced by changes in the relative prices of commodities. As different areas of the Basin tend to have a dominant sector, changes in relative commodity prices will also tend to move the demand for water across the Basin accordingly.

4.17 Different types of production also affect GVIAP in different ways, with the key drivers in producer decision making being the price of water and intensity in water use—as indicated by the gross profit margin per unit of water applied—and whether the activity is annual (low level of fixed costs, e.g. rice) or perennial (higher level of fixed costs, e.g. grape vines).

4.18 Of these factors, gross profit margins are determined by prices received for the commodity produced, the price of water per megalitre, and the yield per megalitre of water applied. The complex interplay between these determinants of gross profit plays the key role in determining what production occurs, with business decisions typically taken based on a seasonal outlook—refer to Box 8.

4.19 However, where significant fixed costs occur, such as with permanent plantings of grapes or fruit trees, these costs have a major bearing on net profit results and long-term business decisions, and producers may rationally bear significant short-term losses if the long-term outlook is favourable. These business decisions in the presence of significant fixed costs are much more difficult to incorporate into modelling than decisions based on changes in gross profit margins—refer to Box 9.
Box 8: The importance of commodity prices in determining outcomes

Relative changes in the prices of key irrigated agricultural commodities will influence the demand for water across the Basin. Given the strong connections between most of the key irrigated agricultural commodities and international markets, commodity prices tend to be determined by factors outside of Australia. As such, changes in the domestic production of agricultural commodities are expected to have minimal implications for commodity prices in the Basin, particularly where there is a significant international trade in a commodity and where Australian production is a relatively small proportion of total world production.

In practice, many annual cropping activities may respond quite quickly to seasonal fluctuations in prices, while other activities, such as perennial horticulture, will be slower to adjust and will be driven more by long-run expectations of future prices. As illustrated in Figure 23 and Figure 24, a number of commodities, including wheat, hay and dairy, experienced a peak in prices in 2007–08. Rice also experienced a price spike, but production levels were very low over this period and prices were influenced by producer subsidies. Prices have since moderated. In the case of grapes, there has been a significant price decline since 2001–02.

To examine the effect of average relative changes in commodity prices over the period, ABARES undertook sensitivity analysis to compare estimates based on 2005–06 commodity prices with average prices in the period since 2005–06.

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**Figure 23: Index of agricultural commodity prices, 2001-02 to 2010-11**

* although rice prices peaked in 2008-09, production levels were low due to climate conditions in the Basin

**Figure 24: Average change in relative commodity prices since 2005-06**

Source: ABARES (2011d)

Sources: ABARE-BRS (2010c) and ABARES (2011d)
Box 9: The importance of fixed costs in determining outcomes

Many annual cropping activities respond to annual fluctuations in prices, while other activities, particularly perennial horticulture (but also dairy), will be slower to adjust and be driven more by long-run expectations of future prices.

The substantial reduction since 2005–06 in the prices received for some horticulture products, particularly grapes, relative to other types of agriculture in the Basin is likely to have resulted in some land use adjustment. In the short run, horticulturalists will continue to produce even if the prices they receive result in low levels of profitability. We saw this during the recent drought, when large volumes of water shifted from rice production to grape vines, even though prices for rice were high and prices for grapes were very low. But if horticulturalist’s expectations are for continuing low commodity prices in the long run, insufficient to cover their long-run costs of capital, they will tend to exit production. Evidence of this trend will be of key importance to incorporate into the modelling once the 2011 agriculture census data is available.

In order to illustrate the implications of this effect, ABARES modelled a scenario in which it was assumed that there would be a 20 per cent reduction in land use for perennial horticulture. The results indicate that, when compared with no constraints on land use, the effect on GVIAP was significant—an additional 4 per cent in GVIAP in the southern Basin, where most perennial horticulture occurs.

Table 8: Sensitivity analysis of impact of change in perennial horticulture

<table>
<thead>
<tr>
<th>per cent</th>
<th>SDLs</th>
<th>20% reduction in perennial land use</th>
<th>Difference (percentage points)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Southern Basin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GVIAP</td>
<td>-15.5</td>
<td>-19.9</td>
<td>-4.4</td>
</tr>
<tr>
<td>Land use</td>
<td>-28.2</td>
<td>-28.7</td>
<td>-0.5</td>
</tr>
<tr>
<td>Water use</td>
<td>-33.9</td>
<td>-33.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Profit</td>
<td>-11.7</td>
<td>-12.4</td>
<td>-0.7</td>
</tr>
<tr>
<td><strong>Northern Basin</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GVIAP</td>
<td>-9.7</td>
<td>-10.9</td>
<td>-1.2</td>
</tr>
<tr>
<td>Land use</td>
<td>-10.8</td>
<td>-11.2</td>
<td>-0.4</td>
</tr>
<tr>
<td>Water use</td>
<td>-14.9</td>
<td>-14.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Profit</td>
<td>-4.0</td>
<td>-4.4</td>
<td>-0.4</td>
</tr>
</tbody>
</table>

Source: ABARES (2011d)

4.20 The modelling also illustrates the inherent difficulties in estimating the regional and local impacts of the Basin Plan, because water trade and future commodity prices will influence where the greatest impacts are likely to occur. However, the modelling indicates that allowing water to flow to its highest value use through trade reduces the size of the
impacts for the Basin as a whole—reductions in GVIAP are estimated to be 2.3 per cent lower because of trade (ABARES 2011d).

4.21 The ABARES modelling primarily used 2005–06 baseline data and commodity price information, as these constitute the most comprehensive and complete data set until the results of the 2011 agricultural census become available.

4.22 In recognition that these data do not necessarily reflect current conditions, or indeed conditions up until 2019 and beyond, the MDBA requested ABARES to undertake a sensitivity analysis to assess the effects of updated commodity prices. The analysis uses the average changes in prices from 2006–07 to 2011–12, referred to as ‘updated commodity prices’ in Figure 25 and Figure 26. During this period, rice, hay and cereals have had relatively higher average prices than in 2005–06, while fruit and nuts, grapes and meat cattle have had relatively lower prices—refer to Box 8.

4.23 Marked differences in water movements are evident when comparing changes in water use by sector under a pre water trade scenario (which reflects the initial reductions in water availability under the Basin Plan), a post water trade scenario (which reflects estimated trading patterns under the Basin Plan), and updated commodity prices scenario (which reflects changes in the relative prices of agricultural commodities between 2006–07 and 2011–12).

4.24 Proportional changes in irrigated agricultural production will be substantially lower than changes in water availability, as water is only one input in the production process. Figure 25 illustrates that the largest percentage changes in water use are estimated to be experienced by hay, other broadacre and cereals in the post trade scenario, but this changes significantly when updated commodity prices are imposed, with the largest percentage changes then experienced by the meat cattle and other broadacre sectors.

4.25 Intuitively, annual crops and those that can be produced without the assistance of irrigation are likely to experience the largest volumetric changes, as they are likely to have the most flexible responses to changes in the price and availability of water.
Figure 25: Percentage reductions in water use by commodity: before trade, after trade and using updated commodity prices (a)

(a) All scenarios include investment in water saving infrastructure. Trade (updated prices) uses the average of changes in relative prices from 2006-07 to 2011-12

Source: ABARES (2011d)

4.26 The same changes in water use by industry can also be examined using total volumetric reductions, as outlined in Figure 26, with rice production estimated to experience the largest volumetric reductions under all scenarios.

Figure 26: Volume reductions in water use by commodity: before trade, after trade and using updated commodity prices (a)

(a) All scenarios include investment in water saving infrastructure. Trade (updated prices) uses the average of changes in relative prices from 2006-07 to 2011-12

Source: ABARES (2011d)

Regional impacts

4.27 ABARES (2011d) estimates that the regions that are likely to experience the largest reduction in GVIAP are the Murrumbidgee, New South Wales Murray and Goulburn–Broken regions. While this regional pattern is influenced by trade and commodity price assumptions,
these are also the catchments where the greatest volumes of water are available—any method of estimating volumetrically where water will be recovered from will find that these catchments are significant contributors.

4.28 ABARES estimates that:

- for the Murrumbidgee region, GVIAP will be reduced by 18.7 per cent ($145.5 million) with the largest reductions experienced by rice ($72.6 million) and cereals ($29.1 million)
- for the New South Wales Murray region, GVIAP will be reduced by 20.8 per cent ($92.4 million) with the largest reduction experienced in rice ($58.6 million)
- for the Goulburn–Broken region, GVIAP will be reduced by 12.9 per cent ($88.2 million), with the largest reductions experienced by dairy, meat cattle and hay.

4.29 Where rivers are highly interconnected between catchments, particularly in the Southern Basin, the modelled regional distribution of the impacts of the Basin Plan are subject to a significant degree of uncertainty when compared with modelled Basin scale impacts. In part, this is due to the fact that water trade has the ability to move water across the Basin to higher value uses in response to fluctuations in commodity prices and climatic conditions.

**Impact of Australian Government infrastructure investment and buyback programs**

4.30 Measurement of the impact of the Water for the Future program is a key area of inquiry in all the economic modelling. In summary, the modelling finds that Water for the Future is likely to significantly reduce the economic impacts on communities and will actually have a stimulatory impact on employment and consumption for Basin communities over the period to 2019.

4.31 Water recovery will occur through two main mechanisms under Water for the Future.

- Water that is recovered through purchase from irrigators of water entitlements removes water from irrigation use. While this would reduce farm production, farmers are paid a market price for the water recovered and the proceeds from buyback could have broader flow-on economic benefits for the community.
  
  - To the extent that buyback proceeds are reinvested in local economies—either through enabling additional farm investment or improving the financial capacity of the community to consume—broader economic activity will be higher when compared with the baseline estimates.
  
  - However, to the extent that buyback proceeds are a permanent leakage from the economy—either because they are used to repair otherwise unsustainable financial positions or the recipients migrate to other parts of Australia—broader economic activity could be lower when compared with the baseline estimates.
• Water that is recovered through irrigation infrastructure upgrades increases the amount of water available for both the environment and irrigation.
  o Water recovered in this way increases farm production and has flow-on economic benefits.
  o Construction activity associated with the infrastructure investment will also provide a short term stimulus to local economies.
  o While water recovered through infrastructure investments has a higher cost to the Commonwealth than water recovered through buybacks, infrastructure investments have the potential to result in wider economic benefits not captured in a simple cost effectiveness (dollars per megalitre recovered) calculation.

4.32 ABARES (2011d) estimates that infrastructure investments will significantly reduce the impacts of the Basin Plan:

• ABARES estimates that for the agricultural sector, GVIAP would be reduced by an additional 3.7 per cent (12.7 per cent compared to 9 per cent) or $223.5 million if the infrastructure investments were not included.

• At the Basin scale, ABARES estimates that GRP for the Basin would be reduced by an additional 0.32 per cent (1.13 per cent compared to 0.81 per cent) in the long run if the effects of water savings from infrastructure investments were not included.

4.33 In comparison:

• Monash University estimates that gross regional product for the Basin would be reduced by an additional 0.13 per cent (0.18 per cent compared to 0.05 per cent) in the long run if infrastructure investments were not included.

• Monash estimates that household consumption would increase by 0.42 per cent when these proceeds remain within the Basin in 2020, compared with the scenario where all buyback proceeds are assumed to exit the Basin and consumption is estimated to be reduced by 0.10 per cent (Wittwer 2011a).

4.34 Figure 27 demonstrates just how significant the infrastructure investment stimulus will be in the Basin over the time path that the Basin Plan is introduced.
The adjustment process—from short term to long term

4.35 While the economic modelling has found that the costs of the Basin Plan are likely to be relatively small overall in the long-term and at the aggregate (Basin-wide) level, the Authority recognises that, in the short-term and at the local level, some communities may be more significantly affected.

4.36 As demonstrated through history, and again during the recent drought,\(^\text{13}\) farmers are able to adjust their production decisions in light of changing circumstances. The Basin Plan will induce farmers to adjust their production decisions, over a number of years, to a future with less water available for irrigation. These changes to patterns of production will have flow-on effects on industries and communities. While communities that have little reliance on irrigated agriculture are unlikely to experience significant impacts, some communities are likely to face a more challenging adjustment path—particularly if they are heavily reliant on irrigation, or have other characteristics that decrease their capacity to adjust, for example if they are already suffering because of drought, or are experiencing declining or ageing populations.

4.37 In recognition of these limitations, the MDBA has also considered the estimated impacts of the Basin Plan using LGA scale analysis for 12 case studies across the Basin. These findings are presented in detail in Chapter 5.

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\(^{13}\) The Authority acknowledges that adjustments to droughts are different to the response that is required for the Basin Plan, and that the adjustment required in light of the Basin Plan will be different to previous adjustments to changes in water availability in the context of drought. Refer to discussion on page 47.
Employment impacts

Community feedback and updated modelling

4.38 The Authority heard significant concerns during consultations with the Basin community about the effects of the Basin Plan on employment in the Basin. In particular, there was widespread concern about potentially large job losses. There was widespread scepticism about the employment effects being understated in the Guide to the proposed Basin Plan.

4.39 The MDBA has consulted with experts and considered updated estimates of changes to employment from a range of modelling exercises. These estimates present a broad, but not definitive, indication about the potential employment impacts of the Basin Plan.

4.40 Overall, the different modelling exercises tend to generate similar results, with differences in estimates mostly explained by differences in the timeframes involved, and assumptions about whether employment is flexible and people are able to look for alternative employment in other locations.

4.41 Long-run modelling results estimate that there will be relatively minor reductions in employment from the Basin Plan. The small magnitude of these impacts reflects modelling assumptions that labour markets will adjust and displaced labour is able to gain employment in other regions and/or industries (ABARE-BRS 2010c). For modelling purposes, employment is measured in net terms—a job loss is not counted if the model assumes it will result in a job gain elsewhere.

4.42 At the same time that the Basin Plan is being implemented, the Australian Government’s irrigation infrastructure investment program will provide local economic stimulus which offsets short-term job losses in the Basin by providing new job opportunities for communities. Both ABARES (2011d) and Monash University (Wittwer 2011a) estimate that in the short term these stimulatory effects from infrastructure investment will more than offset any job losses resulting from the Basin Plan.

4.43 This underscores the very significant level of expenditure committed to these programs and the larger flow-on economic effects that construction activity has relative to farm production. While the construction stimulus is relatively short-term—the program is expected to be finished by 2019—the programs will assist significantly in smoothing the transition to the Basin Plan.

Short-run employment effects

4.44 In the short run (i.e. until approximately 2015), taking into account the water reductions and the offsetting construction stimulus effect from infrastructure investment and buyback proceeds:

- Monash University modelling estimates that employment could be approximately 0.22 per cent higher (around +2,000 jobs) when compared with baseline employment.

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14 All jobs estimates calculated using 2006 ABS Basin employment figure of 921,300.
• ABARES modelling estimates that the short-run net effect could increase employment by 0.33 per cent (approximately +3,000 jobs).

4.45 In the short run, if we ignore the offsetting construction stimulus effect from infrastructure investment and buyback proceeds:

• Monash University modelling estimates that employment could be approximately 0.03 per cent lower (around -300 jobs) when compared with baseline employment.

• ABARES modelling estimates that the short-run net effect could reduce employment by 0.05 per cent (approximately -500 jobs).

4.46 The MDBA has compared these employment estimates with the estimates from local scale analysis, which used multiplier analysis to estimate the potential impacts for 12 case study LGAs (each of which have a significant reliance on irrigated agriculture) that could potentially be more heavily affected by the Basin Plan (Arche Consulting 2011). While these results provide a useful indicator of potential changes in employment in the short term, it is also important to note that:

• the localised nature of the analysis is not able to take into account the offsetting stimulus effects of the Australian Government’s Water for the Future programs, dynamic change and structural adjustment, the gradual implementation of the Basin Plan, potential employment opportunities in neighbouring LGAs and general mobility of employment across the Basin, or underlying growth in employment and the economy.

4.47 The Authority recognises that any estimate of job numbers may still not capture the true nature of these impacts for local communities. Those who lose their jobs may not be the same people that gain new employment and, even where a new job is gained, job change often results in additional social costs that are not captured by the economic modelling. Temporary or transitional unemployment can have negative effects on an individual’s self-esteem and financial position. The loss of professional and personal networks and relationships, moving locations and learning new skills all have social costs. This is in addition to the loss of identity that may be felt by the farmers choosing to seek off-farm employment, or exiting farming altogether.

Long-run employment effects

4.48 In the long run—after the construction stimulus effect has dissipated—Monash University estimates that employment will be 0.17 per cent lower (around -1,600 jobs) if the buybacks proceeds are not reinvested in the economy and 0.08 per cent higher (around +700 jobs) if the buyback proceeds are reinvested (Wittwer 2011a). ABARES (2011d) estimates that employment will be 0.03 per cent (around -300 jobs) lower if buyback proceeds are reinvested.
4.49 The MDBA specifically asked for modelling of the effects under alternative scenarios of the buyback proceeds being reinvested in the Basin economy and not being reinvested. The MDBA’s consultations with the Basin community revealed significant sensitivity about this assumption.

- The first scenario—buyback proceeds are invested in an annuity with a real rate of return of 5 per cent—represents a standard approach to modelling the economic effects of this type of transaction.

- The second scenario—buyback proceeds are not reinvested in the economy—are representative of two concerns that were raised in consultations as to why the standard economic approach may not be appropriate in this case.
  
  o Many irrigators in the Basin are under considerable financial stress. If this financial stress is such that the irrigator has no access to further capital, they may decide to sell some of their water entitlements to the Commonwealth in order to relieve some of that financial stress. If so, it is possible that the buyback proceeds may have prevented foreclosure, but haven’t allowed the irrigator to use those proceeds to reinvest in their farm (and hence increase their gross income). And while the proceeds will have reduced the irrigator’s interest bill (and hence increased their net income), it could be that the effect on net income is not sufficient to induce them to increase their consumption—in which case, there is no real economic effect.

  o There was a concern that many irrigators would use the opportunity to sell their entitlements to the Commonwealth and the proceeds would leave the Basin. For example, this could occur if older farmers took the opportunity to retire and migrate out of the Basin. There were also concerns about corporate farms repatriating buyback proceeds to corporate headquarters located outside of the Basin.

4.50 The employment results are estimated in the standard way for economic analysis, in order to understand the effect of a policy change on underlying employment. To highlight this change, the trend in underlying employment is effectively removed. However, to fully understand the real world implications of the estimates, the underlying trend needs to be reapplied.

- Job availability in the Basin is also likely to be influenced by businesses’ expectations about future economic conditions, not just current economic circumstances—and by wider economic conditions in the Australian economy, not just in the Basin.

- Without the Basin Plan, employment in the Basin would be expected to increase in line with the national economy, at almost 2 per cent annually – or approximately 13,000 new jobs every year.

- With the Basin Plan, the Monash University long-run employment outcome (which represents the largest modelled employment effect) indicates that employment will be about 0.17 per cent lower (-1,600 jobs) (Wittwer 2011a).
o This is a relatively small impact by 2019 when compared with the expected underlying growth in jobs of around 13,000 jobs annually over the same period.

o The reduction in the level of employment by around 1,600 jobs by 2019 represents about 200 jobs annually.

4.51 In summary, the Authority considers that the employment modelling represents a realistic range of the best available estimates of potential changes in employment under a range of different scenarios.
Chapter 5: Local community impacts

Key points

- The nature of the adjustment path will influence how the Basin Plan impacts on communities. The level of total production in the Basin is estimated to be reduced by less than 1 per cent, and more than offset by broader economic growth over the transition period to 2019-20. However some towns in the Basin may face more significant adjustment as a result of the Basin Plan.
  - The Australian Government's infrastructure investment program in the Basin is estimated to assist in significantly offsetting the social and economic costs for communities, particularly in the short term through economic stimulus.
  - Water recovered through irrigation infrastructure will increase farm production and flow-on economic activity. Construction activity associated with infrastructure investment also provides a short-term stimulus to local economies.
  - Water recovered through buybacks reduces farm production, but if reinvested in local economies will result in higher levels of economic activity compared to baseline forecasts.

- Communities that are likely to experience relatively greater potential impacts as a result of the Basin Plan have:
  - relatively higher sensitivity to changes in water availability, largely because of greater water use intensity and a greater proportion of employment in agriculture
  - greater exposure to changes in water availability, because there are larger proposed reductions in diversions under the Basin Plan, and/or because water trade is likely to result in large amounts of water leaving the community.

- The adjustment path for these communities will be influenced by their capacity to adapt to change. Some communities have relatively low capacity to adapt, due to relatively high debt levels, limited access to capital, and limited opportunities for diversification within agriculture.
  - The recent severe and prolonged drought has placed many farmers in the Basin under financial stress. While recent rains have helped many, farmers are likely to require several years to fully return to their pre-drought financial positions.

- Taking all of the above findings into account, the Authority considers that some communities are likely to experience more significant impacts from the Basin Plan. These areas are estimated to be:
  - communities in the cotton growing areas of the Lower Balonne
  - the rice growing areas of the Murrumbidgee and NSW Murray
  - smaller dairying communities in northern Victoria
  - horticultural communities in Sunraysia and the South Australian Riverland.

- Indigenous people are also vulnerable to the impacts of the Basin Plan. The Authority has determined that there is a need to better define Indigenous water requirements.

Direct impacts on communities

5.1 To complement the macroeconomic modelling, and provide more local level indications of potential impacts on regional production and employment, the MDBA also
drew on the findings of a series of case studies by Arche Consulting (2011). The case studies used multiplier analysis to estimate the potential impacts for 12 LGAs (each of which have a significant reliance on irrigated agriculture) that could potentially be more heavily impacted by the Basin Plan.

- Towns were matched to the relevant LGA or statistical local area (SLA) using the Australian Bureau of Statistics Geographical Classification, July 2008 (ABS 2008a). Information on the relevant LGAs and SLAs is contained in Table 11 in Appendix C.

5.2 Arche Consulting used local level data from a range of sources to build a local profile of each town, and then calibrated this information with results from the ABARES economic modelling for changes in water use.

5.3 The direct impacts on production were assumed to reduce the level of agricultural production for the dominant irrigated crop in the area, and be substituted with the most likely dryland alternative. As dryland production tends to have lower value per unit of output to irrigated production, these offsetting effects tended to be minor in the results. Direct and indirect employment impacts were also estimated, to give an indication of the potential short term changes in employment.

5.4 The Arche Consulting results offer an additional interpretation of the economic impacts of the Basin Plan on communities by focusing at the local level. The Authority acknowledges that that this type of analysis is subject to numerous limitations such that the results have the potential to be significantly overstated:

- while this type of analysis benefits from a greater level of detail and specification than the macroeconomic modelling described in Chapter 4, it is static (fixed) and is representative of the local economy at a single point in time, with no capacity to incorporate dynamic adjustments and changes between sectors within the local economy
- it does not take into account the offsetting stimulus effects from the Australian Government’s Water for the Future program
- it implies that the full impact of the Basin Plan will occur in a single year, rather than through a gradual transition through to 2019
- it does not take into account the probability that economic and productivity growth will continue over time
- it does not contemplate the potential for alternative job opportunities to arise from outside of the immediate local area
- it does not encompass the potential influence of broader economic and demographic trends.

**Flow on impacts on regions and communities**

5.5 Impacts of the Basin Plan for irrigated agricultural production will also result in flow-on impacts on associated regions and communities. Impacts will be felt by industries
and sectors which service both primary production and secondary processing, such as transport, light engineering, wholesale supplies and machinery sales. Many Basin communities have expressed considerable concerns about these flow-on effects, as they can represent a significant proportion of the economy, particularly within some regional communities. Shops and clubs in many irrigation dependent towns tend to only flourish when farmers earn a living. The potential wealth and employment generated by irrigation also supports a critical mass of activity and population that leads to the provision of essential public sector services in education, social services and healthcare.

‘Agriculture is the generator of wealth, the main street turns it over like value adding, but irrigation has been a major generator’ [Bourke resident, (EBC, RMCG et al. 2011a)]

Social impacts

5.6 The Authority recognises that the impacts of the Basin Plan will be felt as a social as well as an economic issue. The experiences of communities in the recent drought illustrate the potential social impacts of the Basin Plan—if implementation of the Basin Plan is not carefully managed. Alston and Witney-Soanes (2008) found that the negative impacts of the recent drought were felt less in the eastern Shires of the Basin and more so in the western Shires of the Basin. The social impacts of the drought included:

- stress and anxiety often induced by difficult financial situations;
- reduction in educational opportunities as families move in search of work or as children work more hours on the farm;
- increased isolation, declining well-being, longer work hours on and/or off farm amongst women as they seek to ensure family and business survival;
- separation of families as the wife or husband seeks work elsewhere; and
- declining population, loss of skills and knowledge and potential disharmony in communities (Alston and Witney-Soanes 2008; Kiem, Askew et al. 2010; Mooney and Tan 2010; Sobels 2007; 2011).

5.7 While noting that the Basin Plan should not be equated with drought (refer to the discussion beginning on page 47), many of these social impacts also have the potential to occur as a result of the Basin Plan.

‘Communities need people and more importantly families. Once a family leaves they don’t come back. Families populate schools, sporting teams, clubs.’ [respondent from Narrabri, (EBC, RMCG et al. 2011a)]

5.8 The report by EBC, RMCG et al. (2011a) for the MDBA found that towns which are more irrigation dependent would be relatively more vulnerable to these social impacts. The report proposed that communities would be relatively more at risk from reductions in water available for consumptive use if they are more dependent on agricultural employment, and/or have smaller populations. Communities were categorised based on their population size and dependence on agriculture.
• **Category 1**: small towns highly dependent on irrigated agriculture and often geographically isolated.

• **Category 2**: small diverse towns that combine high-value irrigation with tourism and other sectors. These are likely generally protected from changes in water use.

• **Category 3**: larger towns highly dependent on irrigated agriculture. They are robust at current diversion levels, but would be highly exposed to any changes in irrigated agriculture in the region.

• **Category 4**: large, diverse and growing regional centres that have a breadth of activity and employment. These are generally relatively insulated from changes in irrigated agriculture in the region.

5.9 **Figure 28** shows towns in Category 1 (small towns highly dependent on irrigated agriculture and often geographically isolated) marked purple and Category 3 (larger towns highly dependent on irrigated agriculture), marked orange (EBC, RMCG *et al.* 2011a).
Figure 28: Specific towns identified as more sensitive to changes in water availability by the EBC Consortium

Source: EBC, RMCG et al. (2011a).

Health Services

5.10 The report by EBC, RMCG et al. (2011a) found that impacts on health services are likely to vary depending on the size and economic diversity of the community. Category 1 communities have had particular difficulty in attracting and retaining health services, and that
there appears to be a strong correlation between population size and access to key health services. Often professionals such as psychologists, doctors, dentists, and physiotherapists only attend on a fly-in-fly-out basis.

5.11 Category 2 towns generally can attract and afford to pay for service providers as they are attractive locations for professional staff, particularly those looking towards retirement.

5.12 Community representatives in many Category 3 towns reported that their population is currently at a threshold in terms of their ability to provide quality health, and believe that they will struggle to replace current providers when they retire.

5.13 The larger regional centres (Category 4) have generally enjoyed enhanced provision of medical facilities over the last ten years, as new hospitals have been constructed to service a wider regional population.

5.14 Reductions in water availability such as those proposed in the draft Basin Plan could reinforce these trends. Reduced irrigated production in communities associated with medium and small sized towns and associated reductions in population could lead to reduced health services, as investment in health services tends to track population size.

'A farm near Trangie sold its entitlement and reduced its employment from 30 workers to 2, so there is no doubt that will impact the community, economically and socially.' [respondent from Trangie, cited in (EBC, RMCG et al. 2011a)]

Schools

5.15 As with health services, the report by EBC, RMCG et al. (2011a) found that impacts on education are likely to vary depending on the size and economic diversity of communities. Schools in many small, agriculturally dependent communities (Category 1) have seen a decline in enrolments and size over the last ten years. Schools in such towns often find it difficult to attract children from professional families, as they provide limited subjects and facilities.

5.16 Category 2 towns are relatively attractive places for professional people, and schools are likely to be able to attract and retain good teaching staff (EBC, RMCG et al. 2011a).

5.17 The Authority notes that according to community informants in Category 3 towns, teachers increasingly come to regional communities for a couple of years to earn points towards getting a long-term posting in a more attractive location. They are unlikely to stay permanently in the area. Changes to rural communities as a result of the Basin Plan could exacerbate these staffing challenges and associated student performance in rural areas. There is potential for a negative self-reinforcing cycle to be created, whereby a regional school finds it hard to attract good teachers, and lower standards then deter professional people from sending their children to the school, which in turn leads to declining enrolments.

5.18 Most of the larger Category 4 communities surveyed had seen investment in new schools and teachers, in line with increases in population.

5.19 As with provision of health services, the report by EBC, RMCG et al. (2011a) suggested that proposals for reductions in water availability, such as those in the draft Basin Plan, could reinforce these general trends.
Community identity

5.20 Many irrigation communities have a strong sense of local identity centred on their unique location and agricultural base. Many towns were explicitly established as irrigation communities as part of soldier settlements or, in the case of Coleambally, as a consequence of the Snowy River scheme. Community identity is therefore closely associated with the historical context of irrigation development.

5.21 As a consequence, these communities have formed a social and economic identity and livelihood around the development of irrigated agriculture. Some people stressed that these communities were proud of how they had established and nourished a productive base that had generated food for the nation, exports and a livelihood for their families. People were concerned that the Basin Plan could undermine this community and identity, which has developed across generations over a significant period of time.

‘I don’t know how you can get this down on paper but the community spirit around this place is what keeps what we’ve still got going.’ [Mungindi resident, (EBC, RMCG et al. 2011a)]

Community vulnerability

5.22 The MDBA commissioned work by ABARES to gain a better understanding of the social and economic characteristics of Basin communities and to assess some of the factors that may contribute to them being able to adjust more effectively to changes in water use (ABARE-BRS 2010d; ABARES forthcoming). To do this ABARES developed a range of indices to measure the sensitivity of communities to change and the resources within a community that may allow it to cope with change.

5.23 This work is viewed by the Authority as a starting point for understanding the characteristics of Basin communities, some of which may help a community adapt, and some of which may hinder it in doing so. In that sense, the assessments presented here are not predictors of final outcomes because they draw only on data from a single point in time that can be readily quantified and that does not take into account other community characteristics which may be important. For instance, a community may have particularly capable leaders. These factors are not reflected in the index. This is particularly relevant in the context of the proposed transition period to full implementation of SDLs in 2019 (EBC, RMCG et al. 2011a).

5.24 ABARES calculated and mapped these indicators for each Census Collection district across the Basin. Five measures were developed: exposure (to a change in water), sensitivity, potential impact, adaptive capacity and vulnerability. The relationship between these measures is expressed as follows:

\[
\text{Potential Impact} = \text{Exposure} \times \text{Sensitivity}
\]

\[
\text{Vulnerability} = \text{Potential Impact} – \text{Adaptive Capacity}
\]

5.25 The maps on the following pages illustrate the key findings with respect to which communities are likely to be affected by a water recovery scenario of 2,800 GL. They take
into account water already recovered and projected water savings from infrastructure investment as well as any water trade that has occurs into and out of a region.

Sensitivity

5.26 The first map (Figure 29) shows the relative sensitivity of communities to reductions in water availability. Sensitivity is a measure of how dependent a community is on the factor that is changing. In this case it illustrates the degree to which areas of the Basin are dependent on employment in agriculture and processing and on the use of irrigation water.

![Relative sensitivity across the Murray-Darling Basin](image)

**Figure 29: Relative sensitivity to reductions in water availability, census collection districts**

Source: ABARES (forthcoming)

5.27 Regions that are relatively more sensitive to changes in water availability (as shown by the darker shadings) are:

- in the north of the Basin: the Condamine-Balonne, Moonie, Border Rivers and Gwydir Basin Plan regions

5.28 The percentage of employment in the agriculture sector is illustrated in Figure 30. The Australian Bureau of Statistics does not classify agricultural employment as between irrigated agriculture and dryland agriculture, so this is merely a general indicator of the
importance of agriculture in a district. It is one of the sub-indicators used to derive the sensitivity indicator in Figure 29.

Figure 30: Employment in agriculture as a percentage of total employment, census collection districts, 2006

Source: ABARES (forthcoming)

5.29 Both the ABARES and EBC work on the sensitivity of Basin communities to changes in water availability are consistent with earlier analysis undertaken by MJA, RMCG et al. (2010). Drawing on the quantitative data and information obtained through regional consultations and a Basin wide survey, MJA, RMCG et al. (2010) identified four key factors which make farmers, or farm sectors, more sensitive to changes in water availability:

- the level of dependence on irrigation water of the farm or farm sector: sectors with greater irrigation water dependence were found to be more sensitive to changes in water availability
- the level of financial stress (particularly indebtedness) of the farm or farm sector: farms with more financial stress and higher debt were more sensitive to changes in water availability
- the level of personal well-being and optimism of farmer: irrigators with lower self-reported well-being and less optimism about their farming future were more sensitive to changes in water availability, with these farmers more likely to seek to leave farming altogether
- the proportion of middle-aged farmers in the farm or farm sector: middle aged farmers were more sensitive to reductions in future water availability.
5.30 The report found that at the time of the assessment, dairy, horticulture and rice farmers were relatively more sensitive to the introduction of SDLs. The report did not include cotton in its analysis, due to insufficient survey results being obtained for that sector.

5.31 MJA, RMCG et al. (2010) also used three indicators to assess community sensitivity to water availability reduction: economic diversity, socio-economic condition, and nature of the region’s farms and their links to the regional economy. Each of these factors has different dimensions and correlates. As a result, regional sensitivity to reduced water allocations was found to vary markedly across the Basin.

5.32 This report found that irrigated agriculture is more central to some regional economies than others. In quantitative terms, irrigation dependence can be appraised using a suite of indicators including: the percentage of irrigated agriculture in total agricultural production; the estimated relative sensitivity of the irrigation sectors to SDLs; irrigation value chain integration; and economic diversity.

- For example, in the southern Murray and Murrumbidgee irrigation regions (excluding the South Australian Murray below Lock 1), irrigated agriculture accounts for 79 to 92 per cent of total agricultural production. In comparison, in the northern regions of the Basin irrigated agriculture accounts for 15 to 52 per cent of total agricultural production. Therefore, even allowing for drought impacts on regional irrigated output, regional communities of the south are likely to be more sensitive to the introduction of SDLs.

5.33 The report describes how socio-economic condition is a key indicator of a region’s ability to cope with shocks and change. Regions that have higher levels of education, greater household wealth, better essential services, higher wellbeing and less social disadvantage are better positioned to cope with regional stresses than communities that have less of these things. While these are generalisations that are more nuanced within each region, in quantitative terms, socio-economic disadvantage is a useful, readily available index.

- The report found that the South Australian Murray below Lock 1, Sunraysia, the Riverland in the southern systems, and the Macquarie, Namoi and Border Rivers have relatively high levels of disadvantage.

5.34 The report then combined these two indicators (water dependency and socio-economic disadvantage) to assess indicative risk of regions to reductions in water availability. Taken together, the two indicators suggest that the South Australian Murray below Lock 1, Riverland, and Sunraysia may be particularly sensitive to reductions in consumptive water.

5.35 These studies confirm that the nature of farming in each region influences the sensitivity of that region to changes in water availability. Compared with dryland farming, irrigated agriculture uses less land and delivers greater flow-on employment and economic activity. The differences in flow-on intensity between an irrigation sector and dryland are greatest for horticulture and dairy and least for cotton and rice. In irrigation regions, irrigated agriculture is an important employer (directly and indirectly through food and fibre processing) and source of wealth. In addition, at least 75 per cent of total farm operating expenditure takes place in the regional economy, typically within 50 kilometres of the farm gate, and a large proportion of irrigated production is processed in the same region—contributing to sensitivity to changes in water availability.
Exposure

5.36 While important, sensitivity alone is not indicative of the potential impact of water recovery on communities. The potential impact is influenced by a combination of sensitivity and exposure to change. Exposure is a measure of the degree to which communities are affected by an external stress. In this case, exposure itself depends on

- the proposed SDL for the relevant catchment
- how much water has already been acquired for the environment in each catchment; in some catchments, there have already been significant acquisitions, and minimal further reductions are required
- patterns of water trade, and related to this
- other factors such as commodity prices.

5.37 Exposure to changes in water for consumptive use will be less in catchments where there has already been significant water recovery, and where minimal further reductions are required (e.g. the Lachlan). Exposure will be greater in catchments where there are large proposed reductions in current diversions, and/or where water trade is likely to result in large amounts of water leaving that catchment.

5.38 Commodity prices vary significantly between years as a result of many factors, such as climatic conditions and global supply and demand. Prices, in turn, affect the modelled distribution of reductions in water availability across regions after accounting for estimated trade outcomes. Figure 31 and Figure 32 illustrate the effect of commodity prices and water trade on eventual exposure under different sets of prices. Darker shaded regions are those which have a greater exposure to water use reductions.

- If commodity prices are assumed to be as in 2005–06 (Figure 31), water trade would be expected to lead to relatively greater amounts of water trading out of the Murrumbidgee because at that time prices for grapes were relatively high, particularly in relation to rice.
- If relative prices changed to reflect the more recent decline in grape prices (Figure 32), significantly less water would be expected to be traded out of the Murrumbidgee downstream into the Sunraysia and Riverland regions.

5.39 Given that it is impossible to predict commodity prices for when the Basin Plan will be implemented in 2019, it is not possible to definitively determine the relative impacts of the Basin Plan on different catchments. However, given current land use patterns, hydrological factors and market conditions a relatively small number of regions appear to generally be affected more than others—these being the Murrumbidgee, Murray, Goulburn–Broken, Lower Balonne and SA Riverland.
Figure 31: SDL contributions required after modelled water trade, Basin Plan regions, 2005–06 commodity prices
Source: ABARES (forthcoming)

Figure 32: SDL contributions required after modelled water trade, Basin Plan regions, 2006-12 commodity prices
Source: ABARES (forthcoming)
Potential impact

5.40 The three maps in Box 10 show the differential relative potential impacts under each of three water recovery scenarios—2400, 2800 and 3200 GL. Potential impact measures the degree to which areas are sensitive to change (because of their dependence on irrigation water and agricultural employment) combined with the magnitude of exposure to change. In this case, exposure is the remaining change required in the volume of water available for consumptive use, after accounting for savings from infrastructure and entitlements already purchased. Therefore the maps illustrate the potential impact of the ‘further effort required’ to meet the SDLs.

5.41 The dark shading indicates areas that may have higher relative potential impact scores under the particular scenario. The lighter areas are likely to be those areas that have already substantially adapted—they have little sensitivity to the changes in water availability or their contribution to meeting the SDL under the scenario has already been largely met.

5.42 The maps show that fewer regions are relatively highly impacted under the 2400 and 2800 scenarios, compared with the 3200 GL scenario. More areas in the southern Basin move into the top 20 per cent ranked areas as the volume of water recovery increases. This change is especially apparent for communities in the Murrumbidgee, Murray, Lodden, Wimmera-Avoca and Lower Darling Basin plan regions. Potential impact rankings of areas in the northern Basin do not change under the different water recovery scenarios.

5.43 The Paroo, Ovens and Eastern Mt Lofty Basin Plan regions will experience negligible exposure as reflected in their lower potential impact rankings.

5.44 Note that there is an imperfect mapping between the Australian Bureau of Statistics’ statistical local areas (SLAs) and the Basin’s catchments, and many large SLAs lie substantially across two or more catchments. So, for example, while the Paroo catchment has no exposure in any of the scenarios, it contains several SLAs in common with the Lower Darling and Barwon Darling catchments which derive their exposure from those catchments.

5.45 It is crucial to remember that potential impact does not predict outcomes for communities. There are many ways that impact can be mitigated. One way is to reduce exposure. This could be achieved by reducing the volume of water recovered. It could also be achieved by recovering water more slowly (i.e. over a greater period of time and giving communities the chance to adjust), recovering water by methods that preserve more irrigated agricultural productive capacity (e.g. irrigated infrastructure investments) or modifying current river operations to achieve more with less environmental water. All of these actions are currently under the consideration of governments.

5.46 Alternatively, investments could be made that reduce the sensitivity of communities to changes in the volume of water available for irrigation, especially those that reduce reliance on irrigated agricultural industries. Some programs, such as Strengthening Basin Communities and work by the Department of Regional Australia through the Regional Development Authorities are addressing these issues.
Box 10: Sensitivity analysis—2400 GL, 2800 GL and 3200 GL water recovery scenarios

The Authority has assessed the potential social and economic impacts of 2400 GL, 2800 GL and 3200 GL water recovery scenarios. These scenarios have been used to inform sensitivity analyses on the range of potential impacts, and the magnitude of the differences between these scenarios. Sensitivity analyses have been completed by ABARES (2011d; forthcoming) (economic modelling and vulnerability analysis) and Monash University Centre for Policy Studies (Wittwer 2011a).

The results generally conclude that economic impacts on communities would move in a linear fashion in response to smaller or larger change in the reduction in water use. However, this is likely in part to reflect modelling constructs, and the Authority considers that, in practice, social and economic impacts are likely to rise more steeply as the volume of water recovery increases.

ABARES economic modelling estimates that GVIAP would be 7.7 per cent lower under a 2400 GL water recovery scenario and 10.3 per cent lower under a 3200 GL water recovery scenario, compared with 9.0 per cent under the 2800 GL water recovery scenario (all scenarios include infrastructure investments). GRP is estimated to be 0.7 per cent lower under a 2400 GL water recovery scenario and 0.9 per cent lower under a 3200 GL water recovery scenario, compared with 0.8 per cent lower under a 2800 GL water recovery scenario.

Monash University Centre of Policy Studies estimates that, under a 2800 GL scenario, GRP would be 0.05 per cent lower, compared with 0.03 lower for the 2400 GL scenario, and 0.09 per cent lower for a 3200 GL scenario. Monash employment estimates for all scenarios in 2020 are very similar, predicting an increase in employment of around 0.2 per cent for all scenarios, in recognition of the stimulatory impact of the infrastructure investment program. However, the estimates indicate that the gains in employment grow proportionally less from 2,400 through to 3,200.

Because infrastructure investment remains the same under all scenarios, infrastructure investments recover a greater proportion of the total water recovery required under lower SDLs.

Mapping the results

The three maps on the following page show the differential potential impacts under each of three water recovery scenarios. Potential impact measures the degree to which areas are sensitive to change (because of their dependence on irrigation water and agricultural employment) combined with the magnitude of exposure to change. In this case, exposure is the remaining change required in the volume of water available for consumptive use, after accounting for savings from infrastructure and entitlements already purchased. Therefore the maps illustrate the potential impact of the ‘further effort required’ to meet the SDLs.
Box 10 continued

Figure 33: Sensitivity analysis for relative potential impact after accounting for water savings from infrastructure investment and buybacks to date

Source: ABARES (forthcoming)

The dark shading indicates areas that may have relatively higher potential impact scores under the particular scenario. The lighter areas are likely to be those areas that have already substantially adapted—they have little sensitivity to the changes in water availability or their exposure has already been largely met.

The maps show that fewer regions are relatively highly impacted under the 2400 GL and 2800 GL scenarios, compared with the 3200 GL water recovery scenario. More areas in the southern Basin move into the top 20 per cent ranked area as the volume of water recovery increases. This change is especially apparent for communities in the Murrumbidgee, Murray, Loddon, Wimmera–Avoca and Lower Darling Basin plan regions. Potential impact rankings of areas in the northern Basin do not change under different water recovery scenarios. Paroo, Ovens and Eastern Mt Lofty Basin Plan regions will experience negligible reductions due to SDLs as reflected in their lower potential impact rankings.

Note: there is an imperfect mapping between the Australian Bureau of Statistics’ statistical local areas (SLAs) and the Basin’s catchments, as many large SLAs lie substantially across two or more catchments. So, for example, while the Paroo catchment has no exposure in any of the scenarios, it contains several SLAs in common with the Lower Darling or Barwon–Darling catchments which derive their exposure from those catchments. In addition, relative potential impact is smoothed across regions. For example, the Lower Darling region is very large and has areas ranked with highest relative potential impact; however, irrigation only occurs in a very small area of the region along the southern border. As such, the map indicates there will be a large area of potential impact when much of the effect will be confined to these southern areas.
Adaptive capacity

5.47 Initiatives such as those outlined above would likely contribute to enhancing the adaptive capacity of Basin communities. Adaptive capacity is the inherent capability of a community to manage or cope with change. The potential impact of change in a community can be mitigated by a community's adaptive capacity.

5.48 Some communities have a greater capacity than others to adapt to change. Previous studies have found that adaptive capacity is positively related to the resources available to the community. A common way of describing these resources is to classify them as various forms of capital, namely built, human, natural, social or financial capital (Burnside 2007; Ellis 2000; Nelson, Kokic et al. 2005; Yohe and Tol 2002). Communities have greater adaptive capacity if they have a greater diversity of these stocks of capital. It also desirable that capital be mobile, which increases the flexibility with which it can be applied to new or alternative ends. For example, communities with relatively more labour mobility have a higher degree of adaptive capacity.

5.49 Capital stocks are a function of recent and past history. Hence, communities which have enjoyed prosperity will have greater capital stocks, and communities which have recently suffered (for example, from drought) have lower stocks of capital—manifested, for example, by higher debt levels, smaller populations, and a shortage of skilled workers.

5.50 To quantitatively assess community adaptive capacity, ABARES developed an index which takes into account measures such as income, education levels, age structure, mobility, housing and economic diversity, and volunteering rates. These indicators represent proxy measures for local economic diversity, human capital, and social capital. Some communities have lower adaptive capacity than others: in particular, communities with lower levels of economic diversity or lower levels of education. Remote communities generally have lower levels of adaptive capacity.

5.51 Figure 34 presents the relative adaptive capacity of communities across the Basin. The darker shaded areas are those with relatively lower levels of adaptive capacity. That is they have relatively lower levels of economic diversity, human capital, and social capital compared to other areas in the Basin. There is a pattern of decreasing relative adaptive capacity moving from south-east to north-west of the Basin. This pattern correlates with the population distribution map at Figure 2 on page 26 of this report. The major factor driving the pattern is likely to be the increased economic diversity of larger and less remote centres in the eastern regions of the Basin (noting that Canberra has been removed from the analysis of this and all the other maps presented in this section).
By synthesising the findings of these analyses of sensitivity, exposure, potential impact and adaptive capacity, communities that are more likely to be relatively more vulnerable to the changes proposed in the draft Basin Plan can be identified. Communities in these areas have a combination of relatively higher sensitivity to changes in water availability (i.e. very high dependence on water for agriculture and high agricultural employment), relatively limited levels of adaptive capacity (i.e. lower levels of human capital, social capital and economic diversity) and are more exposed to changes in access to water under the Basin Plan when compared with other areas in the Basin. It should be noted that the Lower Darling region is very large and has areas ranked with high relative vulnerability, however irrigation only occurs in a very small area of the region along the southern border. As such, the map indicates there will be a large area that appears vulnerable when much of the effect is confined to the southern part of these areas. Refer to Figure 35.
Impacts on specific industry based communities

5.53 Through its combined methodologies, the Authority has identified that four specific industry based communities are likely to experience relatively more significant impacts from the Basin Plan. This section summarises the potential impacts. The analysis draws on a range of sources already discussed, including economic modelling, assessments of vulnerability, and findings from community consultations.

5.54 The communities described below are more vulnerable to the Basin Plan because they are highly exposed to changes in water availability, highly sensitive to changes in water availability, and may be relatively less able to adapt. However, the impacts described in the following sections are not predictive of the future for these communities. Rather, they represent the potential short- to medium-term impacts of the Basin Plan, based on significant and numerous assumptions. Key factors such as commodity prices, technological change, climate variability and adaptive capacity will play major roles in shaping the actual impacts. In the longer term, communities will adjust. The issue that the Authority has devoted considerable attention to is the nature of this adjustment path. Some communities will adjust by changing their production patterns, for example through substitution of new activities or increased productivity. Others may benefit from government investment in infrastructure improvements, or by reinvesting buyback proceeds. There are also significant policy
opportunities for governments to smooth the adjustment path. These opportunities are discussed in more detail in Chapter 7.

Cotton communities in the Lower Balonne

5.55 Cotton is grown in the Darling Downs, around St George and Dirranbandi, and in the Macintyre Valley. The area under cotton production has grown rapidly since the 1970s (less than 50,000 ha) to peak in the late 1990s at over 500,000 ha. In the Condamine-Balonne, cotton has become the major source of agricultural income (45 per cent of GVAP in 2005-06). Other significant industries include beef (34 per cent of GVAP) and horticulture (10 per cent). Both dryland and irrigated cotton is grown. The region is home to several cotton gins, including at Dalby, Cecil Plains, St George, Beardmore and Dirranbandi. The economies of St George and Dirranbandi are dependent on irrigated agriculture, and thus sensitive to the reductions in water use proposed in the draft Basin Plan.

5.56 Recovery of water sufficient to meet the sustainable diversion limits proposed in the draft Basin Plan will have limited impact during drought years, as under these conditions there would only be very limited water for irrigation. The impacts are likely to be felt most acutely in the Lower Balonne region, as this area generally has the lowest opportunity cost of buying back entitlements on a $/ML basis and the environmental gains from those purchases are likely to be relatively higher.

5.57 Economic modelling of the impacts of the Basin Plan on the Condamine-Balonne region by ABARES (2011d) estimates that under a 2,800 GL water recovery scenario, the gross value of production in the region will, in the long-term, be reduced by 6.6 per cent or $30.0 million per year. This constitutes one of the largest percentage changes of all Basin Plan regions. The modelling also suggests that there will be (relatively smaller) reductions in cereal and hay production.

5.58 Analyses of community vulnerability have found that in the Condamine-Balonne, the social catchments of St George and Dirranbandi have relatively low capacity to adapt to reductions in water availability, due to relatively high debt levels, limited access to capital and limited commercial opportunities for diversification within agriculture. Communities in the east of the region (Toowoomba, Dalby, Warwick) have greater resilience and adaptive capacity, as their economies are more diversified and less reliant on irrigated agriculture.

Rice communities in the Murrumbidgee and New South Wales Murray

5.59 The Murrumbidgee has three main irrigated farming systems:

- rice-based mixed farming systems (including winter cereals), which are the most common broadacre irrigated production system in the Murrumbidgee, and based predominantly on general security water
- specialty summer irrigated crops (soybeans, maize), which are produced by a small proportion of farms in association with winter crop production, livestock and dryland cropping
- horticultural crops (citrus, wine grapes, annual vegetable crops), which are produced predominantly using high security water.
In the New South Wales Murray, there are four main irrigated farming systems: rice-based farming, dairying, irrigated cropping/pastures, and horticulture.

Other important industries in the region include road and rail transport, food processing (particularly rice mills at Deniliquin, Leeton and Coleambally), wine processing (near Griffith), fruit processing (Griffith and Leeton), intensive livestock production, service industries (public and private sector) and tourism.

Irrigated agriculture in the Murrumbidgee and New South Wales Murray is highly exposed to changes in water availability. This reflects the relatively large potential water recovery volumes compared with other regions; the high proportion of general security water used; and the relatively low value of rice production per volume of water used, compared with other commodities. Commodity prices will be a key factor in determining patterns of water trade, and hence the extent of the impacts.

Economic modelling of the impacts of the Basin Plan on the Murrumbidgee region by ABARES (2011d) estimates that under a 2,800 GL water recovery scenario, the gross value of production in the Murrumbidgee region will, in the long-term, be reduced by 18.7 per cent or $145.5 million per year. This reduction is significant and represents the largest regional dollar value and percentage reduction of all of the Basin Plan regions. It reflects the high proportions of irrigated cereals and rice grown in the Murrumbidgee region, and an assumption in the model that water will move from lower per unit value uses (such as rice) to higher per unit value uses, such as horticulture—which are relatively more important outside the Murrumbidgee region. The magnitude of the reduction in dollar value also reflects the fact that the Murrumbidgee is one of the largest and most populated regions in the Basin.

Economic modelling of the impacts of the Basin Plan on the New South Wales Murray region by ABARES (2011d) estimates that under a 2,800 GL water recovery scenario, the gross value of production in the region will, in the long-term, be reduced by 20.8 per cent or $92.4 million per year. This is the second highest percentage change and third highest production value reduction under the Basin Plan of all the modelled regions. This result is primarily driven by the assumption in the model that rice production will decrease as water moves to higher value uses. Relatively minor reductions are also predicted across other agricultural sectors, including cereals, dairy, hay, meat cattle and sheep.

The impacts on rice and other sectors will be influenced significantly by commodity prices, and hence the extent to which water is traded out of the Murrumbidgee and the New South Wales Murray—for example, to horticultural producers downstream on the Murray.

In the Murrumbidgee local processing is likely to decline in proportion to the reductions in irrigated production, with potential employment impacts and associated flow-on impacts for communities. There are major rice mills in Leeton (capacity 230,000 tonnes a year, employing 160 FTEs) and Coleambally (capacity 280,000 tonnes per year, employing 75 FTEs). Furthermore, wine processing at Griffith would be affected by changes to wine production, and citrus processing at Leeton by changes to citrus production. There would be a flow-on effect on the employment and thus population of the region's service centres (except Wagga Wagga), on businesses that provide services to irrigated agriculture (e.g. irrigation farm businesses, irrigation corporations, food processing, transport, specialist
agricultural and engineering services) as well as local government, the retail sector, government service sector (e.g. education) and the broader commercial sector.

5.67 In the Murrumbidgee, it is anticipated that impacts will be most significant in Griffith, Leeton, Coleambally, Darlington Point and Hay. Towns in the upper Murrumbidgee (e.g. Wagga Wagga, Tumut and Gundagai) will not be especially affected as they have a more diverse economic base and are less dependent on irrigation.

5.68 In the Murray, a major rice milling facility is located at Deniliquin. Businesses in Barham, Wakool, and Moulamein are directly linked to agriculture. Other smaller towns (e.g. Finley, Berrigan, and Jerilderie) are also dependent on supplying the irrigated agriculture sector.

5.69 In the Murray, it is anticipated that impacts of the Basin Plan will be most significant in the smaller towns (e.g. Finley, Berrigan, Jerilderie and Barham), which are highly dependent on irrigated agriculture. Local rice processing at Deniliquin is likely to decline subject to the level of change to water availability, leading to employment impacts and associated flow-on impacts for the community. Deniliquin would also be impacted but to a lesser extent than the smaller towns as the rationalisation of services may lead to a contraction back to the major regional centre. The township of Moama would be relatively less affected, as it has a more diverse economy.

Dairy communities in Northern Victoria

5.70 Dairy producers are the main consumptive user of irrigation water in the Goulburn-Murray Irrigation District (GMID). Prior to the drought, the GMID represented the largest dairy region in Australia, accounting for more than 90 per cent of dairy farms in the Basin and over 2.3 billion litres in milk production (MJA, EBC Consultants et al. 2010:21).

5.71 Three key companies have five plants in the GMID: Murray Goulburn Cooperative (Rochester and Cobram); Fonterra Milk (Stanhope and Echuca); and Tatura Milk (Tatura). Specialist processors value-add onto dairy products produced within and outside of the region: Nestlé at Tongala and Bega Cheese at Strathmerton; and a number of companies source milk from the region but process outside: Parmalat, National Foods/Dairy Farmers, United Dairy Power, Australian Consolidated Milk and True Organic Cooperative.

5.72 Further downstream on the Murray, the area around Kerang is also highly reliant on irrigated agriculture, and Cohuna has a high reliance on the dairy industry.

5.73 The dairy industry is highly exposed to the export market, and producers need to be able to cope with volatile milk prices. During the recent drought, a combination of low water allocations, high input prices and a volatile milk price have increased the financial pressures on dairy producers. While farmers have been largely able to maintain production during the drought by buying in fodder, this has come at a financial cost. Many producers are under cash flow pressure, and average total farm debt increased significantly.16

16 Analysis of ABARES farm survey data indicates that average farm debt in the Murray Dairy region increased from $408,000 in 2005–06 to over $575,000 in 2010–11, and that expressed in terms of debt per cow, debt increased by 72 per cent over this period (ABARES various years).
5.74 While dairy dominates, other irrigation activities are also important in the region. The region produces a significant proportion of the value of the national apple and apricot crop, and more than half of the gross value of the Australian pear, nectarine, plum and peach crop. There are numerous fruit packaging facilities; SPC Ardmona is the major processor, with key plants at Shepparton, Mooroopna and Kyabram. The main annual horticultural crop is tomatoes, both fresh and processed; processing plants are located in Echuca and Girgarre, and secondary processing in Shepparton and Echuca. Mixed farming enterprises use irrigation water to provide fodder and agistment.

5.75 These industries are likely to be affected to different degrees by the water recovery scenario proposed in the draft Basin Plan. It is likely that permanent horticulture will generally retain entitlements and therefore be relatively less affected. Annual horticulture may be at greater risk than permanent horticulture, due to potentially increased input costs and the rising annual delivery cost and opportunity cost of owning water. The margins are small and costs cannot be passed on to buyers in an international market.

5.76 The dairy industry and mixed farming operations are likely to be relatively more affected, as many dairy and mixed farms are likely to sell water to horticulturalists. For the dairy industry, a key issue will be the extent to which water can be substituted with other inputs (e.g. fodder bought in from elsewhere). While, historically, this has enabled the dairy industry to maintain production even in times of reduced water availability, increased costs of water and reduced fodder production could increase the costs of feed. Furthermore, as already mentioned, many dairy producers are already in a weak financial position due to the drought.

5.77 Economic modelling of the impacts of the Basin Plan on the Goulburn–Broken region by ABARES (2011d) estimates that under a 2,800 GL water recovery scenario, the gross value of production in the region will, in the long-term, be reduced by 12.9 per cent or $88.2 million per year. This is one of the highest percentage changes of all the Basin Plan regions. This modelled result reflects an assumption that dairy production in the region will decline, as water moves to higher value uses. The modelling also predicts reductions in hay, meat cattle and sheep production.

5.78 Reduced dairy production would affect processing plants at Rochester and Cobram (Murray Goulburn Cooperative), Stanhope and Echuca (Fonterra Milk), and Tatura (Tatura Milk), as well as specialist processors who value-add onto dairy products.

5.79 Smaller communities (for example, Undera, Stanhope, Wunghnu, Waaia, Katamatite, Strathmerton and Cohuna) would be more vulnerable to changes in water availability and to changes in dairy output.

**Horticultural communities in Sunraysia and the South Australian Riverland**

5.80 The Victorian Murray region is one of the major irrigated regions within the Basin, and hence highly sensitive to changes in water availability. Specialised irrigated horticulture (both permanent and annual), and the food processing that adds value to these products, is central to the regional economy—around 26 per cent of regional employment is in these two sectors. Other industries include food processing (e.g. wine and table grapes, dried fruit, juicing), dairy, and milk processing. A significant irrigation services industry provides
ongoing maintenance of systems, and contributes to the development and introduction of improved technology. Mildura, in particular, also serves as a road transport hub.

5.81 The South Australian Riverland is one of Australia’s largest wine producing regions. Wine grapes account for more than 60 per cent of the irrigated area in the region. The region also produces and processes citrus, stone fruit, almonds and vegetables.

5.82 The impacts on horticulture in these regions will depend on the extent to which horticulturalists sell water entitlements and purchase water allocations from other users, and on the extent to which high security entitlements are acquired for the environment. Commodity prices are also a key variable affecting the likely impacts. There is an expectation that continued reduced water availability may require producers of crops experiencing low commodity prices to sell water. For example, if grape prices continue to be low for a significant period, this could induce many grape producers to take advantage of the Australian Government’s buyback program to exit the industry.

5.83 In the Victorian Murray, the EBC, RMCG et al. (2011a) report found that growers that are productive and profitable producers will not be directly affected by water recovery, as they will tend not to sell and would have the capacity to purchase extra entitlements or allocations to manage demand. Producers will be more significantly impacted if they lack capacity to purchase water on the market—i.e. if their financial situation is weaker. Non-modernised, smaller holdings managed by aging producers are more likely to fall into this category. Such producers may be assisted by the water recovery process, especially the buying back of entitlements, which could allow debt-laden producers to leave the industry ‘with dignity’ (Wheeler, Zuo et al. forthcoming).

5.84 Economic modelling of the impacts of the Basin Plan on the Victorian Murray region by ABARES (2011d) finds that under a 2,800 GL water recovery scenario, the gross value of production in the region will, in the long-term, be reduced by 5.2 per cent or $41.1 million per year. This is a relatively small percentage change in production, but a relatively large reduction in production value. The modelling estimates that there would be reduced production across a range of commodities including dairy, grapes, hay and meat cattle.

5.85 In the South Australian Murray, the effects of reduced water availability will depend upon the long-term profitability of irrigated permanent horticulture. If profitability remains low, especially for wine grapes, the area of horticultural production is likely to be reduced, with no replanting of dried-off areas. This would likely lead to flow-on effects on communities, including reduced business activity and employment. If profitability returns, producers will potentially purchase water from other areas and expand production, as has occurred over the last fifteen years. In the Lower Murray region, more reliable flows are likely to provide tourism and fishing businesses in the region with confidence to invest and grow.

5.86 Economic modelling of the impacts of the Basin Plan on the South Australian Murray region by ABARES (2011d) finds that under a 2,800 GL water recovery scenario, the gross value of production in the region will, in the long term, be reduced by 2.6 per cent or $14.6 million per year. This represents a relatively small reduction in production, reflecting estimates of relatively small production losses in fruit and nuts, grapes and vegetables.
5.87 In the Victorian Murray, all towns and villages except Mildura are highly dependent on irrigated agriculture and the performance of irrigated commodities. Changes to levels of primary production could have a significant effect on service providers and local processing, including the possibility of closure of wineries, dried fruit processing plants and fruit packing houses, with consequent potential employment and associated flow-on impacts on communities. Larger centres such as Mildura and high-producing horticultural areas such as Robinvale would be expected to continue population and income growth, while small satellite towns may continue to decline.

5.88 In the South Australian Murray, impacts could be felt in the regional centres of Renmark, Loxton, Barmera, Berri and Walkerie, as well a number of other smaller towns.

**Modelled impacts on selected local communities**

5.89 A study by Arche Consulting (2011) estimated the potential short term direct impacts for 12 case study LGAs within the Murray-Darling Basin. The study also considered the potential flow-on effects for employment in other sectors of the local economy.

5.90 As outlined at the beginning of this chapter, this analysis was conducted in order to complement the macroeconomic modelling, which estimated the impacts of the draft Basin Plan at a Basin and broad-region level.

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<th>Irrigated production per cent</th>
<th>Dryland production $m</th>
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Table 9: Estimated local community impacts for water recovery remaining under the Basin Plan, selected Local Government Areas \(^{(a)}\)

(a) Scenario results are pre water trade
Source: Arche Consulting (2011)
Balonne LGA

5.91  ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Balonne LGA to be a 25.2 per cent reduction in baseline irrigation use—refer Table 9.

5.92  The study estimated that this reduction in water use would reduce irrigated cotton and cereals production by $62.9 million, partially offset by a $2.6 million increase in dryland grazing. The combined effect would be to reduce farm employment by 59 employees. Arche also calculated the flow on effect would reduce total employment in the Balonne LGA by 137 employees (Arche Consulting 2011).

Moree Plains LGA

5.93  ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Moree Plains LGA to be a 1.5 per cent reduction in baseline irrigation use—refer Table 9.

5.94  The study estimated that this reduction in water use would reduce irrigated cotton production by $6.4 million, partially offset by a $0.4 million increase in dryland cereals. The combined effect would be to reduce farm employment by 5 employees. Arche also calculated the flow on effect would reduce total employment in the Moree Plains LGA by 12 employees (Arche Consulting 2011).

Narromine LGA

5.95  ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated that there is no water recovery remaining for the Narromine LGA—refer Table 9, and as such, no further reductions in irrigation production or employment are estimated as a result of the Basin Plan (Arche Consulting 2011).

Griffith LGA

5.96  ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Griffith LGA to be a 15.6 per cent reduction in baseline irrigation use—refer Table 9.

5.97  The study estimated that this reduction in water use would reduce irrigated rice production by $27.8 million, partially offset by a $2.3 million increase in dryland grazing. The combined effect would be to reduce farm employment by 59 employees. Arche also calculated the flow on effect would reduce total employment in the Griffith LGA by 89 employees (Arche Consulting 2011).

Leeton LGA

5.98  ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on
this, Arche Consulting calculated the water recovery remaining for the Leeton LGA to be a 15.6 per cent reduction in baseline irrigation use—refer Table 9.

5.99 The study estimated that this reduction in water use would reduce irrigated rice production by $18.6 million, partially offset by a $1.8 million increase in dryland grazing. The combined effect would be to reduce farm employment by 39 employees. Arche also calculated the flow on effect would reduce total employment in the Leeton LGA by 55 employees (Arche Consulting 2011).

Murrumbidgee LGA

5.100 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Murrumbidgee LGA to be a 15.6 per cent reduction in baseline irrigation use—refer Table 9.

5.101 The study estimated that this reduction in water use would reduce irrigated rice production by $23.2 million, partially offset by a $1.9 million increase in dryland grazing. The combined effect would be to reduce farm employment by 49 employees. Arche also calculated the flow on effect would reduce total employment in the Murrumbidgee LGA by 69 employees (Arche Consulting 2011).

Deniliquin and Murray LGAs

5.102 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the combined Deniliquin and Murray LGAs to be a 15.6 per cent reduction in baseline irrigation use—refer Table 9.

5.103 The study estimated that this reduction in water use would reduce irrigated rice and pasture production by $10.9 million, partially offset by a $1.7 million increase in dryland grazing. The combined effect would be to reduce farm employment by 21 employees. Arche also calculated the flow on effect would reduce total employment in the combined Deniliquin and Murray LGAs by 42 employees (Arche Consulting 2011).

Greater Shepparton LGA

5.104 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Greater Shepparton LGA to be a 22.0 per cent reduction in baseline irrigation use—refer Table 9.

5.105 The study estimated that this reduction in water use would reduce irrigated dairy and cereals production by $32.4 million, partially offset by a $4.6 million increase in dryland grazing. The combined effect would be to reduce farm employment by 67 employees. Arche also calculated the flow on effect would reduce total employment in the Greater Shepparton LGA by 107 employees (Arche Consulting 2011).
Gannawarra LGA

5.106 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Gannawarra LGA to be an 11.0 per cent reduction in baseline irrigation use—refer Table 9.

5.107 The study estimated that this reduction in water use would reduce irrigated dairy and cereal production by $17.7 million, partially offset by a $2.3 million increase in dryland grazing. The combined effect would be to reduce farm employment by 29 employees. Arche also calculated the flow on effect would reduce total employment in the Gannawarra LGA by 46 employees (Arche Consulting 2011).

Mildura LGA

5.108 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Mildura LGA to be an 11.0 per cent reduction in baseline irrigation use—refer Table 9.

5.109 The study estimated that this reduction in water use would reduce irrigated wine grapes, citrus and field crop production by $24.2 million, with no offsetting increase in dryland production. The effect would be to reduce farm employment by 88 employees. Arche also calculated the flow on effect would reduce total employment in the Mildura LGA by 141 employees (Arche Consulting 2011).

Berri-Barmera LGA

5.110 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Berri-Barmera LGA to be a 12.1 per cent reduction in baseline irrigation use—refer Table 9.

5.111 The study estimated that this reduction in water use would reduce irrigated vines and other crop production by $6.1 million, with no offsetting increase in dryland production. The effect would be to reduce farm employment by 29 employees. Arche also calculated the flow on effect would reduce total employment in the Berri-Barmera LGA by 43 employees (Arche Consulting 2011).

Murray Bridge LGA

5.112 ABARES estimated a 2,800 GL water recovery scenario which accounted for expected water savings from infrastructure investments and buybacks to date. Based on this, Arche Consulting calculated the water recovery remaining for the Murray Bridge LGA to be a 12.1 per cent reduction in baseline irrigation use—refer Table 9.

5.113 The study estimated that this reduction in water use would reduce irrigated dairy production by $2.4 million, partially offset by a $0.3 million increase in dryland grazing. The combined effect would be to reduce farm employment by 6 employees. Arche also calculated the flow on effect would reduce total employment in the Murray Bridge LGA by 12 employees (Arche Consulting 2011).
Chapter 6: Benefits of the Basin Plan

Key points

- The Basin Plan will result in significant social, economic and environmental benefits to the environment and communities. It is important that these benefits be assessed and considered when weighing up the costs and benefits of the Basin Plan.

- The concept of ecosystem services provides a basis on which to value environmental assets, and hence, the improvements to environmental assets that may result from a Basin Plan
  - Under current water management arrangements, ecological health is poor and declining across many regions in the Basin.
  - It is possible, drawing on existing data, to estimate the broad costs and benefits that would result from a Basin Plan. The magnitude of the benefits of the Basin Plan is likely to exceed the costs associated with the Basin Plan.
  - However, it is currently difficult to evaluate the improvements to ecosystem services that may result from increased flows. Further scientific research is required to better understand how flows relate to environmental assets, and hence to the ecosystem services provided by those assets.

- The MDBA has commissioned a major new study by the CSIRO, which will apply an ecosystem services approach, and integrate biophysical models and analysis with economic valuation techniques to quantify the likely multiple benefits of the Basin Plan.

Assessing benefits of the Basin Plan

6.1 As described in Chapter 1 of this report, the Basin Plan will result in a range of social, economic and environmental benefits to the environment and to communities.

6.2 These benefits can be measured in a number of ways. From a scientific perspective, an assessment of benefits could be informed by knowledge of the status of ecological or environmental indicators. From a social perspective, benefits might be measured through indicators of social capital (Falk and Harrison 2000). Or, using economic techniques, benefits can be measured in monetary terms.

6.3 The MDBA considers it important that the benefits of the Basin Plan can be expressed in monetary terms, to the extent feasible, as this facilitates comparison of the benefits of the Basin Plan with the anticipated economic costs. Similarly, it is important to that the social costs can also be assessed in qualitative and monetary terms, to the extent possible.

6.4 With this aim in mind, the MDBA has commissioned two studies by Morrison and Hatton MacDonald (2010) and the Centre for International Economics (2011) which have provided the MDBA with indicative monetary measures of some of the benefits of the Basin Plan. These studies present the best available scientific knowledge, as of November 2011, with regard to the quantification of the social and economic benefits of the Basin Plan in monetary terms.
6.5 The findings of these studies confirm that the magnitude of the long run benefits of the Basin Plan is likely to exceed the long run costs.

6.6 The MDBA has also commenced a major new project by the CSIRO to assess the multiple benefits of the Basin Plan. While this project remains incomplete as of November 2011, the MDBA has received and considered an interim report from the study (Crossman, Rustomji et al. 2011) and other outcomes from the project.

**Study by Morrison and Hatton McDonald**

6.7 The MDBA commissioned a study by Morrison and Hatton MacDonald (2010), which reviewed methods that could be used to undertake environmental valuation in the Basin and previous studies which had estimated values of environmental assets within the Basin. Drawing on this information, it presented estimates of environmental values for regions of the Basin and for the Basin as a whole.

6.8 The study identified 15 previous studies which had estimated the value of a range of environmental attributes (recreation, native vegetation, native fish, colonial waterbird breeding, and waterbirds and other species) in 19 regions of the Basin. Drawing on these previous studies, Morrison and Hatton McDonald derived attribute values in the 19 regions, expressed as a value per visit (for recreational values) or per household (for non-use values). They then estimated aggregate values for these environmental attributes. In calculating these aggregate values, assumptions were made about the extent to which households in different regions of the Basin would value environmental attributes outside their region. As a base case, the authors assumed that all households across Australia would value the Murray River, but that other environmental attributes would be valued only by households in the same state. The report also considered scenarios in which a greater proportion of households would value environmental attributes outside their state.

6.9 The study found that:

- Assuming the ‘base case’ scenario, aggregate values for environmental improvements in Basin regions would range from the in order of $300,000 (for a marginal increase in native fish populations in the Moonie region) to $375 million (for a one-year increase in frequency of colonial waterbird breeding in the Murray).

- The largest values for environmental attributes (native vegetation, native fish, frequency of waterbird breeding, and waterbirds and other species, but excluding recreation) are for the Murray River. For most of the attributes, the next highest values are for the Goulburn River. Values for the Ovens, Campaspe and Loddon Rivers are also relatively high. The lowest values are for the Moonie River.

- In general, the values for the NSW and Victorian rivers are fairly similar for vegetation, fish and waterbirds and other species. Values for Queensland and South Australian rivers are lower.

- The values for waterbird breeding are highest in the Murray and Macquarie-Castlereagh systems.
Totalled across the Basin, the aggregate values for marginal increases in environmental quality were estimated at $132 million (for a one percent increase in native vegetation); $95 million (for a one percent increase in native fish populations); $564 million (for a one-year increase in frequency of colonial waterbird breeding); and $44 million (for unit increases in the numbers of waterbirds and other species)—i.e. a total aggregate value in the order of $800 million.

Morrison and Hatton McDonald (2010) also refer to a previous unpublished study by Morrison, Hatton MacDonald et al. (2010) which estimated that the value of improving the quality of the Coorong from poor to good would be $741.44 (present value) per household. Drawing on this study, the authors calculated that the aggregate value of improving the quality of the Coorong would be $4.3 billion.

Overall, the work by Morrison and Hatton MacDonald provides relative estimates of the environmental values that may be associated with marginal increases in environmental quality, in different regions of the Basin, in the context of specific assumptions regarding the extent to which households value environmental attributes outside their immediate region, and an assumption that values from the previous 15 studies can be directly compared.

Study by the Centre for International Economics

The MDBA commissioned a study by the Centre for International Economics (CIE 2011), to further investigate benefits and costs associated with the Basin Plan. This report described the issues and challenges associated with undertaking a benefit–cost analysis of the Basin Plan, and presented illustrative cost and benefit estimates associated with the three SDL scenarios set out in the MDBA’s Guide to the proposed Basin Plan.

The report calculated aggregate environmental benefits, in the context of estimated ecological outcomes, by drawing on valuation estimates by Hatton MacDonald, Morrison et al (2011), Lester and Fairweather (2011) and Morrison and Hatton MacDonald (2010). It presents aggregate benefits for three scenarios:

- a scenario using the estimates compiled by Morrison and Hatton MacDonald (2010)
- a scenario which assumes that benefit values reported for the Murray by Morrison and Hatton MacDonald (2010) can be applied across the whole Basin
- a scenario which estimates the length of river that is improved as a consequence of increased environmental flows.

Under the first scenario, with respect to ‘non use’ values, the report found that benefits would be in the order of $3 billion to $5 billion. If the benefits associated with improved environmental quality in the Coorong are included, the value of the 4,000 GL scenario increases to just over $8.5 billion. Benefit values are higher for the second and third scenarios.

With respect to ‘use values’, the report found that benefits would be in the order of $500 million to $600 million (for recreational value, depending on which water recovery scenario is chosen), and considerably less for other uses.
6.17 The report found that costs as a consequence of SDLs would lie within the range of $1 billion to $4.5 billion (with water recovery of 3,000 GL) up to a range of $1.3 billion to $7.3 billion (with water recovery of 4,000 GL).

6.18 Taking the mid-point of the estimates, the report found that the benefits of the Plan would outweigh the costs.

6.19 The report had some limitations, which the report recognises and proposes could be addressed through further work. These limitations included:

- The need for better science to predict ecological responses to flow events. While there is a body of currently available information about ecological responses to increased environmental flows, and the valuation of those responses, there is a need for further work in this area.

- The need for improved techniques to economically value ecological outcomes. Work is still ongoing to develop better techniques to measure values which cannot be directly measured using market or other objective empirical information.

- The social and economic impacts of the Basin Plan will depend on a wide range of factors other than the Basin Plan, including policy settings (e.g. environmental watering plans, the government’s water buyback program, irrigation upgrade programs, and other structural adjustment packages) and other drivers (e.g. interest rates, commodity prices, costs of inputs and climatic variability).

- The report focused on long-term permanent costs and benefits. However, it is also important to consider short-term adjustment costs.

CSIRO multiple benefits project

6.20 In recognition that the benefits of the Basin Plan require greater attention, the MDBA commissioned a major new study by the CSIRO to assess the multiple benefits of the Basin Plan.

6.21 While ‘non-use’ values are likely to form a significant component of the benefit of policy interventions relating to improved natural resource management, there is significant scepticism about the robustness of their valuation. This is an important point because the CIE report highlighted that most of the benefit of the Basin Plan would be comprised of these ‘non-use’ values. There is also significant scepticism as to whether ‘non-use’ values which accrue to the population outside the Basin should carry equivalent weighting with ‘non-use’ values—or, indeed costs—which accrue within the Basin.

6.22 The CSIRO project adopts an ecosystems services approach for assessing the potential benefits of the Basin Plan that incorporates these values into an overall cost-benefit analysis, and which will allow the MDBA to consider separately the ‘non-use’ benefits accruing in each catchment and nationally.

6.23 The CSIRO multiple benefits project presented an Interim Report to the Murray–Darling Basin Authority in September 2011 (Crossman, Rustomji et al. 2011). This interim report described the condition and trend of the Murray–Darling Basin and concluded on the basis of previous studies that, under current water management arrangements, ecological
health is poor and declining across many regions in the Basin. The report also presents an ecosystem services methodology, which could be used to account for the multiple benefits of implementing the Basin Plan. This approach integrates biophysical models and analysis with economic valuation techniques to quantify the likely multiple benefits of the Basin Plan.

**Implications for the social and economic assessment**

6.24 The Authority considers that the work undertaken to date confirms that the magnitude of the benefits of the Basin Plan is likely to exceed the costs.

6.25 However, the Authority is aware of the limitations inherent in existing work to value the benefits of the Plan. There remain limits to the ability of economics to capture all values associated with ecosystem services, and there is ongoing debate about the reliability of monetary estimates of non-use values of biodiversity derived through stated preference (choice modelling and contingent valuation) studies. There also remains a need to analyse separately the links between hydrological changes and the sustainability of ecological systems—for example, determining thresholds below which stocks of natural assets, and hence ecosystem services, might eventually collapse. There are still significant gaps in data and knowledge about these ecological thresholds.

6.26 In this light, the Authority considers that the work described in this chapter represents just one line of evidence to support analysis of the benefits of the Basin Plan. The MDBA will continue to pursue, through the CSIRO multiple benefits project and other avenues, further improvement in scientific knowledge to build a more complete understanding of the benefits of the Basin Plan and how they can be assessed.
Chapter 7: Managing the transition

Key points

- Looking forward, the focus should be on how communities can adjust to the Basin Plan and how the transition process can best be managed.

- The Authority’s proposed transition period from 2012 to 2019, with a review point in 2015, acknowledges that adjustment takes time, and a longer transition period allows for more gradual adjustment and the incorporation of new knowledge along the way.

- During the transition period, the MDBA will be seeking further scientific, technical and local information to help inform refinements to the Basin Plan and to the SDLs. This new evidence may support changes to the SDLs proposed in the draft Plan.

- In considering the social and economic impacts of the Basin Plan, the Authority has identified policy opportunities which have the potential to mitigate the costs of the Basin Plan. Some of these are the responsibility of the MDBA, while others are the responsibility of other areas of the Australian Government, or of state governments. For this reason, better coordination between the Commonwealth and state governments, as well as with local organisations, is a key area of policy which has the potential to enhance outcomes. Policy opportunities include:
  - the timeframe for implementing the Basin Plan, and the timetable for the Australian Government’s buyback and infrastructure investment programs in the Murray–Darling Basin
  - the role of local community ideas and knowledge in the management of environmental water
  - how water is acquired for, and delivered to, the environment
  - environmental works and measures
  - improved river operations
  - the management and trading strategies of environmental water holders
  - the potential for improved carryover provisions
  - the development of new water trading products
  - additional support for communities in managing the transition.

- The Authority is confident that communities, given time, have the potential to be highly adaptive and innovative when appropriately informed and equipped with the right tools and assistance. This confidence has been an important factor underpinning its judgement about the scale of change.

- The Authority believes that the Basin Plan will be most effective if governments and communities work together, and has proposed that localism should provide a sound foundation on which the Basin Plan process is progressed.
An adaptive plan

7.1 The MDBA has identified a range of impacts of the Basin Plan that are likely to be felt by specific communities. The Authority believes that these estimated impacts are not necessarily deterministic, but frame the possible scope of the social and economic changes required to realise a healthier Basin.

7.2 Looking forward, the focus is now on how communities can adjust, and how this transition process can best be managed and facilitated. As part of this adjustment process, the MDBA supports a seven-year transition period between 2012 and 2019, with a review point in 2015. This period will provide opportunities for:

- Further improvements in scientific knowledge to inform refinements to the Basin Plan and to the SDLs as new evidence may support changes to the SDLs.

- Communities to plan for their own futures, and to successfully adjust to less water. A longer transition period will provide more time for people to adjust and adapt to the Basin Plan. The MDBA is confident that communities, given time, have the potential to be highly adaptive and innovative when appropriately informed and equipped with the right tools and assistance.

- Governments to take actions and examine potential policy opportunities that could mitigate the social and economic impacts of the Plan and ease the transition to new SDLs.

7.3 Change has long been a feature of the agricultural sector, driven by factors including technological change, commodity price changes and climatic variability. Australian agricultural producers have demonstrated considerable capacity to adapt (refer to Box 11).

7.4 In particular, communities in the Basin have demonstrated their resilience and ability to adapt during the recent drought. Experiences in the Lower Lakes and Coorong provide a good example of how communities can adapt to adversity. A report commissioned by the MDBA (Sobels 2011) found that while these communities had experienced considerable stress, many individuals, families and businesses had responded, often quite innovatively, in adjusting to changing circumstances. Changes to the agricultural sector as a result of the Basin Plan need to be considered in this context. Furthermore:

- Australia has a strong agricultural export market, and the continued rise of China and overall strength of Asian markets is likely to see continued strong demand into the future.

- Productivity growth has been strong for the agricultural sector overall, and can be expected to continue into the future. New technologies and research and development, particularly into more efficient uses of water, have the potential to increase the productive capacity and efficiency of the sector.

- The continued development of a sophisticated market for water trading across the Basin will further increase flexibility and efficiency in water allocation, maximising the productive potential of available water.
7.5 The Basin Plan could also benefit existing industries (such as floodplain grazing through overbank flows), create new markets, or facilitate fledgling emerging markets, particularly as more water for environmental purposes has the potential to attract greater numbers of tourists to the Basin. However, while tourism offers some potential, it will not be an appropriate solution for all communities, and will depend on an area’s proximity, natural assets, historical and cultural features.

‘If you want to create new industry in rural areas there has to be natural synergies (distance to market, natural resources etc, Tourism is not (necessarily) the answer. Promote things that are already happening’ [Respondent from the Namoi, (EBC, RMCG et al. 2011a)]

7.6 Some irrigated agricultural areas of the Basin are proving that tourism can be successful. For example, the town of Hay, on the Murrumbidgee, has invested successfully in tourism over recent years. However, as the Hay Council noted in their consultations with EBC, RMCG et al. (2011a), substantial resourcing is required to establish a successful tourism industry, and this is often beyond the reach of smaller communities.

Adjusting to the Basin Plan

7.7 The Basin Plan will require irrigated agricultural producers to adjust to a future with less water available for irrigation. The financial circumstances of producers, including their overall profit margin and underlying capital, debt and cost structures of different enterprises will affect their capacity to change their production operations and to absorb a reduction in diversions. Farmers will have less capacity to adapt if they are under financial stress.

7.8 While recent rains have helped, farmers are likely to require several years to fully return to their pre-drought financial positions. Some farmers have taken out additional borrowing which has stretched their finances to their limits, reducing their financial and emotional capacity to undertake further adjustment.

7.9 Low farm margins, combined with the uncertainty of future water availability (whether because of drought or the Basin Plan) may make farmers unwilling to take on higher debt. Furthermore, while farmers generally have substantial assets, they are generally cash flow poor, and this also affects their capacity to service debt.

7.10 A key adaptation strategy will be increasing productivity. A requirement for farmers contemplating investment in productivity improvements is an adequate level of confidence to make the required investment and access to capital. Farms with higher financial performance are in a better position to innovate (Liao and Martin 2009). On the other hand, unwillingness or lack of capacity to take on debt may constrain the ability of farmers to continue to increase farm productivity through capital investment.

7.11 In some regions, substitution from irrigation to dryland will offset losses in irrigated production. However, in other regions, this is likely to prove difficult. Irrigated farms are often not large enough to convert to profitable dryland farms, as they require different economies of scale and financial structures. Consolidation to achieve larger dryland farms will require access to capital which may not be readily available to financially stressed operators.
Box 11: Structural adjustment in Australia

'Structural adjustment' is the continuing process of compositional shifts in the economy—that is, changes in the relative size and composition of industries and their workforces, and in the size and mix of activities within regions (NWC 2009b; Productivity Commission 2001). It is an ongoing and natural process in all industries, which provides a mechanism by which the economy transforms and grows, and results in better living standards for citizens (Frontier Economics 2010; McColl and Young 2005; Productivity Commission 2001). It can be driven by many factors, including market-related factors (e.g. new technologies, changes in consumer tastes or lifestyles); government-related factors (e.g. changes in trade and investment barriers, industry reforms, and regulatory reform) (Productivity Commission 2001:1); and exogenous factors (e.g. climatic variability).

Structural adjustment involves changes to the circumstances faced by citizens. While it tends to be overwhelmingly positive, the redistributions that result can lead to a relative loss of position for a small number of participants (Productivity Commission 1999b). These relative losses of position need not mean reform should not proceed, as mechanisms are available to help alleviate the impacts of structural adjustment. For example, it is possible to transfer some of the gains from reforms (such as higher taxation revenue) to affected parties through assistance packages and support.

While it is important that governments adequately acknowledge and consider the impacts of structural reforms on those who may be worse off (Productivity Commission 2001), it is also important that governments are not captured by a particular interest group’s concerns to the detriment of Australia as a whole. Australia’s commitment to structural reform has contributed to the prosperity that Australians enjoy today and continued commitment will be necessary to ensure that this prosperity continues to be enjoyed by future generations.

Australia has a long and successful history of structural adjustment. These reforms have served Australia well, and have contributed to the strong economic position that Australia enjoys today.

The 1995 National Competition Policy (NCP) committed Commonwealth and State governments to reforms which have introduced greater competition into government service provision and market regulation. The Productivity Commission’s 2005 review of these reforms found that the NCP reforms delivered significant benefits to the Australian economy (Productivity Commission 2005a). The Organisation for Economic Cooperation and Development (OECD) has recognised Australia’s programme of pro-competitive reforms as a model of successful economic policy.

While the benefits of these reforms may now seem self-evident, the reforms were (at the time) not embraced by all sectors. The 1999 Productivity Commission review of the Impact of Competition Policy Reforms on Rural and Regional Australia (Productivity Commission 1999a) noted that a range of changes that were occurring in regional Australia were becoming the scapegoat for NCP reforms.

Australia’s experience with structural adjustment has demonstrated that:

- Governments should focus on facilitating and expediting adjustment, rather than seeking to maintain the status quo
- The case for adjustment assistance needs to be considered on a case-by-case basis
- The actual effects of adjustment on communities are often less than may have initially been expected by those most likely to be affected as most communities tend to be more resilient in the implementation of reform then may be indicated by the trepidation of proposed reform
- The rates of change — in response to policy induced or market based adjustment — can vary significantly across communities
- The pace of adjustment is only partially dependent on government actions or market forces – individual choices play a central role, and individual decisions often can lag behind the drivers of adjustment due to non-pecuniary variables such as lifestyle.
7.12 Some farmers who are experiencing higher levels of financial stress or higher total farm debt relative to their sector may seek to exit farming altogether. The Australian Government's buyback program provides an opportunity for farmers to exchange their water entitlement assets for monetary assets. In general, a farmer will choose to sell his entitlements only when he considers that he will be in an equivalent, or better, financial position as a result of the sale. This redistribution of assets will facilitate adjustment, by helping farmers to maximise their productivity capacity. Furthermore, under higher water prices as a result of the Basin Plan, farmers will gain additional benefits from the buyback process.

7.13 Where farmers are financially stressed, they may not feel that they have a choice other than to sell their entitlements, if they require the sale proceeds to pay off high levels of debt accrued during drought. In those circumstances, the Government's buyback program provides these farmers with an additional option to purchase their entitlements that would not otherwise be available. Without the buyback program, farmers would not have this opportunity.

7.14 Other farmers may pursue avenues for generating off-farm income. Most irrigation farms in the Basin already have some form of off-farm income. A recent ABARES study has found that around one third of irrigation farms obtained more than half of total family income from off-farm sources (Ashton, Hooper et al. 2010).

Banking sector

7.15 Concerns have been raised that changes to the financial viability of farming operations in the Basin will have implications for the banking sector. Impacts on the banking sector are important to Basin communities. They are major employers in regional towns. Banks also play a major role in supporting agricultural businesses, including farms, suppliers and processors through the supply of capital for investment in those businesses.

7.16 While banks recognise that the drought has increased debt levels, and contributed to some deterioration in interest cover ratios and equity levels, banks consider that this deterioration has not been significant. ABARE survey information shows that, for the majority of farmers, both interest coverage ratios and equity levels have not deteriorated significantly, even given eight years of drought. The strength of these attributes can be seen in the level of loan write downs. Based on the Commonwealth Bank’s annual report for 2010, while there has been some deterioration in the level of impaired assets over the last two years, agricultural lending has had one of the smallest levels of any debt write down of any sector over the last 5 years (EBC, RMCG et al. 2011b).

7.17 In their submission to the Murray–Darling Basin Authority's consultation process following the Guide to the proposed Basin Plan, the Australian Bankers’ Association (ABA) emphasised that they did not expect that the release of the Basin Plan would change the way they manage customers that are in financial difficulty—all such cases will continue to be managed on a case-by-case basis. Should it be the case that a customer’s equity has eroded to a point where they are no longer financially viable, the ABA has suggested that it is industry practice for banks to negotiate an acceptable strategy for debt repayment with that customer—as they would for any other issue (e.g. fire, flood, drought, commodity price downturns) that might impact on that business (Australian Bankers Association 2011).
Overall, banks remain positive about the agriculture sector and, given global dynamics around food demand and shortage of supply, consider that as an investment prospect the sector has a solid future.

**Opportunities for governments**

The SDLs are among many factors that will influence the social and economic outcomes of the Basin Plan. The Authority considers that there are policy opportunities available, in the context of broader water policy and reform surrounding the Basin Plan, which could help to minimise the social and economic costs and improve environmental outcomes. The Authority seeks to highlight these areas as suitable for further consideration and discussion, and does not intend that these be interpreted as specific proposals or recommendations.

These opportunities have, in part, been identified through two studies commissioned by the MDBA: the report by the EBC Consortium (2011a) on the *Community Impacts of the Guide to the proposed Basin Plan* (Volume 4), and a report by the Nous Group (2010), which synthesised the findings of previous studies by ABARE-BRS (2010c) and MJA, RMCG et al. (2010) and discussed the policy implications. The MDBA has also built on these reports with its own analysis.

Some of these opportunities are within the remit of the Authority and the Basin Plan, while others are part of Commonwealth and state governments’ broader policies and programs that provide services and support to citizens in the Basin. The Authority considers that, although many of these policies are not within its area of responsibility, it is nevertheless well placed to provide a perspective on these issues.

In recognition of the responsibilities of different Commonwealth agencies, and the roles of state agencies, the Authority considers that better coordination, at the Commonwealth level and between the Commonwealth and state governments, is a key area of policy opportunity that has the potential to enhance outcomes.

Looking forward, the Authority is committed to improving collaborative working arrangements across and between levels of government, and with local communities, to successfully deliver the Basin Plan. For example, this could include establishing better links between Commonwealth and state governments for disseminating and coordinating social and economic information on the Basin, exploring ways to enhance the coordination of service delivery across different levels or government, improving ways to respond to ‘bottom up’ feedback from communities, and greater public sharing of knowledge and information in these areas.

**Water recovery**

The draft Basin Plan specifies the level of water recovery that will be required. A range of mechanisms for water recovery exist, including purchasing water entitlements (buybacks) and infrastructure investments, to increase water availability for consumptive use.

The Australian Government has committed to ‘bridging the gap’ between current levels of water use and the SDLs under its Water for the Future program, by purchasing...
water and investing in more efficient irrigation infrastructure. This means no individual will have their entitlements compulsorily reduced or acquired as a result of the SDLs.

7.26 Under the Water for the Future program, the Restoring the Balance subprogram for voluntary water buybacks has a $3.1 billion budget for the purchase of water entitlements from the Basin, with additional appropriations to be provided as required to bridge the gap. The current commitment for projects in the Basin from the Sustainable Water Use and Infrastructure subprogram is $4.8 billion. Water recovery from these programs will be complemented by any water savings achieved through changes to river operations and management and environmental works and measures.

7.27 The Australian Government has also provided $10 million for feasibility investigations of environmental works to explore measures, with the potential to deliver more water-efficient environmental outcomes for the Basin’s rivers and wetlands, thereby reducing the need to recover water from consumptive users.

7.28 These programs are administered by the Department of Sustainability, Environment, Water, Population and Communities.

Water purchases—Restoring the Balance in the Murray–Darling Basin (buybacks)

7.29 The Restoring the Balance program (buybacks) under Water for the Future is one of the mechanisms by which water will be recovered under the Basin Plan. It will ensure that farmers who continue irrigating will not have their entitlements or allocations reduced, and farmers who choose to sell their entitlements receive full monetary compensation. Farmers are able to use the proceeds of sale to retire debt, invest in farm upgrades, diversify operations or exit irrigation farming. Some may be able to maintain their existing levels of production by using on farm productivity or efficiency gains.

7.30 Buybacks provide significant off-setting benefit to the individual seller; the changes in asset structures are likely to be, at a minimum, revenue neutral, or farmers would choose not to sell their assets. Buybacks could also generate significant additional revenue for farmers, particularly if water prices rise over the buyback period.

7.31 However, because the reduction in water available for irrigation will change the nature of water availability for farming—water assets will be exchanged for monetary assets—these changes will have flow-on effects on the industries and communities that support and rely upon irrigation farming. Changes to irrigated production will change the mix of agricultural goods and services produced, which will then affect the mix of non-agricultural goods and services as well. For the surrounding communities, these changes have the potential to reduce levels of expenditure and employment, particularly if the area is heavily dependent on irrigation.

7.32 As the implementation of this program is one of the major mechanisms by which water recovery will occur under the Basin Plan, how it is carried out could influence the social and economic impacts experienced by communities.

Timing of water recovery

7.33 A fundamental principle of structural reform is that adjustment requires time to allow resources to be redeployed across the economy. A water recovery strategy with a long time
horizon will allow for more gradual adjustment and therefore a smoother transition. Progressive change that does not impose a shock in any one year that is greater than communities can reasonably be expected to adjust to, is more likely to ensure communities can successfully adapt to that change.

7.34 The water recovery program has a 10 year time horizon, with the Australian Government conducting the first round of water purchases in 2007-08 and the final recovery (through buybacks and infrastructure investments) expected to occur in 2018-19.

7.35 Over a long time horizon, future productivity growth has the potential for assisting communities to ameliorate the adjustment impacts of the Basin Plan. As demonstrated through the strong historical productivity growth of the agricultural sector, farmers are continually adjusting and improving their productive capacity—over the last 30 years, productivity in Australia’s agricultural sector has typically exceeded productivity growth in the rest of the economy. Therefore, a water recovery strategy that loosely matches water availability reductions against expected productivity and efficiency gains could ease the adjustment path for farmers to successfully adapt to the Basin Plan.

**Location of buybacks**

7.36 The Department of Sustainability, Environment, Water Population and Communities issues tenders for the purchase of entitlements on the basis of achieving maximum environmental benefit per dollar spent.

7.37 Any approach which attempted to target specific locations in the Basin could result in a situation where sellers in one location sold to the Government for a certain price and then immediately purchased entitlements from another location at a lower price. Under these circumstances private sellers could profit at the Commonwealth’s expense.

- Water trading allows water to move freely across the Basin. Buybacks that were targeted at a specific location could be unwound by, for example, farmers exchanging their water entitlements for allocation trades, with no difference in production levels.
  - The SDLs comprise in-stream and downstream components. The in-stream component must be recovered from the individual catchment. For the downstream component, it has not been mandated where water recovery to meet the downstream watering needs is to be sourced, other than to identify those catchments that cannot contribute due to a lack of hydrological connectivity. This provides significant flexibility in water recovery activities.

- Location based approaches could disadvantage willing sellers if they are unable to partake in the buyback process because they are not in a desired location. This could have detrimental impacts for these farmers and their communities, particularly if a farmer intended to use the buyback process to consolidate their financial position or restructure their business.

7.38 However, an open market approach could mean that specific areas of the Basin may be faced with uneven adjustment paths, particularly if a single large entitlement holder chose to offer their full entitlement holdings at a single point in time, even though it is appropriate that eligible sellers are able to enter the market at any point in time. Despite this possibility,
attempts to target recovery in specific areas of the Basin may be ineffective, and could have unintended negative consequences.

7.39 Instead, in an interconnected economy where impacts of the Basin Plan are unlikely to be able to be quarantined to a specific area, the Authority considers that in the context of an open market approach, adequate consideration should be given to the timing, scope and size of the buybacks, so as to ensure communities are best equipped to adapt to the Basin Plan, in conjunction with pursuing the required environmental objectives.

7.40 Communities have also expressed concerns that buybacks could reduce the efficiency of delivering water and increase the maintenance costs and delivery fees for the entitlement holders who remain (the ‘Swiss Cheese’ effect).

7.41 There are already policies and programs to help limit these concerns and improve the efficiency of irrigation networks.

- Irrigation infrastructure operators can charge termination fees for irrigators that no longer wish to maintain water delivery services to their property. Termination fee rules set an upper limit on the fees that irrigation infrastructure operators can charge irrigators that no longer wish to maintain water delivery services to their property. While there are some exceptions, the rules cap termination fees at ten times the annual total network access charges. This limits the cost to irrigators exiting the sector (and therefore reduces the risk of termination fees being a barrier to adjustment) and gives infrastructure operators certainty about revenue from fixed access charges. This in turn allows operators time to assess the net impact of water trading on the long run demand for their services and to adjust their operations if necessary through rationalisation or restructuring.

7.42 The Water for the Future program includes investment in programs to assist irrigation infrastructure operators with the modernisation and rationalisation of their networks to assist in their adjustment to the Basin Plan, and provides funding for ‘hotspots’ assessments so that irrigation infrastructure operators can identify the nature, location and volume of water moving out of their system, and identify potential water savings measures. The Department of Sustainability, Environment, Water, Population and Communities is also implementing strategies to further mitigate any unintended consequences of the buyback program for the delivery of water, and is continuing to discuss with stakeholders how to better integrate water purchasing with the rationalisation or reconfiguration of inefficient or underutilised parts of the irrigation delivery network.

Infrastructure investments

7.43 The Sustainable Rural Water Use and Infrastructure Program is administered by the Department of Sustainability, Environment, Water, Population and Communities. This is a national program which includes projects that invest in modernising irrigation delivery systems and more efficient on-farm irrigation technology that generate water savings which are shared between farmers, communities and the environment. While investments in irrigation efficiency have a higher budgetary cost than buyback in terms of the volumes of water recovered, investments could also generate wider economic benefits such as:
• maintaining or increasing existing productive capacity in the irrigation district, thus mitigating flow-on effects associated with water purchases

• higher levels of service in water delivery, which can promote greater productivity on-farm and enhance the productive capacity of the regional economy

• greater benefits under drought conditions, where evaporation and transpiration losses would otherwise be higher

• short-term construction benefits in the region from the works required.

Environmental watering plan

7.44 The environmental watering plan is an important feature of the Basin Plan. Its purpose is to achieve the best possible environmental outcomes using the amount of water made available by the Basin Plan. The environmental watering plan ensures that the size, timing and nature of river flows will maximise benefits to the environment.

7.45 This nature of the environmental water requirements, specified in the environmental watering plan, are likely to influence the social and economic effects of the Basin Plan, with the extent of any impact depending on how reductions in irrigation water availability are distributed over time and under varying seasonal conditions.

7.46 The economic cost of removing water from irrigated production (measured by the market price) is significantly higher in dry years than during wet years, particularly during the short run. As such, while environmental requirements will need to be developed with a view to maximising environmental benefits, maintaining a degree of flexibility over environmental watering has the potential to improve both social and economic outcomes and outcomes for the environment.

• For example, it could be feasible to delay a specific environmental watering event during a drought period in order to achieve greater environmental outcomes in the future when it is possible to piggyback on periods of higher natural flows.

• This could also act to increase the availability of water for irrigation purposes during the drought, therefore lowering overall economic costs.

7.47 To the extent that less water could be available during dry periods, the environmental watering plan could potentially result in a shift in production mix away from perennial activities and toward annual activities.

• Cropping based on lower reliability entitlements is well suited to Australia’s variable climate conditions, and enables farmers to make annual decisions on planting based on water availability at the time.

• Water entitlements are divided into differing classes of security, where security refers to the frequency with which water allocated under that entitlement is able to be supplied in full. Low security entitlements may generate the same average long term yields as high security entitlements, but high security entitlements have higher values because of greater average and less variable yields.
• Entitlement types are not fully interchangeable, even in the long run, as many high value irrigation activities cannot rely on low security entitlements, as the likelihood of low allocations in dry years would create an unacceptable level of risk for their capital investment (e.g. fruit trees or vines). The same logic applies to high value environmental assets that would require watering every year. These differences are reflected in market prices.

7.48 As the mix of entitlement classes are not distributed evenly across the Basin, different environmental watering plans could also have different regional impacts. However, in practice, any effects the Basin Plan may have on long-run irrigator investment decisions are likely to be small relative to the effects of external factors such as climate change and commodity prices (ABARES 2011d).

Environmental works and measures and river operations

7.49 River management involves the storage and delivery of water within a river system—including management of dams and reservoirs, flow regulators, other works and measures, drought conditions, flood risk and water quality issues.

7.50 While most infrastructure will already be operated to most efficiently meet its design objectives (e.g. minimising evaporation in order to maximise the amount of water that can be delivered to entitlement holders), this is not necessarily the best system of operations for environmental needs. Re-examining these river management arrangements may present opportunities for water savings or better environmental outcomes through improved river management. In reviewing arrangements, consideration of changes needs to take account of potential third party impacts.

7.51 Works and measures, such as regulators, levy banks, easements or pumps, could help achieve environmental outcomes, but with lower volumes and less secure entitlements. Alternatively, they could deliver greater environmental benefits for the same amount of water.

• For example, it may be possible to generate the desired in-stream needs of nominated icon sites through direct means rather than through raised overall flow rates. This may allow the same outcomes to be achieved at lower volumes and with less secure entitlements.

• However, the needs of upstream and downstream sites also need to be considered when evaluating any possible increase in SDLs, not just the needs at an individual site. In practice, a suite of works along a whole river reach may deliver the best outcomes.

7.52 Enhanced river operation and management tools might be able to make environmental watering easier and more effective. For example, allowing dams to spill at lower levels would allow more natural flow events and more closely mimic natural wetting cycles. Combining environmental watering with other releases or natural rain events would mean higher flow peaks could be achieved and ensure that environmental water holders get the best value out of held environmental water. Changes to how storages and infrastructure, such as those at Menindee Lakes or at the Lower Lakes, are managed could also have potential for improvements for environmental watering.
7.53 Most rivers in the Basin (particularly in the southern Basin) are now highly regulated, with significant headworks, regulators, weirs and off-stream storages to deliver water for environmental and consumptive uses. Current monitoring arrangements and levels of control are relatively simple, but future, more sophisticated real time river operation and management tools could provide river operators with greatly enhanced ability to measure and control required releases. More focussed and timely releases, delivering the right volume of water to the right location at the right time, would reduce the total volume of water required to meet the environmental outcomes.

7.54 Most of the responsibility for engineering works and measures is likely to be the responsibility of state governments, funded by the Australian Government under National Partnership Agreements; however local community groups and Catchment Management Authorities could also propose projects. In practice, good coordination between the local and state levels and across projects is likely to offer the best improvements in water management.

7.55 River management opportunities are also likely to require coordination between the state and Commonwealth governments. To the extent that changes are proposed to the Murray–Darling Basin Agreement, this would require the approval of the Legislative and Governance Forum.

Inter-annual flexibility (carryover)

7.56 The flexibility to manage environmental water year to year increases the efficiency and effectiveness of how water can be used—a private right to ‘carry-over’ water allows unused allocations to be used in the following season. This gives allocations from low security entitlements some of the characteristics of higher security entitlements, as an allocation in a high rainfall year can then be shared over a number of the following seasons.

7.57 The benefits of carryover are likely to be accessed both by irrigators and environmental managers. Increased carryover capacity could allow either environmental outcomes or irrigation needs to be met with a larger proportion of low security entitlement, decreasing the financial costs.

7.58 However, the Authority acknowledges that, while increasing private carryover may create some economic benefits, it may also reduce storage capacity and increase the risk of spills—increasing the potential for inundation of agricultural land on the flood plain or overbank flows. Individual irrigators will tend to lose water that spills, while the environment may benefit from both carryover and spills.

7.59 Well-defined carryover rights will generally enable irrigators to manage better the variability of irrigation water supplies. However, for water storage rights to be effective (for both irrigators and the environmental managers) they need to be well specified in terms of accurately reflecting hydrological realities. In particular, water storage rights should accurately reflect actual water storage capacity constraints (and storage losses), while not imposing any artificial constraints (Hughes and Goesch 2009).

7.60 The Authority acknowledges that existing allocation regimes already involve complex decisions on the sharing of rights to the available resource within and between seasons, but considers that further examination of the current arrangements may allow for additional
benefits to be realised. Within the Basin, carryover rights are managed by state governments.

Management role of environmental water holders

7.61 The Commonwealth Environmental Water Holder (CEWH) is the independent statutory position created by the Water Act 2007 (Cth) to manage the Australian Government’s portfolio of water assets. The Water Act 2007 (Cth) provides for the CEWH to trade entitlements and seasonal allocations to improve the capacity of the Commonwealth environmental water portfolio to meet environmental objectives. The CEWH will be the largest holder of water entitlements in the Basin and, as such, how it chooses manages that portfolio could have different social and economic effects. In particular, decisions by the CEWH of the extent and types of trading it may wish to carry out could influence the social and economic impacts experienced by communities.

7.62 It is a useful starting point to consider the case where the CEWH does not trade at all. In this case, the CEWH would be required to adopt a risk-averse position where it permanently held the full volume of water entitlements it required in any one year. Because of the large degree of variability in the Basin, this position would result in excess water allocations (and excess financial assets) in some years. This outcome would impose greater economic and social costs on communities, by limiting irrigation opportunities, than would be possible if the CEWH were to flexibly manage its assets, and is likely to be more expensive to maintain.

7.63 The large degree of climate variability in the Basin means that the environment will have changing water requirements over time. Potential changes in climate, as well as new and improved information on environmental management, may mean that the optimal management strategy may shift over time. Active trading of its portfolio by the CEWH would allow for a more flexible mix of watering entitlements that could be more closely matched with the desired outcomes at any point in time.

7.64 Trade also has the potential to benefit the agricultural sector and reduce economic impacts on communities as a result of the Basin Plan. For example, the CEWH might choose to sell a proportion of entitlements back to the market in dry periods if water prices are high, therefore expanding the consumptive pool available for irrigation, and purchase allocations to supplement flows in a wet period.

7.65 In addition, trading allows water to move to its highest value, maximising the returns available each party to the trade. Economic modelling for the MDBA has confirmed that trading with the Basin will reduce the overall economic impacts of the Basin Plan because it allows for adjustment by individual irrigators.

7.66 The Department of Sustainability, Environment, Water Population and Communities released a discussion paper, Commonwealth Environmental Water — Trading Arrangements on 7 November 2011 (SEWPAC 2011) which discusses these issues in more detail.
Development of new water products

7.67 An active water trading market could conceivably be extended to the development of more sophisticated products for acquiring water. The water market is well suited for the further development of financial market products for water, because water is essentially a commodity with minimal and measurable qualitative differentiation across the market. Furthermore, the variable nature of water availability in the Basin makes these types of instruments attractive to financial markets. These products would allow participants to hedge their water portfolios directly (rather than through indirect financial management options) and provide a greater range of management possibilities for participants.

7.68 These possibilities include the development of financial options and futures, covenants, leasing instruments, or the private sector delivery of environmental watering outcomes.

7.69 The Authority acknowledges that further development of the sophistication in the water extends the separation between water entitlements and the end users of the entitlements. These financial products could then be subject to speculation and a range of other factors that affect financial markets that would not be directly linked to the investment decisions of farmers. Therefore the Authority considers that the development of these products would need to be accompanied by adequate consideration of the appropriate regulatory arrangements required to govern a more sophisticated market.

Transitional support

7.70 The impacts of the Basin Plan are likely to be distributed unevenly over time. Costs are likely to be greater upfront, with benefits not realised until further into the future.

7.71 The Australian and state governments already have a range of national or state based programs which are available to assist farmers and communities manage the transition to the Basin Plan. These include employment assistance and training, mental and physical health support, as well as drought assistance, climate change programs and agricultural development policies.

7.72 There are also existing Australian Government programs which have a national scope but may be available to assist Basin communities adapt to the Basin Plan. These programs include $1 billion for infrastructure projects and initiatives that contribute to the long-term growth of communities through the Regional Development Australia Fund; and $20.3 million in funding for Regional Development Australia Committees. The Department of Regional Australia has committed to work with affected regions to assist them adapt to a water constrained environment, capitalise on their competitive advantages and build the economic resilience of communities.

7.73 In addition to these existing programs, the Authority considers that it may be worthwhile examining whether farmers within the Basin could benefit from additional support to assist with planning their futures under the Basin Plan, although the Authority acknowledges that planning programs are already available. Many irrigators will be looking to sell a proportion of, or all of, their water entitlements under the Basin Plan and the Authority considers that good prospective planning can help maximise a farmer’s future financial position and strategic investment decisions.
• Under the planning component of the Australian Government’s Strengthening Basin Communities program, grants are already provided for local governments in the Murray–Darling Basin to help them systematically assess the risks and implications associated with climate change and review existing plans or develop new plans to take account of these risks and implications.

7.74 A key feature of the recently completed review of the pilot drought reform measures in Western Australia was an analysis of the farm planning program delivered as part of the pilot. The review recommended that:

• governments should support strategic farm business planning as a means of improving resilience and adaptability in the farm sector; and

• strategic farm business planning programs should integrate all critical elements of operating a farm business, including financial planning, natural resource management, managing the impact of a changing climate, work-life balance, farm family wellbeing and succession planning.

7.75 The Authority notes that these recommendations may also have relevance for assisting farmers in the Murray–Darling Basin through periods of transition and adjustment. The Authority also notes the pilot review findings that incentive-based initiatives, such as Building Farm Businesses, which provided grants to eligible farm businesses to manage and prepare for the impacts of reduced water availability and a changing climate, should not be linked to farm management planning as the differing policy objectives may be compromised if delivered in parallel.

Working together

7.76 The Authority believes that the Basin Plan will be implemented most effectively if governments and communities work together.

7.77 The Authority considers that localism should frame how the Basin Plan process is progressed, and has released a position paper which sets out the Authority’s preliminary views on how this could be achieved (MDBA 2011b).

7.78 The key to working together will be effective community engagement and communication. It is vital that trust in the relationship between communities and government is built and maintained, and that communities are partners in developing solutions, not just consulted. The Authority is committed to developing such a relationship with communities.

7.79 Localism in the context of water management is about governments partnering with local and regional communities to manage water and other natural resources in an integrated way. Localism includes involving communities in developing and implementing reforms so that they have ownership of decisions and actions. It also allows local knowledge

17 Under the Western Australian trial, programs are funded by the Western Australian Government, or jointly by the Australian and Western Australian Governments.
and solutions to be drawn on to meet local needs, while recognising those that fit within Basin and catchment scale strategies and actions. The Authority proposes that localism in water management is about governments partnering with local and regional communities and organisations to manage water and other natural resources in an integrated way.

7.80 Localism would potentially emphasise:

- greater community ownership and implementation of plans and programs which are collaboratively developed between communities and governments;

- greater practicality, creativity and permanence of water management solutions generated by local and regional communities, provided those solutions are consistent with a strategic framework which recognises up- and down-stream interests,

- greater improvements in water management, by making best use of existing delivery capacity at all scales, using governance arrangements that maintain and improve that capacity through time; and

- adaptive management of water as part of the broader integrated management of natural resources.

7.81 The Authority anticipates that communities will contribute many ideas to the proposed 2015 review, including proposals with the potential to result in changes to the sustainable diversion limits. Local communities and organisations are also particularly well placed to manage environmental assets and deliver environmental water. The Authority anticipates that much of the good work that is already being carried out at a local level will continue, and could be increased under the Basin Plan.

- For example, opportunities could be taken to help governments partner with regional natural resource management organisations, to align and coordinate the implementation of environmental watering plans and regional resource management plans.

- Communities may also be able to contribute to the implementation of the buyback and irrigation efficiency programs and the monitoring and assessment process for measuring the social and economic impacts.
Appendix A: Methods used to inform the MDBA’s social and economic analyses

A1 The MDBA commissioned studies and reports, and drew on a large number of non-commissioned studies, to assess the implications of reductions in water availability under the Basin Plan for irrigated agriculture, communities, and regions in the Basin. The commissioned studies and reports, and many of the non-commissioned reports, are available on the MDBA’s online knowledge database, BP-KID.18

A2 Through considering these studies and reports, the MDBA aimed to:

- establish a context and ‘baseline’ for the assessment of social and economic impacts of the Plan, by establishing an analytical framework for the assessment, and by considering the social and economic context—including past, present and future social and economic trends and drivers of change—into which the Basin Plan would be implemented
- assess the costs and benefits of the draft Basin Plan, at the aggregate (Basin-wide) scale, and on regions, industries and communities
- consider how the social and economic impacts of the Basin Plan could be mitigated, and the ways in which communities and governments could play a part in the transition process.

A3 The commissioned and non-commissioned social and economic studies and reports drew on ‘best available’ scientific knowledge and socio-economic analysis from a range of sources, including:

- social, economic and historical information on Basin communities and economies, from the Australian Bureau of Statistics, the Australian Bureau of Agricultural and Resource Economics and Sciences, the Productivity Commission, and social and economic researchers
- analyses of potential benefits of the Basin Plan, drawing on the concept of ‘ecosystem services’ and an emerging body of work which is seeking to value environmental assets, and the improvements to those assets that may result from changed environmental flows
- economic modelling and analysis of the impacts of the Plan on irrigated agricultural production and associated Basin communities
- analyses of community vulnerability to the Basin Plan, taking into account both quantitative social and economic indicators, and qualitative information obtained through consultations with communities.

Commissioned reports

A4 The MDBA commissioned 22 reports which informed the MDBA’s social and economic analyses in five broad areas:

- the social and economic context for assessing the impacts of the Basin Plan
- measuring the social and economic benefits of the Basin Plan
- economic modelling and analysis
- assessments of community and local impacts
- synthesis and policy.

A5 The reports and areas of work are summarised in Table 10 below. Note that some of the areas of work overlapped (for example, economic modelling and analysis informed assessments of community and local impacts). Hence, while Table 10 categorises the reports for presentational purposes, it should not be assumed that reports listed under a particular area of work only informed work in that area.

A6 Summaries of the commissioned reports are presented in Part B to this document.

Table 10: Commissioned reports which informed the MDBA’s social and economic analyses

<table>
<thead>
<tr>
<th>Area of work</th>
<th>Report</th>
<th>Main methods used</th>
<th>Contribution to the MDBA’s social and economic analysis</th>
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<tbody>
<tr>
<td>Social and economic context for assessing the</td>
<td>ABS, ABARE et al. (2009) Socio-economic context for the Murray–Darling</td>
<td>Analysis of census and other socio-economic</td>
<td>Presents a range of social and economic data on the</td>
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<td>Bureau of Agricultural and Resource Economics, and the Bureau of Rural</td>
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<td>of population and housing, and also from other</td>
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<td>Sciences to the Murray–Darling Basin Authority.</td>
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<td>sources.</td>
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<td>Social and economic context for assessing the</td>
<td>Frontier Economics (2010). *Structural adjustment pressures in the</td>
<td>Literature review Policy analysis Analysis of</td>
<td>Helps frame analysis of social and economic impacts,</td>
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<td>impacts of the Basin Plan</td>
<td>irrigated agriculture sector in the Murray–Darling Basin.</td>
<td>economic data</td>
<td>by describing a conceptual framework for structural</td>
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<tr>
<td>Measuring the social and economic benefits of the Basin Plan</td>
<td>Crossman, N., Rustomji, P. et al. (2011). <em>Status of the aquatic ecosystems of the Murray–Darling Basin and a framework for assessing the ecosystem services they provide. An interim report to the Murray–Darling Basin Authority from the CSIRO Multiple Benefits of the Basin Plan Project.</em> Commonwealth Scientific and Industrial Research Organisation, Canberra.</td>
<td>Hydrological modelling Environmental valuation Benefit-cost analysis</td>
<td>The CSIRO multiple benefits project aims to robustly enumerate the environmental, social and economic benefits of environmental water prescribed under the proposed Basin Plan. This interim report from the project presents a literature review, and proposes an approach for assessing the multiple benefits of the Basin Plan.</td>
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<td>Area of work</td>
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<tr>
<td>Economic modelling and analysis</td>
<td>ABARES (2011d). <em>Modelling the economic effects of the Murray–Darling Basin Plan.</em></td>
<td>Economic modelling</td>
<td>This report was commissioned to update the economic modelling to reflect the Authority’s consideration of water recovery of 2,800 GL. The report consolidates developments and improvements to the modelling that have been made since the Guide to the Proposed Basin Plan. The report also considers a range of additional sensitivity analyses of 2,400 GL and 3,200 GL water recovery scenarios, and a wider breadth of options for consideration of the economic impacts.</td>
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<td>Assessments of community and local impacts</td>
<td>ABARE-BRS (2010d). <em>Indicators of community vulnerability and adaptive capacity across the Murray–Darling Basin—a focus on irrigation in agriculture</em>.</td>
<td>Analysis of census and other socio-economic data</td>
<td>Develops an index which measures community vulnerability to changes in water availability, and uses this index to illustrate the relative vulnerabilities of Basin communities to changes to water availability that might occur under a Basin Plan.</td>
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<td>Assessments of community and local impacts</td>
<td>ABARES (forthcoming). <em>Refining the indicators of community vulnerability and adaptive capacity across the Murray–Darling Basin — a focus on irrigation in agriculture</em>.</td>
<td>Analysis of census and other socio-economic data</td>
<td>Updates previous work undertaken by ABARE-BRS in 2010, to take into account a 2,800 GL water recovery scenario, and refine the baseline used for the analysis.</td>
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<td>Area of work</td>
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<tr>
<td>Assessments of community and local impacts</td>
<td>EBC, RMCG, MJA, EconSearch, Geoff McLeod, Tim Cummins, Guy Roth and David Cornish (2011a). <em>Community impacts of the Guide to the proposed Basin Plan.</em></td>
<td>Analysis of census and other socio-economic data Community consultation Policy analysis</td>
<td>Provides an in-depth understanding of the impacts of the proposals in the Guide to the Proposed Basin Plan at the local community level, including consequences for the value chain, supply chain, and social and cultural effects including in relation to mental health and community well-being.</td>
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<tr>
<td>Synthesis and policy</td>
<td>BDA Group (2010). <em>Review of social and economic studies in the Murray–Darling Basin.</em></td>
<td>Literature review</td>
<td>Reviews and summarises social and economic studies relevant to the Basin Plan that had been undertaken until that time.</td>
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<tr>
<td>Area of work</td>
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<tr>
<td>Synthesis and policy</td>
<td>EBC, RMCG, MJA, EconSearch, Geoff McLeod, Tim Cummins, Guy Roth and David Cornish (2011c). Community impacts of the Guide to the proposed Basin Plan: Volume 4 – Informing Choices.</td>
<td>Policy and economic analysis</td>
<td>Examines factors that will have a material impact on the social and economic impacts of the Basin Plan, and describes policy opportunities for meeting environmental outcomes at a lower overall socioeconomic cost.</td>
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Non-commissioned reports

A7 The MDBA also took into account the findings of a significant number of reports and studies which, while not commissioned by the MDBA, were material to the social and economic analysis. A selection of these reports is summarised in Part B to this document.
Appendix B: Approach to monetising the benefits of the Basin Plan

B1 To inform the draft Basin Plan, the MDBA sought to develop a better understanding of how the ecosystem service benefits of water resources in the Basin can be measured in monetary terms. The MDBA assessed the benefits of the draft Basin Plan by considering the benefits in terms of ‘ecosystem services’, and then valuing those ecosystem services using environmental valuation techniques.

B2 Ecosystem services have been defined as the benefits that people obtain from ecosystems (Costanza, d'Arge et al. 1997; Daily 1997; Millennium Ecosystem Assessment 2003). In the context of water resources, they can be defined as including all benefits in the following four groups (Millennium Ecosystem Assessment 2005b):

- provisioning services—including supply of water for towns and agriculture, and for direct harvesting of fish and plants, timber grown in wetlands, and supply of genetic materials
- cultural services—providing recreational, aesthetic, tourism and spiritual benefits
- regulating services—including regulation of floods, disposal of wastes, groundwater discharge and recharge, and maintenance of water quality
- supporting services—such as biodiversity maintenance, soil formation, photosynthesis, and nutrient cycling, and underpinning each of the services described above.

B3 The ecosystem services provided by water resources are associated with a range of eco-hydrologic processes, and attributes of the hydrological system (i.e. quantity, quality, location, and timing of water flows) (Brauman, Daily et al. 2007). Multiple hydrological processes affect multiple ecosystem processes, which then provide multiple benefits to human society (TEEB 2010).

B4 There are, broadly, two types of benefit associated with apportioning a greater share of water back to the environment:

- ‘Use values’, which are associated with the direct or indirect use of environmental assets. Direct uses of environmental assets include recreation and amenity values. Indirect uses include values for improved ecosystem function, such as reduced salinity and turbidity
- ‘Non-use values’, which reflect individuals' willingness to pay to preserve a resource independent of any actual use. For example, individuals may value the maintenance of water quality or species diversity. Non-use values are generally separated into existence, altruism and bequest values.

B5 The sum of use values and non-use values equate to the benefits—the ‘total economic value’—that accrue from marginal changes to environmental quality (Mace, Bateman et al. 2011). Refer to Figure 36.
B6 The development of a practical methodology for valuing these impacts in economic terms requires a definition of the meaning of value. Underpinning all economic evaluation of projects or proposals are the concepts of willingness to pay (WTP)—this being the maximum amount that an individual is prepared to pay to gain the outcomes that they view as being desirable, and willingness to accept (WTA)—this being the minimum amount that an individual is prepared to accept as compensation to forego an outcome that they view as being desirable, or bear some harm. Broadly, the concept of WTP is equivalent to the benefits of a policy or program, while WTA is equivalent to the costs of a policy or program.

B7 These benefits can be estimated using a range of economic techniques. Market prices allow some values\(^{19}\) to be directly measured, through revealed preference and cost-based approaches. These approaches estimate values from what people are willing to pay, from contributions to productivity, from the costs of replacing a service, or the costs avoided by having that service. Other values cannot be directly measured, but have to be estimated through stated preference approaches, which include contingent valuation and choice modelling (Liu, Costanza et al. 2010).

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\(^{19}\) In measuring economic value, it is important to recognise the distinction between economic values and financial prices. The economic concept of value is much broader than the narrow concept of commercial or financial value, as it includes all values, tangible as well as intangible, that contribute to human satisfaction or welfare. The economic value of a good or service is the maximum willingness to pay to obtain that good or service, or the minimum willingness to accept to forego the provision of the good or service. Financial prices are the financial payment that is made for a good or service. There may be a substantial difference between the economic value of a good or service and the price paid for it.
A growing body of work has been undertaken internationally and in Australia to measure and quantify the social and economic benefits of ecosystem services. At a global scale, the United Nations Millennium Ecosystem Assessment (Millennium Ecosystem Assessment 2005a) identified and quantified the various ecosystem services supplied by ten biomes that make up the surface of the Earth. The Economics of Ecosystems and Biodiversity (TEEB 2010) then identified 22 ecosystem services that could be valued, and built a database of approximately 700 published values of ecosystem services.

At a national scale, the United Kingdom’s National Ecosystem Assessment documented the trend and condition of ecosystem services in the United Kingdom. It also calculated a value for many of these ecosystem services (UK National Ecosystem Assessment 2011). In the United States, the United States Environmental Protection Agency has reviewed the concept of ecosystem services and the role that ecosystem service valuation plays in policy making (US Environmental Protection Agency Science Advisory Board 2009).

In Australia, there have been previous efforts to quantify environmental benefits under the Victorian EcoTender program, by the Goulburn–Broken Catchment Management Authority, and by SEQ catchments (Crossman, Rustomji et al. 2011).

The MDBA’s work to inform the Basin Plan has built on these prior efforts.
### Appendix C: Arche Consulting (2011) case study LGA and SLA information

Table 11: Local Government Area and Statistical Local Area information for Arche Consulting case studies

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## Appendix D: Population of selected Murray–Darling urban centres and localities, 1991 to 2006

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<td>499</td>
<td>480</td>
<td>-22.2</td>
</tr>
<tr>
<td>Cunnamulla</td>
<td>1683</td>
<td>1461</td>
<td>1250</td>
<td>1217</td>
<td>-27.7</td>
</tr>
<tr>
<td>Bourke</td>
<td>2976</td>
<td>2775</td>
<td>2418</td>
<td>2146</td>
<td>-27.9</td>
</tr>
<tr>
<td>Mungindi (L)</td>
<td>780</td>
<td>748</td>
<td>652</td>
<td>543</td>
<td>-30.4</td>
</tr>
<tr>
<td>Barham-Koondrook (Koondrook Part)</td>
<td>1217</td>
<td>665</td>
<td>665</td>
<td>802</td>
<td>-34.1</td>
</tr>
</tbody>
</table>


Note that the findings presented in this table should be treated as indicative only, as data for 1991 and 1996 are for place of enumeration, while data for 2001 and 2006 are for place of usual residence. Nevertheless, the table is useful in illustrating broad trends.
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