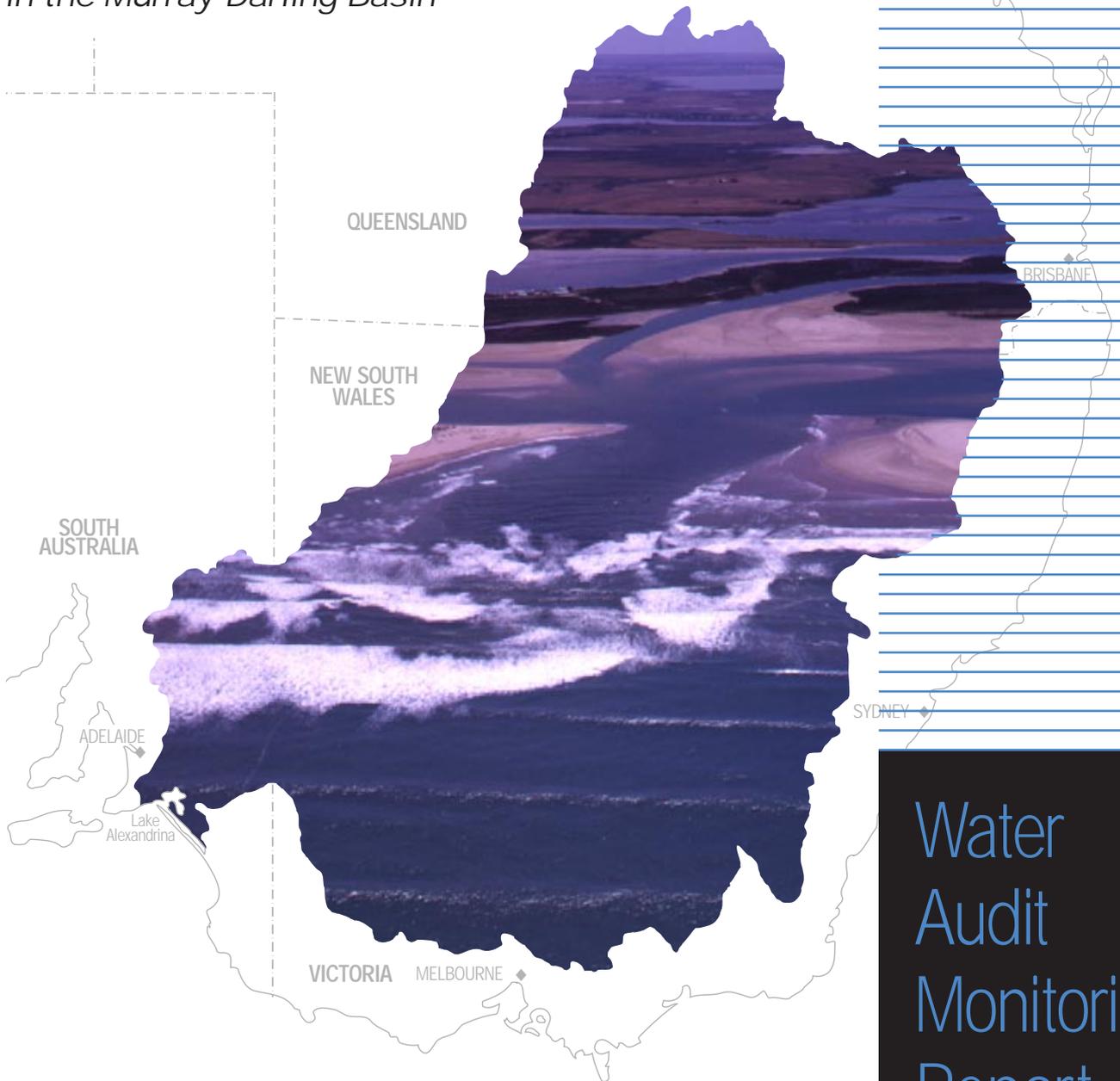


# Water Audit Monitoring Report 1996/97

*Report of the Murray-Darling Basin Commission on the final year of the Interim Cap in the Murray-Darling Basin*



Water  
Audit  
Monitoring  
Report  
1996/97

October 1998



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Murray-Darling Basin  
Commission on the final  
year of the Interim Cap in  
the Murray-Darling Basin***

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**OCTOBER 1998**

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## Acknowledgments

The development of the Murray-Darling Basin Commission's 1996/97 Water Audit Monitoring Report has involved the valuable input, support and commitment of many people. Each stage of the development of the report was overseen by the members of the inter-governmental working groups and committees. Without naming each particular contributor, thanks are due to the following agencies:

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- VIC Department of Natural Resources and Environment; and
- VIC Goulburn-Murray Rural Water Authority.

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# 1. Introduction

In June 1995, in response to an audit of water use in the Murray-Darling Basin the Murray-Darling Basin Ministerial Council agreed to Cap water use within the Basin (the 1995 water audit and subsequent Cap on diversions is explained in Section 2). To make the operation of the Cap open and transparent, the Ministerial Council has agreed that an annual Water Audit Monitoring Report should be produced.

This report outlines the water usage within the Murray-Darling Basin for the 1996/97 water year. In general, the water year is July to June for the Macquarie River and all rivers to the south and October to September for rivers north of the Macquarie. This report outlines water usage in the

States by region and includes estimates of the accuracy of the water use figures presented. Where possible, the actual volume of water used has been compared to the volume of water that should have been diverted under the Cap.

In addition to detailing water use the report also contains information on major activities that impact on water use within the Basin. Each State has provided a description of their major activities occurring in 1996/97 (Sections 4 to 8). A separate section outlines further actions that each State plans to undertake over the coming years (Section 12).

To permit rapid assessment of the findings of this report, Table 1 summarises the compliance of each of the basin States with the objectives of the Cap.

**TABLE 1. 1996/97 Cap Compliance by State**

<i>State/Territory</i>	<i>1996/97 Cap Compliance</i>
<b>New South Wales</b>	A preliminary methodology was used in NSW to determine the Cap diversion limits in each valley. Actual NSW water diversions in 1996/97 were then compared with these estimates to assess Cap compliance. This comparison showed a slight exceedance of the annual targets in some NSW valleys whereas other valleys were below Cap. At a State level the total use is believed to be within the Cap although this statement is qualified due to: <ul style="list-style-type: none"> <li>(i) the preliminary nature of the methodology used to determine Cap diversion limits; and</li> <li>(ii) the Interim Cap arrangements in place in the 1996/97 water year as a precursor to the 'final Cap' arrangements which started on 1 July 1997.</li> </ul>
<b>Victoria</b>	The tools to assess the maximum diversions in Victoria under the Cap are still to be developed. Thus, an assessment of the compliance of the Victorian diversions to the Cap is not possible at this stage.
<b>South Australia</b>	Water diversions in South Australia in 1996/97 were below the Cap. Accordingly, 1996/97 South Australian water use complied with the requirements of the Cap.
<b>Queensland</b>	The Queensland Water Allocation and Management Planning (WAMP) process is still under development. This process will define the final Cap in Queensland. Queensland has complied with the terms of its Interim Cap.
<b>Australian Capital Territory</b>	The ACT has agreed to participate in the Cap following the completion of discussions with the Murray-Darling Basin Commission (MDBC) and the Independent Audit Group (IAG) to determine the detailed form of ACT's participation.

## **2. Background**

### **2.1 Audit of Water Use in the Murray-Darling Basin, June 1995**

In June 1995, the Commission completed an audit of water use in the Murray-Darling Basin ('An Audit of Water Use in the Murray-Darling Basin', Murray-Darling Basin Ministerial Council, Canberra, 1995). This audit revealed that diversions of water from the rivers of the Basin had increased by 8 % in the previous six years and were averaging 10 800 GL/year by 1994.

This level of diversion had significantly reduced the flows in the bottom end of the River Murray. The audit concluded that median annual flows from the Basin to the sea were only 21 % of the flow that would have occurred prior to development. The reduction in flow had occurred most significantly for the small to medium size flood events. Many of these events were completely harvested and the frequency of these flood events had been significantly reduced. It was also found that the end of the river system was experiencing severe drought-like flows in over 60 % of years compared with 5 % of years under natural conditions.

The change in flow regime has had a significant impact on river health. There has been a contraction in the areas of healthy wetland, native fish numbers have declined in response to the reduction in flow triggers for spawning, salinity levels have risen and algal blooms have increased in frequency in line with the increased frequency of periods of low flow. Further deterioration in river health could be expected if diversion levels were to increase.

The audit examined the scope for diversions to grow further under the water allocation system that existed prior to the Cap. The water allocation system evolved at a time when water managers were trying to encourage development of the water resources of the Basin. As such the system rationed water during periods of shortage but was not effective for controlling diversion during normal non-drought conditions. It was reported that, in the five years before the water audit, only

63 % of the water that was permitted to be used was used. The audit found that average diversions could increase by a further 15 % if all existing water entitlements were fully developed. Such an increase would reduce the security of supply to existing water users as well as exacerbating river health problems.

### **2.2 The Cap**

The water audit report was presented to the Murray-Darling Basin Ministerial Council in June 1995. The Council determined that a balance needed to be struck between the significant economic and social benefits that have been obtained from the development of the Basin's water resources on the one hand, and the instream uses of water in the rivers on the other. Council agreed that diversions in the Basin had to be Capped. An Independent Audit Group (IAG) was appointed to report on the level at which diversions should be Capped. In doing so the group took into account the equity issues between the States.

In December 1996, Council considered the Independent Audit Group's November 1996 report 'Setting the Cap' and agreed that:

- For New South Wales and Victoria the Cap is the volume of water that would have been diverted under 1993/94 levels of development;
- For South Australia, diversions were to be Capped at a level that enabled the development of its existing high security entitlements. This represents a small increase in diversion over 1993/94 levels of development Capped at 90 % of existing high security entitlement; and
- The Cap for Queensland should be determined after an independently audited Water Allocation Management Planning (WAMP) process has been completed.

Subsequently, the Australian Capital Territory joined the Murray-Darling Basin initiative and agreed to participate in the Cap following the completion of discussions with the Murray-Darling Basin Commission (MDBC) and the IAG.

The implementation of the Cap will require considerable change to the way the water allocation system is managed across the Basin. It is likely that these changes will alter the expectations that some water users have regarding their water entitlements. In particular there will be conflict between sleepers (those people who have never used their water entitlement) on the one hand, and those irrigators who have consistently used all their allocation on the other. Both New South Wales and Victoria have established processes implementing the Cap which will resolve these issues.

Through Capping diversions at 1993/94 levels of development in the two major water using States coupled with the diversion measures planned for South Australia and Queensland, the Ministerial Council has effectively established a new framework for water sharing in the Basin. Because of the value placed on water rights, it is important that each State is only using water in line with its Cap. For this reason, the implementation of the Cap requires an integrated reporting framework including significant improvements to the way that diversions are monitored and reported.

This report is a part of the improvements that are currently underway. Given the major change in attitude to the allocation and use of water that has occurred as a result of the Cap there has been need for significant development of monitoring and reporting systems by the State agencies. In particular some of the technology based support

systems (eg improved river modelling), are proving to be more involved, time consuming and labour intensive than originally anticipated.

Thus required outcomes, including water user and catchment community understanding and acceptance, are taking longer to be achieved. As such this report does not present a complete and final picture, rather it presents information currently available, highlights areas where information is still unavailable and directions proposed to improve monitoring and reporting performance.

### **2.3 IAG Review of Cap Implementation 1996/97**

At the request of the Ministerial Council, the IAG performed a review of the performance of each State in progressing the implementation of the Cap during 1996/97 ('Review of Cap Implementation 1996/97', published by the Murray-Darling Basin Ministerial Council, August 1997, Canberra). Throughout this review, reference is made to a formal water audit monitoring report for the 1996/97 water year. The present report is this 1996/97 water audit monitoring report.

This present report complements the report of the IAG, however the data presented herein are the final figures for the 1996/97 water year and supersede the data reported by the IAG. Most notably, the Murray-Darling Basin diversions in 1996/97 reported in this present report (Table 2) supersede those reported by the IAG in August 1997 (Table 5 of that report).

### 3. The Year in Review

#### 3.1 Water Use

The data presented in this report has been collected by the relevant State agencies and collated by the MDBC. Accurate diversion data is difficult to obtain as it requires the collection and collation of thousands of individual water use figures. Table 2 presents the overall water usage figures for the basin in 1996/97.

The figures indicate that Basin water use in 1996/97 was the highest on record. Water use in New South

Wales was the highest on record, in Queensland it was the second highest on record, South Australia the fourth highest and Victoria the fifth highest on record. The ACT in 1996/97 continued to use less water than it did prior to 1992.

Figure 1 shows the water use (by State) for the period 1983/84 – 1996/97 which enables a comparison of 1996/97 water use with that of previous years.

Figure 2 shows the same data as Figure 1 but has the vertical axis re-scaled so that the variation for States with lower overall usage is visible.

TABLE 2. Murray-Darling Basin Diversions in 1996/97

<i>System</i>	<i>Irrigation Diversion (GL)</i>	<i>Other<sup>1</sup> Diversion (GL)</i>	<i>Total Diversion (GL)</i>
<b>New South Wales<sup>2</sup></b>			
Border Rivers	193	2	195
Gwydir	415	0	415
Namoi	339	3	342
Macquarie/Castlereagh/Bogan	356	18	374
Barwon-Darling	209	0	209
Lachlan	451	8	459
Murrumbidgee	2 662	13	2 675
Lower Darling	220	4	224
Murray	2 190	33	2 223
<b>Total NSW<sup>3</sup></b>	<b>7 034</b>	<b>81</b>	<b>7 115</b>
<b>Victoria</b>			
Kiewa	9	3	12
Ovens	15	11	26
Goulburn/Broken	1 843	28	1 871
Campaspe	88	36	124
Loddon	165	7	172
Wimmera/Mallee	33	124	157
Murray	1 698	46	1 744
<b>Total Victoria</b>	<b>3 851</b>	<b>255</b>	<b>4 106</b>
<b>South Australia</b>			
Country Urbans	0	35	35
Reclaimed Swamps <sup>4</sup>	83	0	83
Other SA	396	0	396
Metro-Adelaide	0	66	66
<b>Total South Australia</b>	<b>479</b>	<b>101</b>	<b>580</b>
<b>Queensland<sup>2</sup></b>			
Border Rivers	99	3	102
Macintyre Brook	9	0	9
Condamine/Balonne	339	8	347
Warrego/Paroo	2	0	2
Moonie	7	0	7
<b>Total Queensland<sup>3</sup></b>	<b>456</b>	<b>11</b>	<b>467</b>
<b>Australian Capital Territory<sup>5</sup></b>	<b>5</b>	<b>25</b>	<b>30</b>
<b>Total Basin</b>	<b>11 825</b>	<b>473</b>	<b>12 298</b>

1. 'Other Diversion' includes domestic & stock, town & industrial uses.
2. New South Wales and Queensland diversions include an estimate of unregulated stream diversions.
3. An estimate of NSW floodplain diversion is not available for 1996/97. Diversion from floodplains in Queensland has not been included in these totals but is estimated to have been approximately 22 GL for 1996/97.
4. Water use by the Lower Murray Swamp irrigators is based on an estimate of actual crop water use. These diversions are not metered at this time, although it is anticipated that rehabilitation of the area including metering will commence within the next 2 years.
5. This is a net diversion figure. The primary usage in the ACT is for urban supply which has a high return component (approximately 50 %), thus it is the net diversion that is reported.

Not all diversions are metered and some diversions have to be estimated based on area irrigated or duration of diversion. Section 3.2 provides some indication as to the accuracy of the measurements.

### 3.2 Accuracy of Measurement

An attempt has been made to assess the accuracy of the diversion estimates in each river valley. Many of the diversions are measured reliably using either metered pumps or gauged offtake channels.

However a second category of diversions are estimated from regional surveys of areas planted and a third category of estimates is based only on user returns which has proved to be very inaccurate.

Table 3 outlines the confidence the States have in their diversion estimates as reported in Table 2. To develop the figures in Table 3, metered diversions have been assumed to have an accuracy of  $\pm 5\%$ , regional surveys  $\pm 20\%$  and user returns  $\pm 40\%$ .

FIGURE 1. Murray-Darling Basin Diversions - 1983/84 to 1996/97

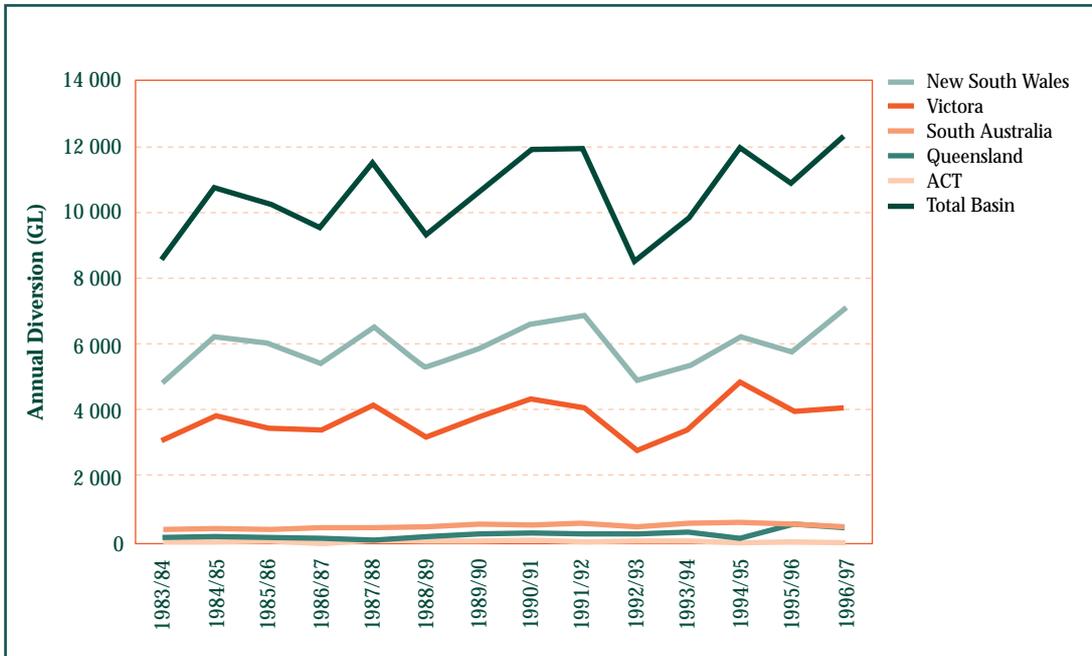
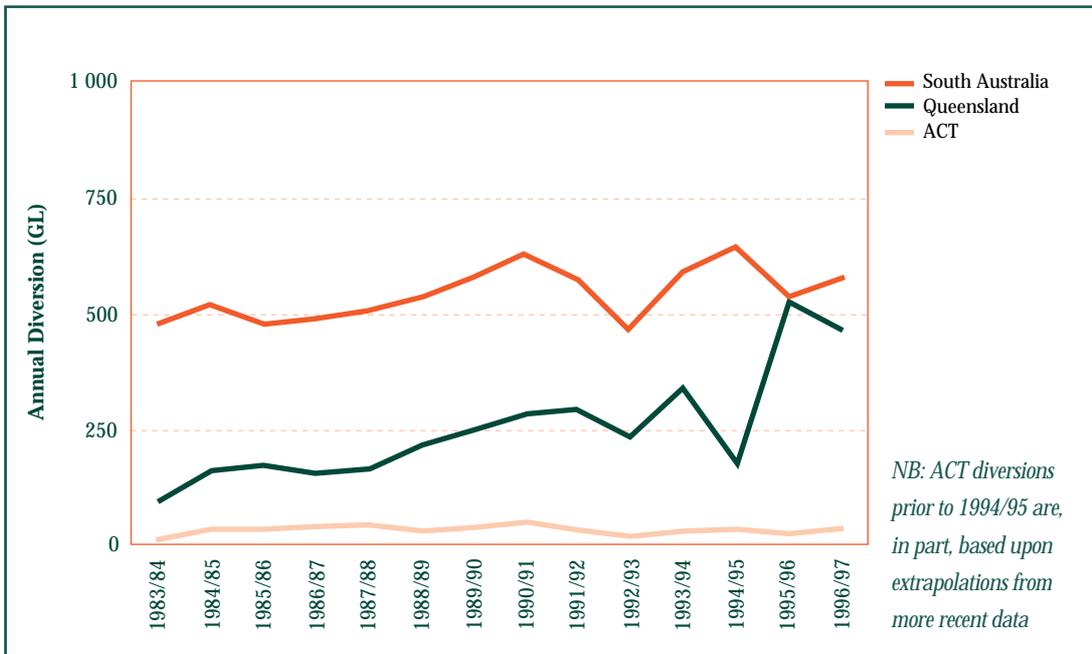


FIGURE 2. Murray-Darling Basin Diversions - 1983/84 to 1996/97 (usage under 1 000 GL/yr)



**TABLE 3. Accuracy of Diversion Estimates in 1996/97**

<i>System</i>	<i>Diversion (GL)</i>	<i>Accuracy ± GL</i>	<i>Accuracy ± %</i>
<b>New South Wales</b>			
Border Rivers	195	18	9%
Gwydir	415	24	6%
Namoi	339	33	10%
Macquarie/Castlereagh/Bogan	356	27	7%
Barwon-Darling	209	16	8%
Lachlan	459	31	7%
Murrumbidgee	2 675	138	5%
Lower Darling	224	11	5%
Murray	2 223	133	5%
<b>Total NSW</b>	<b>7 115</b>	<b>411</b>	<b>6%</b>
<b>Victoria</b>			
Kiewa	12	2	17%
Ovens	26	4	15%
Goulburn/Broken	1 871	94	5%
Campaspe	124	6	5%
Loddon	172	12	7%
Wimmera/Mallee	157	13	8%
Murray	1 744	122	7%
<b>Total Victoria</b>	<b>4 106</b>	<b>253</b>	<b>6%</b>
<b>South Australia</b>			
Country Urbans	35	2	6%
Reclaimed Swamps	83	33	40%
Other SA	396	28	7%
Metro-Adelaide	66	3	5%
<b>Total South Australia</b>	<b>580</b>	<b>66</b>	<b>11%</b>
<b>Queensland</b>			
Border Rivers	102	12	12%
Macintyre Brook	9	1	11%
Condamine/Balonne	347	62	18%
Warrego/Paroo	2	1	50%
Moonie	7	3	43%
<b>Total Queensland</b>	<b>467</b>	<b>79</b>	<b>17%</b>
<b>Australian Capital Territory<sup>1</sup></b>	<b>30</b>	<b>3</b>	<b>10%</b>
<b>Total Basin</b>	<b>12 298</b>	<b>812</b>	<b>7%</b>

1. The accuracy of ACT diversions (metered) is calculated as 5% of gross diversions and expressed as a percentage of net diversions.

### 3.3 Climatic Overview 1996/97

- **Rainfall**

Figure 3 shows rainfall deciles for July 1996 to June 1997 inclusive. These were generally average to above average in the northern Basin with below average rainfall recorded in parts of the southern Basin. Above average rainfalls in the northern Basin did not, however, result in above average flow responses in catchment runoff.

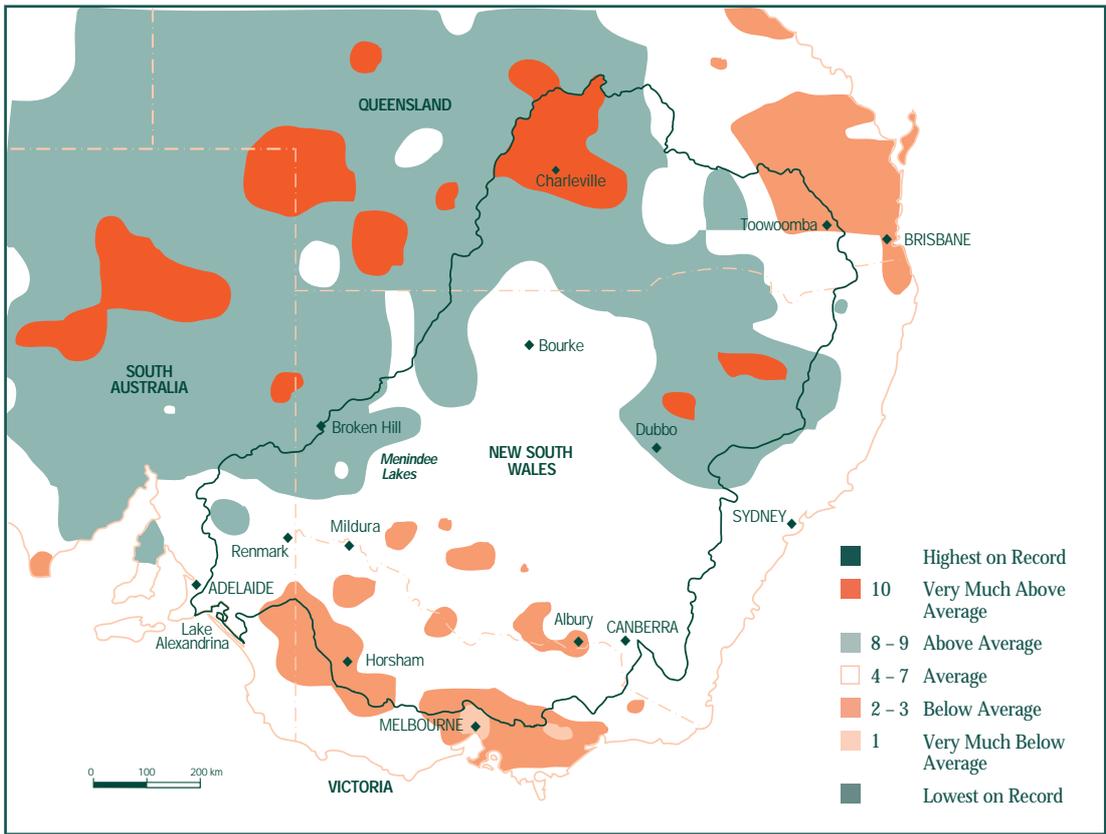
Figure 4 shows the rainfall deciles for the period November 1996 to April 1997 inclusive. This shows that much of the southern Basin received below average rainfall over this period (the primary irrigation season) which resulted in an increased demand for water.

- **Temperature**

Figure 5 shows the temperature anomaly (this is the difference between the recorded temperatures and the long-term average temperatures) for the period July 1996 to June 1997 inclusive. Minimal variation from average temperature conditions was observed throughout the basin during this period.

Figure 6 shows the temperature anomaly for the period December 1996 to February 1997 inclusive (the primary irrigation season). Although observed temperatures were around average over the longer 12 month period (Figure 5), in the peak of the irrigation season observed temperatures were above average throughout the southern Basin and below average in the northern Basin.

**FIGURE 3. Rainfall Deciles for the Murray-Darling Basin for the July 1996 to June 1997 Period**  
(source: Bureau of Meteorology)



**Figure 4. Rainfall Deciles for the Murray-Darling Basin for the November 1996 to April 1997 Period**  
(source: Bureau of Meteorology)

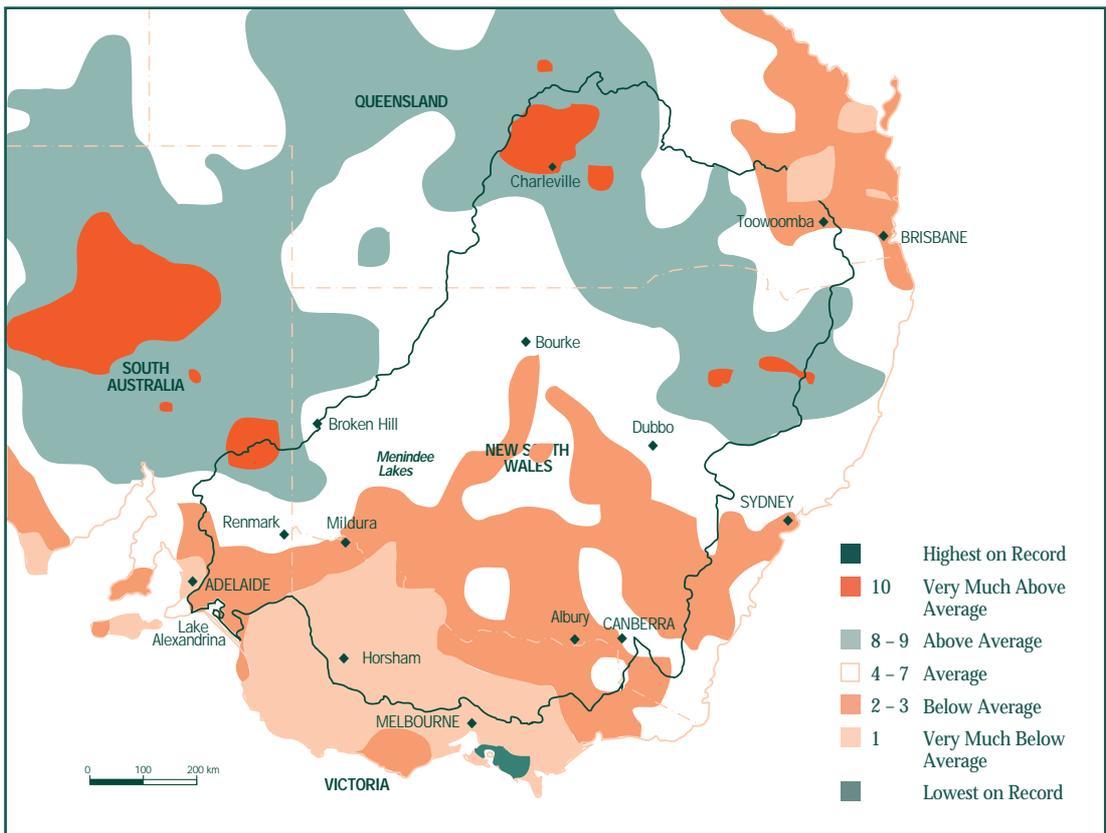


Figure 5. Temperature Anomaly for the 12 Month Period July 1996 to June 1997  
(source: Bureau of Meteorology)

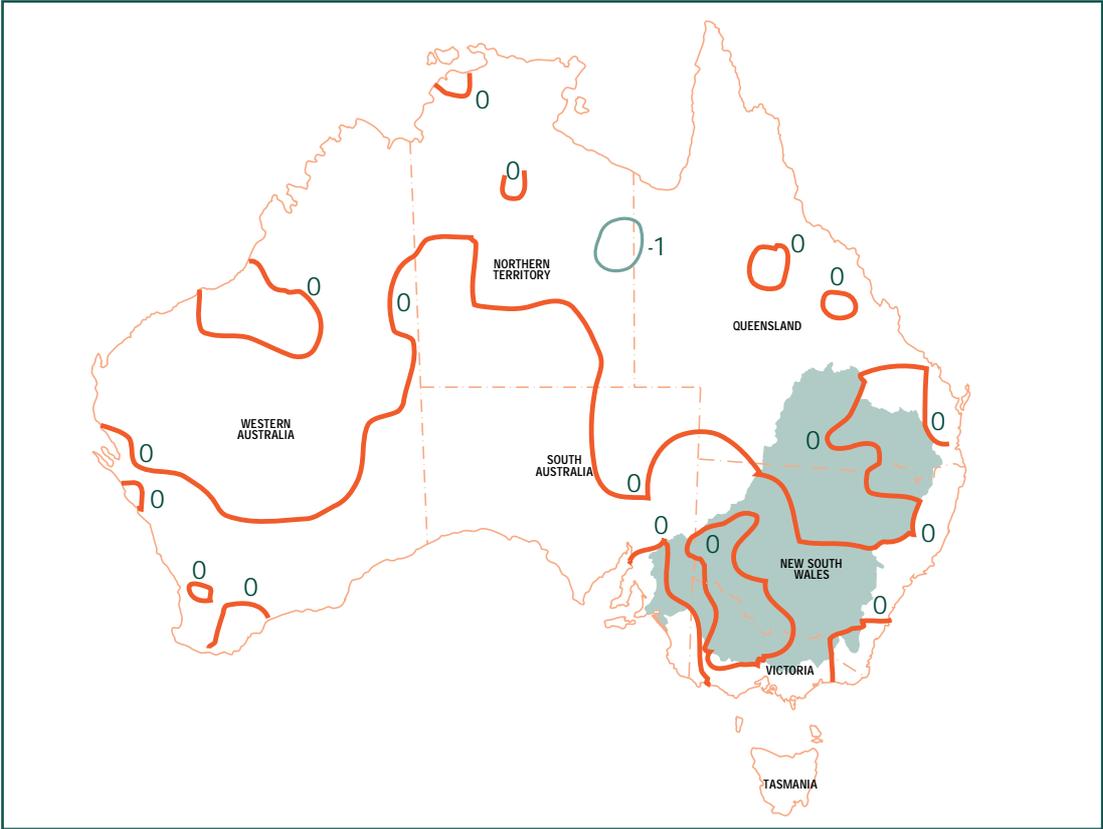
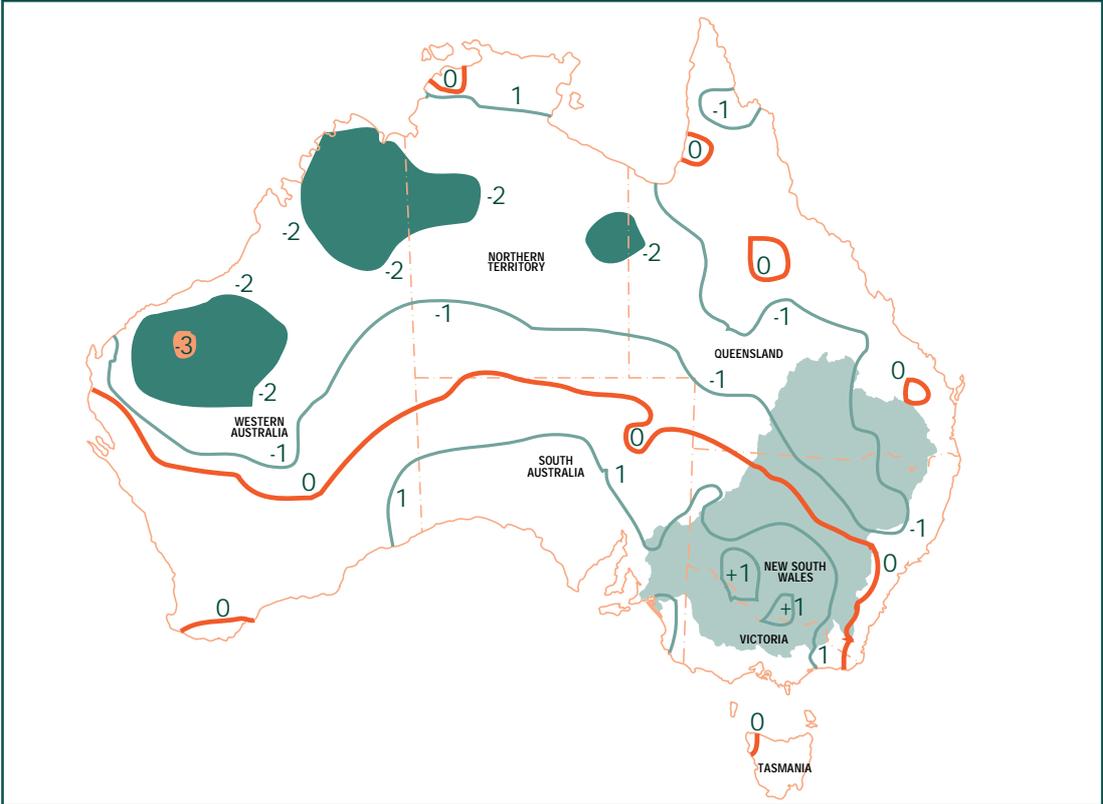


Figure 6. Temperature Anomaly for the 3 Month Period December 1996 to February 1997  
(source: Bureau of Meteorology)



### 3.4 Comparison of 1996/97 Water Use with the Cap

The Murray-Darling Basin Ministerial Council has set the diversion Caps for:

- New South Wales at the volume of water that would have been diverted under 1993/94 levels of development plus an allowance in the Border Rivers for Pindari Dam;
- Victoria at the volume of water that would have been diverted under 1993/94 levels of development plus an allowance (initially 22 GL/year) for Mokoan Dam in the Goulburn/Broken/Loddon and/or the Murray Valley systems;
- South Australia at:
  - a total of 650 GL over any five-year period for urban water supply delivered through metropolitan Adelaide water supply systems,
  - 50 GL/year to supply water to country towns;
  - 83.4 GL/year for irrigation in the reclaimed swamps, and
  - a long-term average diversion for other irrigation of 440.6 GL/year being 90 % of the total allocation of 489.6 GL.

The Ministerial Council has not yet set a Cap for Queensland but will do so following the completion of the Water Allocation and Management Planning (WAMP) process in that State.

The ACT has agreed to participate in the Cap on diversions and will do so following the completion of discussions with the Commission and the Independent Audit Group.

The Cap in NSW and Victoria is not the volume of water that was used in 1993/94. Rather the Cap in any year is the water that would have been used with the infrastructure (pumps, dams, channels, areas developed for irrigation, management rules, etc) that existed in 1993/94 taking into account the climatic and hydrologic conditions that were experienced during the year under consideration.

A primary task in monitoring the Cap in these States is determining the size of the Cap for each year. This calculation is done at the end of each year and uses the observed climatic and hydrologic data. In the south of the Basin this will tend to result in lower Caps in years when there is significant rainfall in the irrigation areas and larger Caps in years with less rainfall when demand is higher. However the annual Cap in a given year will also be affected by the availability of water. In very dry years in the south of the Basin, the annual Cap will reflect the resource constraints. In the north of the Basin, the Cap will be very much affected by the opportunities to harvest water into on-farm storages.

Because of these complexities, the calculation of the Caps will eventually be made by use of computer models with relationships for water use that include a range of climatic factors and detailed modelling of flows and storage behaviour. Setting up these models is a major task. To date only a few of the models have been completed and none have been subject to rigorous peer review. The peer review commenced in July 1998 and will continue until all of the models meet the required standards. At this stage it is not possible to present final figures of the diversion Caps for 1996/97, although New South Wales has prepared preliminary estimates based on simple climate diversion relationships.

The calculation for the Cap in South Australia is relatively straightforward although the Cap for the fourth category of South Australian diversions described above is a long term climate adjusted average of 440.6 GL and in extremely dry or wet years may deviate substantially from this value. In the calculation of the Metro-Adelaide Cap, the allocation of 650 GL over 5 years is designed to provide a water supply with 99 % security to a major urban city of over 1 million people. This allocation has been based on a 200 year simulation of the amount needed from the River Murray to supplement the primary source from the Mount Lofty Ranges. Actual demand will vary from between about 20 GL (or 10 % of Adelaide's needs) to about 190 GL (or about 95 % of demand).

**TABLE 4. Comparison of Diversions with Cap Levels in 1996/97 for NSW and South Australia (excluding Metro-Adelaide)**

<i>System</i>	<i>Total Diversion (GL)</i>	<i>Cap Diversion Target (GL)</i>	<i>Difference between Diversion and Cap (GL)</i>
<b>New South Wales</b>			
Border Rivers	195	195	0
Gwydir	415	416	-1
Namoi	342	240	+102
Macquarie/Castlereagh/Bogan	374	585	-211
Barwon-Darling	209	209	0
Lachlan	459	392	+67
Murrumbidgee	2 675	2 484	+191
Lower Darling	224	n/a <sup>1</sup>	n/a <sup>1</sup>
Murray	2 223	2 264	-41
<b>South Australia</b>			
Country Urbans	35	50	-15
Reclaimed Swamps	83	83	0
Other SA	396	n/a	n/a
Metro-Adelaide		See Table 5	
<b>South Australia (Country Urbans &amp; Reclaimed Swamps)</b>	<b>118</b>	<b>133</b>	<b>-15</b>

1. While the absolute value of the Cap diversion target in the Lower Darling, restricted access to water during 1996/97 in this system would have ensured that diversions were below Cap (see Section 4.10).

Diversions for 1996/97 are for the last water year to be covered by the Interim Cap. The Ministerial Council has agreed that a State's compliance with the Cap will be tested against the cumulative difference between actual diversions and the calculated Caps from 1 July 1997 onwards. If that difference exceeds trigger values that are specified in Schedule F to the Murray-Darling Basin Agreement, the Commission must declare that a State has exceeded the Cap.

Table 4 presents a comparison of actual diversions to the annual Caps for New South Wales and South Australia (except Metro-Adelaide). The results for New South Wales are only preliminary results and may be adjusted when the final analysis is undertaken using computer models. The Cap for Metro-Adelaide is based upon usage over a five year period (Cap of total usage over any five year period of 650 GL). The status of usage by Metro-Adelaide against this Cap is shown in Table 5.

**TABLE 5. Comparison of diversions with Cap levels in 1996/97 for Metro-Adelaide, South Australia**

<i>System</i>	<i>Total Diversion 1996/97 (GL)</i>	<i>Total Diversion – 5 Years up to and including 1996/97 (GL)</i>	<i>5 Year Cap Diversion Target (GL)</i>	<i>Difference between Diversion and Cap (GL)</i>
<b>South Australia</b>				
Metro-Adelaide	66	428	650	222

## ***4. Review of 1996/97 Water Use in New South Wales***

### **4.1 Overview**

In NSW the 1996/97 diversion in most Valleys was within Cap confidence limits. Those Valleys where the Cap was exceeded were the Murrumbidgee, Lachlan and Namoi. Details of the factors affecting gross water use in NSW in 1996/97 are given below.

### **4.2 Murrumbidgee**

The Murrumbidgee Valley diversion for 1996/97 was 2 675 GL. This diversion is the highest ever recorded in the Murrumbidgee Valley, exceeding the mean Cap figure by 191 GL. The factors that contributed to Cap exceedance are described below.

An allocation of 100 % was announced in the Murrumbidgee in July 1996, giving irrigators a total resource availability of 2 358 GL, not including off-allocation, unregulated stream use and system losses not included in allocation. As a Cap management measure an off-allocation limit of 440 GL, with access restricted to those users with a history of dependence, was also put in place. In October 1996 the off-allocation Cap was cancelled and irrigators were given unlimited access to off-allocation. This was due to dam safety releases from Hume Dam and concerns that Murrumbidgee resources may be required to meet Murray requirements due to the reduced resource available in the Murray system resulting from dam safety releases from Hume Dam. As a result, water availability was high and these measures did not lead to Cap compliance.

Climatically, conditions in the Murrumbidgee Valley were very dry, with a combined net evapotranspiration of 1 616 mm recorded for the July 1996 to June 1997 period. Thus, 1996/97 was the second driest year in the Murrumbidgee Valley since 1979/80. Extended dry periods over the summer, autumn and winter resulted in high water usage throughout the year.

Rice areas increased by 4 000 ha from the area planted in 1995/96 giving a record total area of 82 000 ha of rice for the 1996/97 water year. Evidence from regional officers of the Department of Land and Water Conservation (DLWC) indicates

that there have been substantial increases in the area of 'other crops' grown in the Murrumbidgee Valley over recent years, a trend that is likely to have continued in 1996/97. This increase in the total area of crops grown in the Murrumbidgee Valley in 1996/97 would also have contributed to Cap exceedance in 1996/97.

### **4.3 Murray**

The 1996/97 Murray Valley diversion was 2 223 GL, which is well within Cap confidence limits.

The allocation in the Murray Valley for 1996/97 was 100 % with a 10 % overdraw also made available in early February 1997. As a Cap management measure a 250 GL limit was placed on off-allocation, with access restricted to those users with a history of dependence. This limit was cancelled in October 1996 due to dam safety releases from Hume Dam.

Climatically the 1996/97 season was relatively dry, with a total October 1996 to April 1997 rainfall of 137 mm. Based on historical data it had only been drier in 24 % of the years since 1909/10.

Cap compliance was achieved in the Murray Valley despite an increase in rice areas of 11 000 ha. Much of the water that would usually be extracted to support winter crops was actually used over the summer to sustain the larger rice crop. As a result there was a significant decline in water usage over the winter. Another factor leading to Cap compliance in 1996/97 was the provision of continual updates of Cap progress to Murray Irrigation throughout the 1996/97 season.

### **4.4 Lachlan**

Total usage in the Lachlan Valley in 1996/97 was 459 GL. This exceeds the mean Cap by 67 GL.

At the beginning of August 1996 sufficient resources were available for the announcement of a 70 % allocation with 20 % carryover from the previous season. This effectively gave irrigators a 90 % allocation at the beginning of the season. Rainfall in the Lachlan catchment in September and October 1996 resulted in the spilling of

Wyangala storage. Consequently, carryover was cancelled and the level of allocation increased to 100 %. As a Cap management measure an off-allocation limit of 30 GL was also put in place.

In response to high resource availability, a record 95 145 ha of crops were irrigated in the Lachlan Valley in 1996/97. This represents a 14 % increase from the area irrigated in 1995/96. It includes increases in the area of summer and winter pastures, summer and winter cereals, oilseeds, vegetables and fruit. The only exceptions were lucerne and forage crops which declined by 9 % and 16 % respectively. In 1996/97 winter cereals became the dominant crop type representing 28 % of the total area of crops grown. The increases in all other crops more than offset the decline in lucerne and forage crops.

By early 1997, most irrigators in the Lachlan still had a large proportion of their allocation remaining. Climatic conditions from February to April were very dry, conditions in April being the driest on record. Most of the remaining allocation was therefore used to sustain the much greater area of winter crops planted in 1996/97. This resulted in record usage over the winter period.

In summary, the combined effects of high water availability, record areas and extended dry periods over the summer, autumn and early winter, resulted in annual target exceedance in the Lachlan Valley in 1996/97.

#### 4.5 Gwydir

Usage in the Gwydir Valley in 1996/97 was 415 GL. This was within Cap confidence limits.

The 1996/97 allocation was limited to 75 %. The area irrigated was 72 680 ha.

Environmental flow rules were introduced in the Gwydir Valley in 1995. These rules limit off-allocation extractions to a maximum of 50 % of each flow event, the other 50 % being used for wetland management purposes. DLWC Integrated Quantity and Quality Model (IQQM) runs for the Gwydir under 1993/94 conditions indicate that these rules, together with other general

management practices, result in long-term average diversions below those expected under 1993/94 levels of development. Model runs carried out at the end of 1996/97 confirm that these rules also resulted in Cap compliance in 1996/97.

#### 4.6 Macquarie

Total usage in the Macquarie Valley in 1996/97 was 374 GL. This is below the mean Cap by 211 GL.

The timing of allocation announcements had an important influence on water usage in the Macquarie Valley in 1996/97. On 1 July 1996 an initial allocation of 0 % was announced with a 25 % carryover from the previous season. Conditions improved in August and October giving irrigators an allocation of 70 % with a 25 % carryover. A final allocation of 85 % including a 25 % carryover was announced in February 1997. Although the initial allocation was low, rainfall in the first few months of the 1996/97 water year provided enough water in the soil profile for planting to begin in early September. The estimated area of cotton grown in 1996/97 was 34 000 ha.

Two major water policy changes also significantly influenced the amount of water used in the Macquarie Valley in the 1996/97 water year. They were the 1996 Macquarie Marshes Water Management Plan and the Macquarie Valley carryover scheme.

The 1996 Macquarie Marshes Management Plan aims to share flows in the Macquarie between all users in order to provide resource security for users as well as general health benefits to the Macquarie Marshes. In 1996/97 the flow to the Marshes was 350 GL. This compares to an estimated 180 GL which would have occurred under the previous Plan.

The introduction of a carryover scheme has resulted in significant changes in the Macquarie irrigation industry. In 1996/97 water use on low value commodities declined significantly and many inefficient crop practices were eliminated. Water usage on two of the most productive crops in the valley, cotton and wine grapes, increased substantially.

The net result of these changes was:

- Cap compliance in 1996/97 based on a reduction in water usage of over 30 % from the volume that would have been expected based on 1993/94 levels of development;
- significant environmental benefits to the Macquarie Marshes; and
- continued economic growth in the irrigation industry through the concentration on water-use efficiency and high value crops.

#### 4.7 Namoi

Total usage in the Namoi Valley in 1996/97 was 342 GL (note the water year in the Namoi Valley and valleys to the north is October to September). This exceeded the mean Cap by 102 GL. The sequence of events that led to Cap exceedance in the Namoi Valley in 1996/97 is described below.

An allocation of 100 % was announced for the Namoi Valley on 4 October 1996. This provided irrigators with sufficient resources to plant a record area of 65 000 ha. As usual, cotton was the dominant crop, representing approximately 95 % of this total area.

Climatically, the 1996/97 water year was median to wet, with a total net evaporation for the October 1996 to May 1997 period of 943 mm. In terms of cotton production, the first half of the season was not climatically favourable. However, improved weather conditions and abundant supplies in the second half of the season resulted in considerable yields.

The option to carry-over some of the 1996/97 allocation into the 1997/98 season was put to the Namoi irrigators in mid 1997. Both the irrigators and the DLWC agreed not to declare carryover due primarily to concerns over the activation of conjunctive-use licences (which can only take place when the allocation falls below 100 %) which may have resulted in increased stress on the Namoi Valley's already stressed groundwater systems. As part of this agreement, the Namoi Valley irrigators made assurances to the DLWC that they would only use that part of the remaining 1996/97 allocation needed for essential crop requirements. Cap progress reports up until the end of July 1997 indicated that usage would be close to that expected under 1993/94 levels of development.

In early August 1997 an early allocation announcement of 100 % was made for the 1997/98 season.

In the remaining part of August and September 1997 irrigators elected to fill their on farm storages with the remaining 1996/97 allocation. This sequence of events resulted not only in record usage in September, but also in annual target exceedance for the 1996/97 water year.

#### 4.8 Barwon – Darling

The total Barwon-Darling (Barwon-Darling system above inflow into Menindee Lakes) diversion in 1996/97 was 209 GL. Infrastructure development, including increases in both areas planted and on farm storage volume, imply significant growth in diversions since 1993/94. In accordance with these trends it is likely that the annual target was exceeded in 1996/97. However, these results can only be validated using the Barwon-Darling IQQM which is currently in the final stages of development.

#### 4.9 Border Rivers

In 1996/97 the total diversion from the NSW portion of the Border Rivers was 195 GL. The 1996/97 A-class allocation was 100 % and the B-class allocation was 65 %. Due to the under utilisation of resources that is typically observed in the Border Rivers this means that the Valley was constrained in terms of announced allocation, but not in terms of water availability.

A tool for Cap auditing in the Border Rivers is not yet available. The Border Rivers IQQM, which is expected to be completed in early 1999, will need to be used to determine whether 1996/97 usage did or did not exceed the Cap.

#### 4.10 Lower Darling

Total consumptive usage in the Lower Darling (Darling system below inflow into Menindee Lakes) in 1996/97 was 224 GL. At present the DLWC does not have an auditing methodology for the Lower Darling. However, since Tandou access to off-allocation was terminated at a Menindee Lakes storage of 2 030 GL rather than the 1993/94 policy of off-allocation access down to 1 680 GL, it is known that usage must be below Cap. Compared to the historical maximum diversion to Tandou of 210 GL, the 1996/97 diversion of 134 GL could be as much as 76 GL below target.

## **5. Review of 1996/97 Water Use in Victoria**

### **5.1 Water Use Capping Measures**

Following the Murray-Darling Basin Ministerial Council decision to Cap water use, a number of changes to water management were introduced prior to the 1995/96 season to stop future increases in water use. These included restrictions on temporary and permanent water trading, reductions in allocations for a given resource, and limits on issuing of new entitlements.

Prior to the 1996/97 season, these changes were reviewed and amended. The changes prior to the 1996/97 season were:

1. Diversion Licences for direct pumping from a stream only allowed to trade upstream where the volume is small, and the trade does not significantly impact on stream flow. This is generally for domestic and stock use only.
2. The Cap on maximum sales water allocations in the Campaspe system was raised to 120 % (with other systems to remain at 100 %). This increase was made after analysis showed that the earlier setting of a 100 % maximum sales allocation over-constrained water use in this system.

### **5.2 Volumes Diverted**

The volumes diverted in the Victorian portion of the Murray-Darling Basin are presented in Table 2. Diversions from rivers and streams during 1996/97 were above the 10 year average diversions in most areas due to the hot dry season. Deliveries to Goulburn-Murray Water customers were the third highest on record. The persistence of dry conditions throughout the autumn and winter of 1997 provided few opportunities for harvesting from Goulburn Weir to Waranga Basin in preparation for the 1997/98 season. Consequently, the total diversion for the year was lower than expected given the high deliveries. Autumn and winter rains would normally provide significant opportunities to refill Waranga Basin for the following irrigation season (typically 160 GL in this period).

Total diversion from the Victorian part of the Murray-Darling Basin was approximately 4 106 GL. The allocated volume authorised for use (which includes system losses) was around 5 535 GL, resulting in a utilisation of 74 % of allocated volume.

### **5.3 Review of 1996/97 Irrigation Season**

#### **5.3.1 Allocation**

The 1996/97 Seasonal Allocations were announced on 22 August 1996 at the maximum level of 100 % Water Right plus 100 % Sales in the Goulburn and Murray systems, and 120 % Sales in the Campaspe system. The allocation in the Broken system was 100 % Licence Volume plus 70 % Sales, which is the maximum level.

#### **5.3.2 Off-Quota**

Off-quota periods were announced for all river systems during the early part of the 1996/97 Irrigation Season. On the Murray, Mitta Mitta, Broken and Goulburn-below-Broken River systems, off-quota was available until 6 November 1996. On the Loddon and Goulburn-upstream-of-Broken off-quota was available until 23 October 1996, on the Campaspe until 30 October 1996 and on the Ovens until 25 December 1996.

Usage during the off-quota periods was estimated at 262 GL, however most of this was by irrigators who did not subsequently exceed their original allocated volume.

#### **5.3.3 Initial Storage Conditions**

At the beginning of the 1996/97 irrigation season Murray-Darling Basin Commission (MDBC) and Goulburn-Murray Water (G-MW) storages were in a healthy position, overall holding 89 % of capacity. By early October 1996 the storage position had improved to 98 % of capacity following good spring rains resulting in inflows with a 10 % probability of exceedance.

### 5.3.4 Final Storage Conditions

By the end of the irrigation season the overall storage capacity had been reduced to 56 %, compared to 63 % at the end of the previous season.

In October 1996, a decision was taken to release water from Hume Dam to ensure the safety of the structure. This did not affect supply in 1996/97, but reduced water availability for 1997/98.

### 5.3.5 Deliveries

- **Pattern**  
The 1996/97 season began with average to above average rainfall during winter and early spring. Demand in the Goulburn-Murray Irrigation District (GMID) began in earnest from mid-October and continued at the strongest rate on record until the end of the season in May, due to one of the driest November to April periods on record. There were only two relatively minor rain events which reduced demand briefly, on Christmas Day and around Australia Day.
- **Operational Issues**  
Sustained high demand and the lack of significant rain events resulted in sustained high releases from Eildon at rates only exceeded previously when water was being transferred to the Murray System. The high releases were required to maintain target levels in Waranga Basin and ensure that adequate rates of delivery to the Waranga Western Channel could be maintained towards the end of the season.
- **Final Deliveries**  
Total irrigation deliveries onto farms for the season were approximately 2 710 GL, of which 910 GL (55 % of Water Right) was Sales, exceeding the 10 year average sales of 665 GL.
- **Historical Comparison**  
Total irrigation deliveries were the third highest on record, after 1994/95 and 1990/91.

Deliveries were slightly higher than in 1987/88, but sales usage was actually lower and water right utilisation higher than in 1987/88.

### 5.3.6 Channel Capacity Issues

As a result of the extended hot weather over the summer period, irrigation demand was extremely high and exceeded the delivery capacity of the channel network in many Areas. Rochester and Pyramid Hill often experience problems on the Waranga Western Channel and did so again in 1996/97. The Yarrawonga Main Channel supplying Murray Valley was also at maximum capacity for extended periods. Areas like Central Goulburn and Shepparton that rarely experience these sort of problems were also affected. This limited diversion of water to some extent.

As a result of good reserves in Menindee Lakes and an earlier than usual reduction in NSW water demands, there were no significant channel capacity problems on the River Murray during the season.

## 5.4 Trading

Permanent trade of approximately 11 000 ML occurred during 1996/97. This was similar to 1995/96 levels of permanent trading, but was about 3 500 ML less than in 1994/95.

Over 99 000 ML of water was temporarily traded during 1996/97 - about 50 % of this was Water Right and Licence Volume, and 50 % was Sales. This was 30 % less than the 1995/96 levels of trading, primarily due to the lower Goulburn system allocation in 1995/96. It was also 60 % less than the 1994/95 levels of trading, due to the drier conditions in 1994/95 and the introduction in 1995/96 of restrictions on sales water trading.

## 5.5 Environmental Flows

Neither the Barmah-Millewa Forest nor the Northern Victorian Wetlands used any of their environmental water allocation during 1996/97.

## 6. Review of 1996/97 Water Use in South Australia

TABLE 6. Summary of Irrigation Water Use in South Australia

<i>Water Use</i>	<i>Cap (GL)</i>	<i>1993/94 (GL)</i>	<i>1994/95 (GL)</i>	<i>1995/96 (GL)</i>	<i>1996/97 (GL)</i>
Pumped Irrigation	440.6	374.1	363.2	365.0	395.9
Swamp Irrigation	83.4	83.4	83.4	83.4	83.4
Total Irrigation	524.0	457.5	446.6	448.4	479.3
Rainfall (mm)	-	330	240	290	280

Irrigation diversions in South Australia remained well within the long-term average Cap of for this component of water use in South Australia of 440.6 GL (ie, 90 % of a total allocation of 489.6 GL). Water use by pumped districts and private diverters increased by approximately 8 % in 1996/97 over the previous year, although the rainfall received was effectively the same. A summary of irrigation water use in the South Australian portion of the Murray-Darling Basin over the four water years to 1996/97 is provided in Table 6.

The primary reason for the increase in irrigation diversions probably relates to the increased water requirements of maturing permanent plantings undertaken in 1993/94 and 1994/95. Significant new development occurred at this time as a result of permanent transfers of existing water allocations within the State. As these plantings mature, it is anticipated that diversions will increase for the next 4-5 years (ie, until 1999/2000).

The rate of development of new plantings appears to have decreased over the past two years, probably as the availability of dozer and/or sleeper water allocations has decreased. It is anticipated that the permanent trade of water allocations (State and Inter-State trade) will facilitate

continuing development of both private and pumped scheme irrigation at a level similar to the current rate.

A number of factors will be contributing to a possible reduction in use of water or at least improved efficiency of use during this period. All transfers of allocations within or into South Australia require the preparation and implementation of an Irrigation and Drainage Management Plan (IDMP) to optimise irrigation efficiency. In addition, there are more grower education courses available and a greater percentage of growers have completed courses on irrigation efficiency, scheduling and general property management.

1996/97 water use in the country urban areas of the State supplied by the Murray system was 35 GL which is well below the Cap limit of 50 GL for this usage.

The Cap for Metro-Adelaide usage (pumped from the River Murray to Adelaide) is a total usage over a five year period of not more than 650 GL. Usage of River Murray water by Metro-Adelaide in 1996/97 was 66 GL and the total for the five years to 1996/97 was 428 GL which is well below the five year Cap of 650 GL.

## **7. Review of 1996/97 Water Use in Queensland**

### **7.1 Overview**

Queensland continues to comply with water audit requirements by maintaining its Interim Cap provisions and regularly reporting on the development and water use practices that are occurring while comprehensive water management planning initiatives progress.

Following the decision made by the Murray-Darling Basin Ministerial Council on 30 June 1995 to introduce a Cap on water diversions, interim actions were put in place to limit further development. Revised approaches to Cap management in Queensland were presented to the Ministerial Council meeting on 28 June 1996. At that time it had become obvious that final Cap arrangements across the Basin would take longer to establish than originally expected.

This situation still applies and the revised moratorium remains in place to act as a management holding pattern. It recognises Queensland's development history and equity position. At the same time it acknowledges the need to ensure that actions taken under the moratorium will not exceed the diversion limits that are likely to result from a final Cap based on a thorough planning process including a precautionary approach to protect environmental values.

Key elements of the interim arrangements in place include:

- A continued hold on dealing with applications for new extractions;
- Consideration of applications lodged prior to administrative holds on licensing that had previously been initiated in Queensland;
- Consideration of applications relating to extractions within existing entitlements and applications associated with non-licensable extractions;
- Provision for small entitlement drought proofing supplies;
- Right for full utilisation of existing licences;

- Negotiations with users to promote comprehensive metering and volumetric management of water harvesting; and
- Advancement of certain government projects.

The group water supply projects, which form part of the government planning and development agenda, include:

- A dam on the Granite Belt (Border Rivers headwaters);
- St George off-stream storage (Balonne River). The filling of this storage utilises existing diversion entitlements; and
- Four weirs on the Condamine River (totalling 14 000 ML capacity).

### **7.2 Progress Towards Final Cap**

Whilst work on the final Cap arrangements is progressing as quickly as possible, Queensland was unable to complete all the necessary studies and community consultation to enable final Cap arrangements to be established by 1 July 1998. It is now expected that a further 12-24 months will be needed to establish draft planning outcomes across the respective Queensland valleys. Some of the factors that are influencing progress are:

- Catchment communities are seeking more time for adequate consultation to occur;
- There is a need for coordination with New South Wales on the river flow and management processes for the Border-Barwon-Darling system. While this has commenced, with good progress now evident, the year has been essentially characterised by delays in getting hydrologic modelling finalised. Implementation of the New South Wales water reform package is severely stretching the available hydrologic modelling resources in that State which are also required for the completion of the Cap work on the Border Rivers;
- Hydrologic modelling in both Queensland and NSW is taking much longer than originally

expected as a daily model is being used and thus the data collation and checking exercise is increased by an order of magnitude over the use of monthly models; and

- Other high priority water allocation and management planning projects in priority catchments (eg. the Fitzroy), have placed demands on Queensland's available skilled resources.

Regardless, Queensland remains committed to establishing the final Cap arrangements and anticipates this will be achieved progressively over the next two years.

### 7.3 Review of 1996/97 Season

A basin-wide approach to the gathering of information relating to licensing, diversion and

allocation has been under way since 1993/94. Annual monitoring reports for Queensland have now been compiled for the 1993/94, 1994/95, 1995/96 and 1996/97 water years. Work is about to commence to prepare the 1997/98 report. The diversion profile since 1983/84 can be seen in Figures 1 and 2.

The 1996/97 water year followed significant flood events through the Border Rivers system, Moonie River and the Condamine Balonne firstly in January 1996 and again in May 1996. Flows also occurred in the Paroo and Warrego (January 1996 only) but to a lesser extent.

As a result most storages, private and major 'on stream', started the water year and irrigation season at full or near full in September 1996. Announced allocations to commence the year for most State

**TABLE 7. Flows and Diversions within Queensland**

<i>Valley</i>	<i>Flow and Diversion Performance</i>
Condamine Balonne Upper Condamine (Darling Downs)	A series of smaller flow events through to December 1996 with limited harvesting opportunity. More significant flows in February and March 1997 peaking at 9 000 ML/day. Limited water harvesting opportunity through the year.
Condamine Balonne Lower Reaches (Lower Balonne)	Smaller flows in 1996 did not extend into the Balonne. A compensation release was necessary from Beardmore Dam through December 1996 and January 1997. A total of 28 800 ML was released over a 30 day period. Significant flows occurred in February and March peaking above 60 000 ML/day. This provided good water harvesting opportunity, beneficial floodplain inundation, as well as through flow to the Barwon-Darling.
Border	Flows peaking at over 45 000 ML/day at Goondiwindi occurred in October 1996 giving 31 days of water harvesting opportunity. This was followed by limited harvesting opportunity (3 days/month) until the February/March 1997 event which occurred right across the western sector of the catchment. This event peaked at over 50 000 ML/day at Goondiwindi allowing a further 29 days of water harvesting opportunity.
Boonie	Two related flow events through February and March 1997 peaking at 24 000 ML/day. There is limited development on this stream.
Warrego/Paroo	Limited flow in the Warrego in the earlier part of the water year with the only significant event in February/March 1997 peaking at 115 000 ML/day. Frequent low flows in the Paroo through to significant floods above 50 000 ML/day in February 1997. There is limited development on these streams.

**TABLE 8. Approximate Water Volumes Harvested in Queensland in 1996/97**

<i>Gauging Stations</i>	<i>Approximate Volume of Flow (ML)</i>	<i>Approximate Volume Harvested (ML)</i>
Condamine River @ Chinchilla	100 000	45 000
Balonne River @ St George	860 000	180 000
Macintyre River @ Goondiwindi	660 000	50 000
Total	1 620 000	275 000 (17 % of total flow)

managed schemes were in the 80 - 100 % range with the exception of St George which relies on flows through the season to ensure full allocation.

Flow events in the various individual valleys over the year have been summarised in Table 7. They are essentially characterised by frequent low flows in the more eastern part of the Basin from October through to December 1996 followed by significant flow events in February and March 1997. Winter flows were of no significance.

#### **7.4 Water Harvesting**

Volumes harvested from the more developed catchments during the October 1996 to March 1997 period are summarised in Table 8.

The harvesting of 17 % of total flows in 1996/97 (Table 8) compares with 400 000 ML harvested in the 1995/96 year from total flows of 6 400 000 ML (6 % of total flow). Average annual flow at the three gauging stations listed in Table 8 amounts to almost 3 000 000 ML.

#### **7.5 Irrigation**

Major 'on stream storages' performed well throughout the Summer season with Beardmore Dam at St George most depleted at 46 % at the end of January 1997. This situation was rectified with the major flows through February and March. Final announced allocation across the Basin for most major schemes was 100 % except for the Upper Condamine and St George schemes at 75 %.

Approximately 150 000 ML was delivered through the major irrigation schemes from a total nominal allocation of 200 000 ML. This figure included 22 000 ML of carryover of which 12 000 ML was

cancelled during the water year. The shortfall in on-allocation usage resulted from extended periods of announced water harvesting on the Border Rivers through the summer irrigation season.

#### **7.6 Unregulated Irrigation and Urban, Industrial & Stock**

This usage is small in comparison with water diverted by water harvesting or into Government storages. Unregulated irrigation largely depends on the availability of water from naturally flowing streams and naturally occurring waterholes, and the irrigation need for the particular year. Usage for the 1996/97 year was estimated at 25 000 ML, similar to that of 1995/96 but well up on the previous drought years through 1993 to 1995.

Urban, industrial, and stock usage remains fairly static in the catchment as it is generally allocated as high security water and is normally able to be reliably supplied. Total usage for the 1996/97 year is estimated at 12 000 ML.

#### **7.7 Conclusion**

Flows in the Queensland section of the Basin were considerably less than average for the year, particularly in the Condamine where flows were only around 20 % of long term averages.

It is difficult to establish a clear view of any diversion trend for Queensland because of the severe drought over the period 1993 through 1995. The increased diversions in 1995/96 relate to the passage of a year where above average flows were evident in the two major developed catchments. The less than average flow regime in the 1996/97 year has seen a corresponding reduction in access to flow which is reflected in the reduced water harvesting extraction for the year.

## **8. Review of 1996/97 Water Use in ACT**

The ACT experienced dry conditions during the 1996/97 year with lower than average flows and rainfall across the Territory. This was reflected by a drop in reservoir level in Corin Dam (the main water supply reservoir for the ACT). At the start of the year Corin was at 95.5 % capacity but by the end of the year it had dropped to 70 % capacity. For the other main reservoirs water levels were consistent at the beginning and end of the period with Googong at 100 %, Bendora at 83 % and Cotter at 100 % capacity.

To coincide with this drop in water storage, consumption (through the reticulated network) was relatively high at 61.8 GL for the period. Of this approximately half was returned to the Murrumbidgee River (and thus to Burrinjuck Dam) through the sewage treatment plants. There is no information available relating to self-supplied water however once water resource legislation is passed this information will be able to be collected.

There are no provisions for the assessment of water use in the ACT under the Cap. Thus, an assessment of the compliance of the ACT diversions to the Cap is not possible at this stage.

## 9. Water Trading in the Murray-Darling Basin

In recent years there has been considerable growth in water trading in the Murray-Darling Basin. Water trading has been encouraged by Governments as a means of moving irrigation from those uses which produce low returns to others which can generate greater economic returns. It is also expected to have environmental benefits since increased profits from irrigation will make it easier for managers to invest in more efficient water delivery systems which will produce better returns for the volume of water used and reduce accessions to groundwater.

Initially water trading was confined to trades within irrigation systems. However over time, changes have been made to the trading rules which have permitted inter-valley and more recently interstate trade to take place. In recent years, Australian governments have been working together to reduce the differences in water entitlements in preparation for the introduction of increased interstate water trading. These changes are part of the water market reform package which was endorsed by the Council of Australian Governments (COAG) in 1994.

Trade has an impact on the implementation of the Cap. The trade in previously unused

entitlements affects the size of the allocation that can be announced by the water managers whilst inter-valley and interstate trade affects the Cap targets for the individual river valleys. It is therefore important that data on water trading be collected and published in the Water Audit Monitoring Report.

Table 9 details the total volume of water trades (both intra-valley and inter-valley) that occurred during the 1996/97 water year.

Table 10 shows the net trade between valleys. The sign convention used in Table 10 is that a negative value indicates a trade out of the valley and a positive value indicates a trade into the valley. It can be seen from this that compared to the total volumes of water traded, the inter-valley trades in 1996/7 were small and the interstate trades were negligible. Permanent inter-valley trades will result in permanent changes to the valley Caps usually calculated as the volume of entitlement traded multiplied by an agreed transfer factor. Temporary trades will alter the annual Cap targets usually on a one for one basis. Trade will therefore affect the Caps for individual valleys but will not result in an increase in the overall Cap for the Basin.

**Table 9. Trading in Water Entitlements in 1996/97 (Listed by source of transferred entitlement)**

<i>System</i>	<i>Permanent Entitlement Transfer (ML)</i>	<i>Temporary Entitlement Transfer<sup>1</sup> (ML)</i>
<b>New South Wales</b>		
Border Rivers	14 751	3 578
Gwydir	5 832	43 150
Namoi	6 151	33 928
Macquarie/Castlereagh/Bogan	1 424	50 319
Barwon-Darling	0	0
Lachlan	1 445	20 557
Murrumbidgee	2 520	181 776
Lower Darling	86	0
Murray	5 313	50 598
<b>Total NSW</b>	<b>37 522</b>	<b>383 906</b>
<b>Victoria</b>		
Kiewa	0	179
Ovens	255	666
Goulburn/Broken	2 553	24 109
Campaspe	293	11 925
Loddon	2 567	26 775
Wimmera/Mallee	0	0
Murray	5 218	35 652
<b>Total Victoria</b>	<b>10 886</b>	<b>99 306</b>
<b>South Australia</b>		
Country Urbans	0	0
Reclaimed Swamps	0	0
Other SA	4 075	5 890
Metro-Adelaide	0	0
<b>Total South Australia</b>	<b>4 075</b>	<b>5 890</b>
<b>Queensland</b>		
Border Rivers	0	7 000
Macintyre Brook	0	0
Condamine/Balonne	0	6 000
Warrego/Paroo	0	0
Moonie	0	0
<b>Total Queensland</b>	<b>0</b>	<b>13 000</b>
<b>Australian Capital Territory</b>		
	<b>0</b>	<b>0</b>
<b>Total Basin</b>	<b>52 483</b>	<b>502 102</b>

1. Temporary Entitlement Transfer includes temporary trade in both water rights and sales entitlement.

**TABLE 10. Net Inter-valley Water Entitlement Transfers in 1996/97**

<i>System</i>	<i>Permanent Entitlement Transfer<sup>a</sup> (ML)</i>	<i>Temporary Entitlement Transfer<sup>a</sup> (ML)</i>
<b>New South Wales</b>		
Border Rivers	0	0
Gwydir	0	0
Namoi	0	0
Macquarie/Castlereagh/Bogan	0	0
Barwon-Darling	0	0
Lachlan	0	0
Murrumbidgee	0	-21 640
Lower Darling	0	9 720
Murray	0	11538
<b>Total NSW</b>	<b>0</b>	<b>-382</b>
<b>Victoria</b>		
Kiewa	0	0
Ovens	-64	-5
Goulburn/Broken	-22	1 793
Campaspe	1 190	1 463
Loddon	-1 161	-3 648
Wimmera/Mallee	0	0
Murray	57	379
<b>Total Victoria</b>	<b>0</b>	<b>-18</b>
<b>South Australia</b>		
Country Urbans	0	0
Reclaimed Swamps	0	0
Other SA	0	400
Metro-Adelaide	0	0
<b>Total South Australia</b>	<b>0</b>	<b>400</b>
<b>Queensland</b>		
Border Rivers	0	0
Macintyre Brook	0	0
Condamine/Balonne	0	0
Warrego/Paroo	0	0
Moonie	0	0
<b>Total Queensland</b>	<b>0</b>	<b>0</b>
<b>Australian Capital Territory</b>		
	<b>0</b>	<b>0</b>
<b>Total Basin</b>	<b>0</b>	<b>0</b>

1. The sign convention used is that a negative value indicates a trade out of the valley and a positive value indicates a trade into the valley.

## ***10. Water Availability for the Year 1996/97***

### **10.1 Water Availability**

The 1995 report to the Ministerial Council 'An Audit of Water Use in the Murray-Darling Basin', found that water users had only diverted 63 % of the water that they had been authorised to use in the previous 5 years. (The amount allocated was not restricted to the quantity available and in some years exceeded it.) This highlights the fact that the States' allocation systems have evolved to encourage development of the Basin's water resources and are not well suited to being used to impose a Cap on diversions.

A key step in the process to implement the Cap will be the adjustments that are made to the States' allocation systems. In the process, it is expected that many existing water users who are disadvantaged by the implementation of the Cap will look at other systems and highlight any inconsistencies. To aid such comparisons and to make Cap implementation more transparent, the water used in each valley has been compared with the quantity of water that has been authorised for use in that valley in 1996/97 (see Table 11).

Water is allocated in many different ways across the Basin and there are differences between States, valleys and regions depending upon the reliability of supply and the degree of regulation. These types of allocations are summarised below.

#### **10.1.1 Volumetric Allocations**

Water users in regulated streams and in some unregulated systems are issued with volumetric entitlements. These entitlements specify a base volume of water that can be diverted each year and come in three main categories:

- High security entitlements which are available every year,
- Volumetric entitlements on unregulated streams which are available provided there is flow in the stream,
- Normal security entitlements which are subject to allocation announcements made at intervals throughout the season. These

entitlements, which include Victorian water right and sales, are the largest category of volumetric entitlement in the Basin. For these entitlements, the volume allocated is the base entitlement multiplied by the announced percentage allocation at the end of the season.

The first column of Table 11 lists the base water entitlements for each valley while the second column lists the total volume of water allocated in the valley.

#### **10.1.2 Announced Overdraw**

In some valleys an announcement is sometimes made during the season permitting irrigators to draw on next year's allocation. This increases the quantity of water that can be diverted in the season but will, if not cancelled by a spill from storage, reduce the volume available for the next season. The base entitlement multiplied by the announced overdraw is reported in the third column of Table 11.

#### **10.1.3 Allocation Transferred into Valley**

A temporary inter-valley transfer will increase the allocation in the purchasing valley and reduce the allocation in the selling valley. The net transfer into each valley has been copied from Table 10 to the fourth column in Table 11.

#### **10.1.4 Carryover and Overdraw from the Previous Year**

In some valleys, irrigators have been given the right to carry over unused allocation from the previous season. This system allows individual irrigators to adjust their level of water use to change their risk profile (ie by use of carryover the irrigator has a greater security of supply in the following year). Ultimately such a system will allow individual irrigators to select their own security of supply and thus allows for a greater diversity of crop types. An underdraw from last season, that has not been cancelled as a result of a spill from storage, will add to this season's allocation. Table 12 shows the balance between the carryover from last season and the overdraw utilised (as opposed to announced). The net carryover minus overdraw from 1995/6 adjusted where necessary for any cancellation is included as column 5 in Table 11.

TABLE 11. Water Allocated in 1996/97

<i>System</i>	<i>Base Valley Water Entitlement<sup>1</sup> (GL)</i>	<i>Announced Allocation<sup>2</sup> (GL)</i>	<i>Announced Overdrawn<sup>3</sup> (GL)</i>	<i>Allocation Transferred into Valley<sup>4</sup> (GL)</i>	<i>Net Overdrawn from 95/96<sup>5</sup> (GL)</i>	<i>Total Allocated Water in Valley<sup>6</sup> (GL)</i>
<b>New South Wales</b>						
Border Rivers	266	182	0	0	0	182
Gwydir	523	396	0	0	0	396
Namoi	295	278	0	0	0	278
Macquarie/ Castlereagh/Bogan	657	562	0	0	159	721
Barwon-Darling <sup>7</sup>	n/a	n/a	n/a	n/a	n/a	n/a
Lachlan	709	704	0	0	5	709
Murrumbidgee	2 380	2 380	0	-22	0	2 358
Lower Darling	82	82	0	10	0	92
Murray	2 160	2 160	191	12	-1	2 362
<b>Total NSW</b>	<b>7 072</b>	<b>6 744</b>	<b>191</b>	<b>0</b>	<b>163</b>	<b>7 098</b>
<b>Victoria</b>						
Kiewa	15	15	0	0	0	15
Ovens	57	57	0	0	0	57
Goulburn/Broken	730	1 355	0	2	0	1 357
Campaspe	270	498	0	1	0	500
Loddon	280	537	0	-4	0	533
Wimmera/Mallee	106	134	0	0	0	134
Murray	1 233	2 044	0	0	0	2 044
<b>Total Victoria</b>	<b>2 691</b>	<b>4 640</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4 640</b>
<b>South Australia</b>						
Country Urbans	50	50	0	0	0	50
Reclaimed Swamps	83	83	0	0	0	83
Other SA	490	490	0	0	0	490
Metro-Adelaide <sup>8</sup>	288	288	0	0	0	288
<b>Total South Australia</b>	<b>911</b>	<b>911</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>911</b>
<b>Queensland</b>						
Border Rivers	87	87	0	0	0	87
Macintyre Brook	18	18	0	0	2	20
Condamine/Balonne	119	100	0	0	21	121
Warrego/Paroo	3	3	0	0	0	3
Moonie	0	0.2	0	0	0	0.2
<b>Total Queensland</b>	<b>227</b>	<b>208</b>	<b>0</b>	<b>0</b>	<b>23</b>	<b>231</b>
<b>Aust. Capital Territory<sup>9</sup></b>	<b>30</b>	<b>30</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>30</b>
<b>Total Basin</b>	<b>10 931</b>	<b>12 533</b>	<b>191</b>	<b>0</b>	<b>186</b>	<b>12 910</b>

1. Sum of the volumetric entitlements in valley. Includes unregulated stream entitlements where these are expressed volumetrically (eg in Victoria). Includes permanent trades from Table 10.
2. Sum of base entitlements multiplied, where appropriate, by the largest announced percentage allocation in the season.
3. Base entitlement multiplied by the announced percentage overdraw.
4. Net temporary inter-valley entitlement transfer from Table 10.
5. Net Carryover less Overdraw from Previous Year (see Table 12).
6. Allocated water = announced allocation + announced overdraw + inter-valley trade + net carryover from last season.
7. Water is allocated in the Barwon-Darling system on an event basis.
8. The water allocated for Metro-Adelaide in 1996/97 is based upon the usage in the previous four years against the five year rolling total of 650 GL.
9. No formal entitlement in ACT; net diversion shown.

### 10.1.5 Off-Allocation and Water Harvesting Use

Water is made available to irrigators in regulated streams during periods when storages are spilling or there are unregulated flows by declarations of periods off-allocation. Water diverted in these

periods does not count against an irrigator's allocation for the rest of the season. Historically there were no controls over the size of these diversions other than the duration of the event and the licensed pump capacity. However in recent years quotas have been established in some systems and annual limits have been imposed.

TABLE 12. Carryovers and Overdraws for 1996/97

<i>System</i>	<i>Overdraw from 1995/96 (GL)</i>	<i>Carryover from 1995/96 (GL)</i>	<i>Overdraw Cancelled in 1996/97<sup>1</sup> (GL)</i>	<i>Carryover Cancelled in 1996/97<sup>2</sup> (GL)</i>	<i>Net Carryover from 95/96<sup>2</sup> (GL)</i>	<i>Overdraw from 1997/98 (GL)</i>	<i>Carryover to 1997/98 (GL)</i>
<b>New South Wales</b>							
Border Rivers	0	0	0	0	0	0	49
Gwydir	0	0	0	0	0	0	0
Namoi	0	0	0	0	0	0	0
Macquarie/ Castlereagh/Bogan	0	159	0	0	159	0	381
Barwon-Darling	0	0	0	0	0	0	0
Lachlan	0	5	0	0	5	0	132
Murrumbidgee	0	0	0	0	0	0	0
Lower Darling	0	0	0	0	0	0	0
Murray	1	0	0	0	-1	0.1	0
<b>Total NSW</b>	<b>1</b>	<b>164</b>	<b>0</b>	<b>0</b>	<b>163</b>	<b>0.1</b>	<b>562</b>
<b>Victoria</b>							
Kiewa	0	0	0	0	0	0	0
Ovens	0	0	0	0	0	0	0
Goulburn/Broken	0	0	0	0	0	0	0
Campaspe	0	0	0	0	0	0	0
Loddon	0	0	0	0	0	0	0
Wimmera/Mallee	0	0	0	0	0	0	0
Murray	0	0	0	0	0	0	0
<b>Total Victoria</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>South Australia</b>							
Country Urbans	0	0	0	0	0	0	0
Reclaimed Swamps	0	0	0	0	0	0	0
Other SA	0	0	0	0	0	0	0
Metro-Adelaide	0	0	0	0	0	0	0
<b>Total South Australia</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Queensland</b>							
Border Rivers	0	0	0	0	0	0	30
Macintyre Brook	0	2	0	0	2	0	0
Condamine/Balonne	0	33	0	12	21	0	23
Warrego/Paroo	0	0	0	0	0	0	0
Moonie	0	0	0	0	0	0	0
<b>Total Queensland</b>	<b>0</b>	<b>35</b>	<b>0</b>	<b>12</b>	<b>23</b>	<b>0</b>	<b>53</b>
<b>Aust. Capital Territory</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Total Basin</b>	<b>1</b>	<b>199</b>	<b>0</b>	<b>12</b>	<b>186</b>	<b>0.1</b>	<b>615</b>

- Under certain conditions (such as storage spills), carryovers and overdraws from the previous season can be cancelled.
- Net carryover is defined as: {(carryover less cancelled carryover) - (overdraw less cancelled overdraw)}.

Water harvesting licences have been issued in some Queensland streams. Irrigators with these licences are limited by their diversion capacity and by the flow at which they can commence to pump but not by the volume of water they can divert or by the area they can plant.

In some river valleys, a considerable percentage of the water diverted is authorised by the off-allocation or water harvesting rules. In theory it would be possible to determine the maximum volume of water that it would be possible to divert each year under these rules by assuming that irrigators divert at their diversion capacity for as long as the flow conditions apply. In practice this has not occurred as diversion capacity is limited by off stream storage development and related irrigated areas. Only the use from off-allocation and water harvesting has been added to the allocated water in Table 13 which underestimates the volume of water authorised for diversion. Options for improving this calculation are being examined for possible inclusion in future reports.

### **10.1.6 Area Licences on Unregulated Streams**

Some entitlements on unregulated streams specify an area that can be irrigated but not the volume of water which can be diverted. Although it would be possible to estimate the volume of water made available to these licences by multiplying the licensed area by an assumed usage, this has not been done and only the volume of water used by area licences has been added to the allocated water in Table 13. This process underestimates the volume of water authorised for use. New South Wales is moving toward replacing area licences with volumetric entitlements so this will be less of an issue in future years.

### **10.1.7 Irrigation System Losses**

In some irrigation distribution systems, water entitlements specify the rights to water delivered at the farm gate. The losses incurred by the water authority in delivering water from the diversion point on the river to the farm gate are therefore not

covered by the announced allocation and need to be added to the allocation to determine the authorised diversion. These losses are included in the fourth column of Table 13. For other irrigation distribution systems such as the privatised districts in the New South Wales Murray, an allowance for system losses has been included in the water entitlement.

## **10.2 Comparison of Diversions with Water Authorised for Use**

The final column in Table 13 lists the total volume of water that could be diverted in 1996/97 if all authorities to use water in 1996/97 were fully utilised (with the qualifications for off-allocation, water harvesting and area licences made in Sections 10.1.5 and 10.1.6). In Table 14 these volumes are compared with the water used in each valley and the percentage use of the water made available by the water authorities for diversion is presented.

In calculating the water used in the Victorian river valleys, the volumes diverted from each stream have to be adjusted for the water diverted from other valleys (second column of figures in Table 14). This refers to water that is physically transferred from the Goulburn Valley into the Campaspe and Loddon Valleys via the Waranga Western channel.

It is expected that diversion as a percentage of the water authorised to be diverted will fluctuate from year to year depending upon the climatic conditions and the degree to which the diversions are constrained by the physical resources available. Typically the utilisation of the allocations will be higher in the drier years and lower in the wetter years, especially in the south of the Basin. It is also expected that allocations would reduce and utilisation increase if the allocation system was tightened to prevent growth in diversions under the Cap. In this context, the 76 % utilisation of Basin allocations in 1996/97 is higher than the average of 63 % reported for the 5 years to 1993/94 in the 1995 report to the Ministerial Council 'An Audit of Water Use in the Murray-Darling Basin'.

**TABLE 13. Water Authorised for Use in 1996/97**

<i>System</i>	<i>Total Allocated Water in Valley<sup>1</sup> (GL)</i>	<i>Off-Allocation Water Harvesting Use<sup>2</sup> (GL)</i>	<i>Unregulated Stream Use not in Allocation<sup>3</sup> (GL)</i>	<i>System Losses not in Allocation<sup>4</sup> (GL)</i>	<i>Authorised Use in Valley<sup>5</sup> (GL)</i>
<b>New South Wales</b>					
Border Rivers	182	65	23	0	270
Gwydir	396	79	10	0	485
Namoi	278	58	46	0	382
Macquarie/ Castlereagh/Bogan	721	23	25	0	769
Barwon-Darling <sup>5</sup>	n/a	n/a	209	0	209
Lachlan	709	30	23	0	762
Murrumbidgee	2 358	412	12	380	3 162
Lower Darling	92	132	0	0	224
Murray	2 362	616	6	0	2 984
<b>Total NSW</b>	<b>7 098</b>	<b>1 415</b>	<b>354</b>	<b>380</b>	<b>9 247</b>
<b>Victoria</b>					
Kiewa	15	0	0	0	15
Ovens	57	0	0	0	57
Goulburn/Broken	1 357	108	0	177	1 642
Campaspe	500	4	0	19	523
Loddon	533	0	0	75	608
Wimmera/Mallee	134	0	0	84	218
Murray	2 044	150	0	278	2 472
<b>Total Victoria</b>	<b>4 640</b>	<b>262</b>	<b>0</b>	<b>633</b>	<b>5 535</b>
<b>South Australia</b>					
Country Urbans	50	0	0	0	50
Reclaimed Swamps	83	0	0	0	83
Other SA	490	0	0	0	490
Metro-Adelaide <sup>6</sup>	288	0	0	0	288
<b>Total South Australia</b>	<b>911</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>911</b>
<b>Queensland</b>					
Border Rivers	87	50	6	0	143
Macintyre Brook	20	0	1	0	21
Condamine/Balonne	121	226	18	11	376
Warrego/Paroo	3	0	0	0	3
Moonie	0.2	7	0.3	0	7.5
<b>Total Queensland</b>	<b>231</b>	<b>283</b>	<b>25</b>	<b>11</b>	<b>550</b>
<b>Aust. Capital Territory</b>	<b>30</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>30</b>
<b>Total Basin</b>	<b>12 910</b>	<b>1 960</b>	<b>379</b>	<b>1 024</b>	<b>16 273</b>

1. Allocated water from Table 11.
2. The difference between the off-allocation water used and the off-allocation water declared available for use has not been included in this calculation.
3. Unregulated stream entitlement in Victoria is included in the base entitlement.
4. 'System Losses not in Allocation' are losses in those irrigation systems where the entitlement is defined at the farm gate and losses in the distribution system are not covered by an entitlement.
5. Water is allocated in the Barwon-Darling system on an event basis.
6. The water allocated for Metro-Adelaide in 1996/97 is based upon the usage in the previous four years against the five year rolling total of 650 GL.

**TABLE 14. Use of Valley Allocations in 1996/97**

<i>System</i>	<i>Diversion from Valley (GL)</i>	<i>Diverted from other Valleys (GL)</i>	<i>Total use in Valley (GL)</i>	<i>Authorised use in Valley (GL)</i>	<i>Use as a % of authorised Valley use (GL)</i>
<b>New South Wales</b>					
Border Rivers <sup>1</sup>	195	0	195	270	72 %
Gwydir	415	0	415	485	86 %
Namoi	342	0	342	382	90 %
Macquarie/ Castlereagh/Bogan	374	0	374	769	49 %
Barwon-Darling <sup>1</sup>	209	0	209	209	100 %
Lachlan	459	0	459	762	60 %
Murrumbidgee	2 675	0	2 675	3 162	85 %
Lower Darling <sup>1</sup>	224	0	224	224	100 %
Murray	2 223	0	2 223	2 984	74 %
<b>Total NSW</b>	<b>7 115</b>	<b>0</b>	<b>7 115</b>	<b>9 247</b>	<b>77 %</b>
<b>Victoria</b>					
Kiewa	12	0	12	15	80 %
Ovens	26	0	26	57	46 %
Goulburn/Broken	1 871	-660	1 211	1 642	74 %
Campaspe	124	292	416	523	80 %
Loddon	172	331	503	608	83 %
Wimmera/Mallee	157	5	162	218	74 %
Murray	1 744	32	1 776	2 472	72 %
<b>Total Victoria</b>	<b>4 106</b>	<b>0</b>	<b>4 106</b>	<b>5 535</b>	<b>74 %</b>
<b>South Australia</b>					
Country Urbans	35	0	35	50	70 %
Reclaimed Swamps	83	0	83	83	100 %
Other SA	396	0	396	490	81 %
Metro-Adelaide <sup>2</sup>	66	0	66	288	23 %
<b>Total South Australia</b>	<b>580</b>	<b>0</b>	<b>580</b>	<b>911</b>	<b>64 %</b>
<b>Queensland</b>					
Border Rivers <sup>1</sup>	102	0	102	143	71 %
Macintyre Brook	9	0	9	21	43 %
Condamine/Balonne <sup>1</sup>	347	0	347	376	92 %
Warrego/Paroo	2	0	2	3	67 %
Moonie <sup>1</sup>	7	0	7	7.5	93 %
<b>Total Queensland</b>	<b>467</b>	<b>0</b>	<b>467</b>	<b>550</b>	<b>85 %</b>
<b>Aust. Capital Territory</b>	<b>30</b>	<b>0</b>	<b>30</b>	<b>30</b>	<b>n/a</b>
<b>Total Basin</b>	<b>12 298</b>	<b>0</b>	<b>12 298</b>	<b>16 273</b>	<b>76 %</b>

1. The authorised use in valley does not satisfactorily describe the volume of water that could be utilised for water harvesting, off-allocation and area licences on unregulated streams.
2. The water allocated for Metro-Adelaide in 1996/97 is based upon the usage in the previous four years against the five year rolling total of 650 GL.

## 11. Comparison of Actual Flows with Natural flows

A key factor in the Ministerial Council's decision to implement the Cap was the major changes that had occurred to the flow regime in many of the Basin's rivers. This either presents itself as a change in the seasonality of flow (as occurs below major dams) or a reduction in the total flow volume (as occurs at the bottom end of many of the river valleys). As part of the Cap monitoring process, the States have agreed to report on the way the natural flows in each river have been altered.

The natural flows are estimated from computer modelling studies. Many of the river models are incomplete or not yet modified to allow these numbers to be readily calculated for 1996/97.

Table 15 presents the annual flow volumes recorded and the natural flows at a number of selected key sites and the impact of development can be seen graphically in Figure 7. As such, Table 15 provides the available data and indicates the data that will ultimately be included in such a presentation.

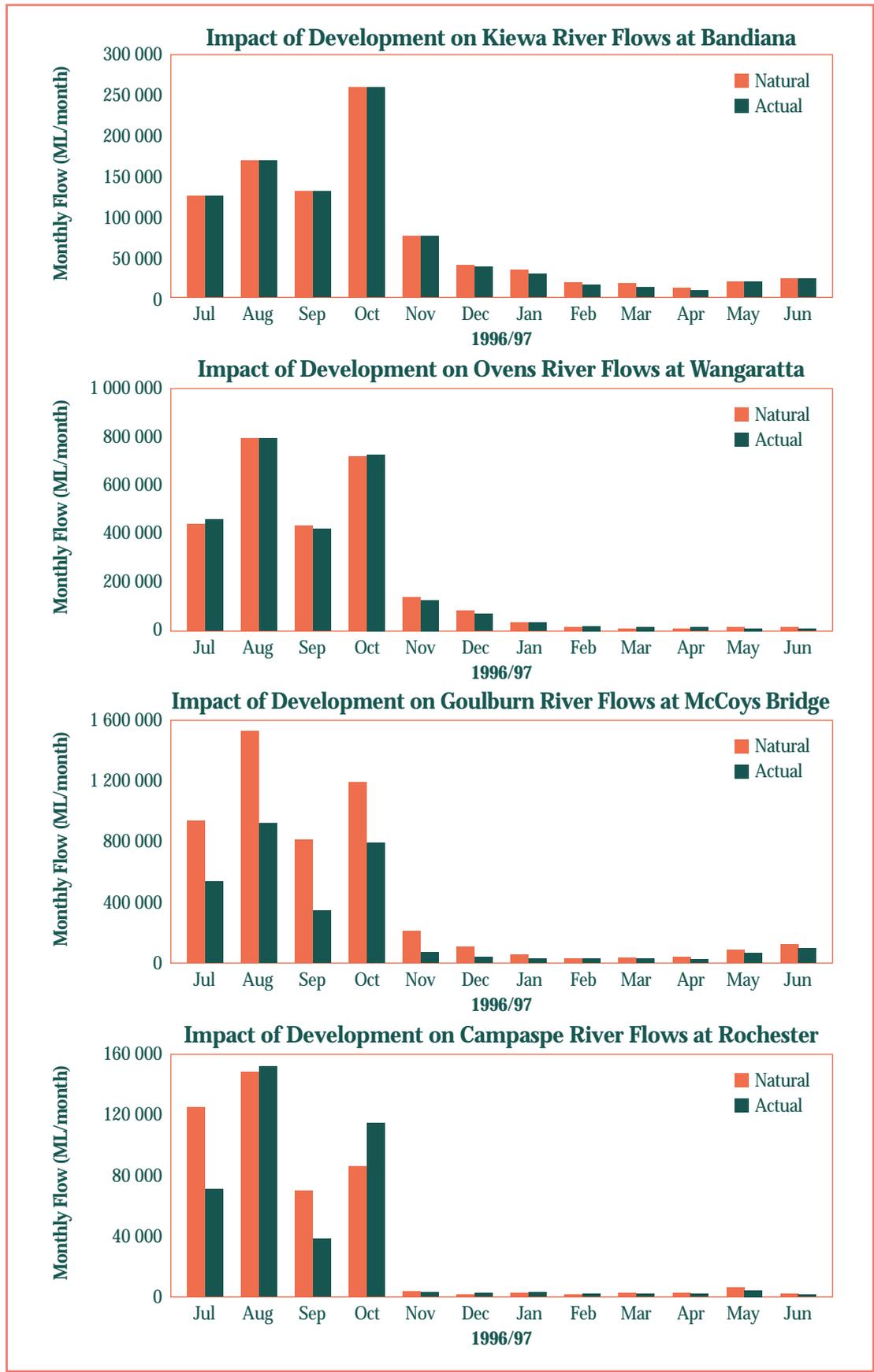
These results show that the flow regime in rivers such as the Kiewa and Ovens are little affected and flows in other streams such as the Goulburn have been significantly reduced. In the NSW Gwydir system the channels have been so altered that water that used to be trapped in wetlands now flows to the Barwon River.

**TABLE 15. Comparison of 1996/97 Actual and Natural Annual Flows for Key Sites**

<i>System</i>	<i>Actual Flow<sup>1</sup> (GL)</i>	<i>Natural Flow<sup>1</sup> (GL)</i>	<i>Actual/Natural (GL)</i>
<b>Snowy River Transfers</b>			
To Murrumbidgee	353	0	-
To Murray	349	0	-
<b>New South Wales Tributaries</b>			
Barwon River at Mungindi + Boomi River	n/a	n/a	n/a
Inflows to Gwydir Wetland	n/a	252	n/a
Gwydir System Outflows to Barwon River	198	103	192 %
Namoi System Outflows to Barwon River	n/a	n/a	n/a
Inflows to Macquarie Marshes	n/a	682	n/a
Macquarie/Castlereagh/Bogan Outflows	123	178	69 %
Darling River Inflows to Menindee Lakes	2 102	n/a	n/a
Lachlan River at Oxley	n/a	318	n/a
Lachlan River at Booligal	207	423	49 %
Murrumbidgee River at Balranald	1 077	n/a	n/a
Lower Darling River at Burtundy	1 333	n/a	n/a
<b>Victorian Tributaries</b>			
Kiewa River at Bandiana	891	903	99 %
Ovens River at Wangaratta	2 696	2 700	100 %
Goulburn River at McCoys Bridge	2 814	4 990	56 %
Campaspe River at Rochester	392	450	87 %
Loddon River at Appin South	214	329	65 %
<b>Queensland Tributaries</b>			
Condamine/Balonne/Culgoa Flows at NSW Border	n/a	n/a	n/a
Warrego River at Cunnamulla	n/a	n/a	n/a
Paroo River at Caiwarro	n/a	n/a	n/a
Moonie River at Fenton	n/a	n/a	n/a
<b>River Murray</b>			
Albury	7 129	n/a	n/a
Yarrowonga	8 413	n/a	n/a
Euston	10 172	n/a	n/a
South Australian Border	10 335	n/a	n/a
Barrages	8 907	n/a	n/a

1. n/a indicates not available

**FIGURE 7. Plots of Flows at Selected Sites Showing Actual and Natural (Modelled) Flows in Victoria**



## ***12. Proposed Water Management Activities***

### **12.1 General**

The Cap is not a panacea for the problems facing the rivers of the Basin. It is merely part of a larger process aimed at ensuring that the management of the Basin's rivers and water resources occurs in a sustainable manner. As such the States are undertaking a range of activities that will impact on water use.

In considering the overall issue of flow management in the Basin's rivers several issues are worth highlighting.

- ***Conjunctive Use***

This is the term used to describe irrigation and other water use where the water is derived from both groundwater extractions and surface water diversions. The issue is that by controlling (restricting) access to surface water to meet the Cap requirements water users increase their groundwater extraction to make up the shortfall. In some cases this is not an issue as the groundwater systems are being used at a level below their capacity but in many cases this results in serious problems where the groundwater is mined (extracted at a rate greater than it is replenished). The impacts of extracting from a groundwater system beyond its capacity can be severe. Often water levels fall such that some users lose access to groundwater and the aquifer can compress (from which it does not recover).

A further issue that is of direct relevance to the Cap is that many groundwater systems are in direct hydraulic connection with the river systems and recharged from the rivers. Thus increased usage of groundwater can result in greater recharge from the river systems and thus lower end of system flows. In these systems a restriction to surface water with no control on groundwater extraction could result in only minimal benefit for the river systems.

- ***Carryover and Overdraw***

The issue of carryover and overdraw only relates to regulated systems. The basis behind

allowing carryover and overdraw is that it permits individual water users to decide on their own pattern of water usage with any under usage being credited to them in the subsequent year. This is of particular value when allocations increase too late in the season to adjust the area of main summer crop planting. Without carryover the general practice was to use the additional water for a winter crop which generally had a much lower return per ML than an alternative summer crop. The reason for doing this was if the water was not used it was forfeited.

Where carryover is allowed, the irrigator can carry this water forward to the next year and can use it on their primary summer crop, thus maximising the profit per ML. The risk in carrying water over is that the irrigator may lose some or all of it if the storage spills, although if this does occur they can expect to have a high allocation. Application of carryover rules on the Macquarie River has indicated that it is well accepted by irrigators. The overall result is that total usage has been reduced but usage on the primary summer crop (cotton) has increased.

- ***Floodplain Harvesting***

This is primarily an issue for the rivers in the north of the Basin. Floodplain harvesting involves capturing surface flows that are not in a defined stream or river channel. In some places this will be due to the river breaking its banks and thus the water has originated from the river system. The alternative is where the water is a direct result of rainfall and has not yet reached a stream or river.

The issue with floodplain harvesting is that, with careful design, harvesting systems can capture large volumes of water before they reach a defined watercourse and thus reduce the overall flow in that watercourse. The different States have different rules covering water harvesting, with the rules varying as to the source of the water (local runoff or from a river breaking its banks).

The following sections outline the States' proposals for further actions aimed at achieving sustainable management of the Basin's rivers and water resources.

## 12.2 New South Wales

### 12.2.1 Future Cap Management in the Regulated Rivers and the Barwon-Darling River

There are two major sets of rules that are likely to significantly influence water usage in NSW regulated valleys over the next 3-5 years. They are the maintenance of practical Cap rules and the introduction of environmental flow rules. The influence of these rules will vary across the State. Details of how they will influence bulk water usage in the major regulated valleys and the Barwon-Darling River system are described below.

In response to the introduction of the Cap in 1995 the DLWC developed a set of practical Cap Management Rules that it will continue to use, where necessary, to ensure Cap compliance across the State. These 'Practical Cap Rules' include limiting the total amount of water available in a given year by adjusting the level of allocation and/or off-allocation access. The DLWC is also reducing the number of forfeit accounting rules in each Valley through the introduction and expansion of carryover schemes. Forfeit accounting rules, with their 'use it or lose it' response have been one of the primary factors driving overuse in the past. If there is evidence of significant growth in any NSW Valley the DLWC will review the effectiveness of these Cap Management Rules.

As part of the NSW Water Reforms, eleven interim state-wide river flow objectives have been established by the Government for the major regulated rivers of NSW. They are currently the subject of broad community consultation. In most valleys across the State a set of indicative flow rules have been agreed to by both the River Management Committees (RMCs) and the Government. These rules will be implemented

during the 1998/99 water year. In the short term, as part of its broader role, the RMCs will monitor the impacts of these rules on the environment and the social and economic fabric of the valley and recommend any appropriate modifications.

Following the five years of experience in flow rules, the Government will establish long-term river flow objectives for all regulated valleys in NSW which will be referred to as River Management Plans. The review of these rules will also be used to assess their ability to achieve Cap outcomes.

The environmental flow rules have been designed to bring long term average diversions to below 1993/94 levels. This means that although the environmental flow rules will ensure that diversions are well below 1993/94 levels in most years, the diversion recorded in some individual years may slightly exceed the Cap. Therefore, the net long-term result of the environmental flow rules will be long term Cap compliance in NSW.

The ability of the environmental flow rules to bring long term diversions to below 1993/94 levels is based upon the assumption that future development remains at current levels. It will be necessary for the DLWC to monitor development to ensure that the indicative flow rules remain effective.

### 12.2.2 Future Cap Management in the Unregulated Streams of the NSW Basin

- *The Stressed Rivers Approach to the Management of Unregulated Streams*

In May 1998 all unregulated streams in the Murray-Darling Basin were classified in terms of stress. The aim of this classification is to establish a consistent and transparent rationale for the future management of unregulated rivers while allowing for different priorities and policies to be set depending on the specific circumstances of each catchment. The classification is the first stage of the NSW Water Reforms as they relate to the management of unregulated streams.

Unregulated River Management Committees have been established for all of the major valleys in NSW. These committees will be directly responsible for developing management plans for the unregulated systems of NSW.

- ***Volumetric Conversion***

The next stage in the water reform process is the volumetric conversion of licences on unregulated streams. This conversion is being carried out on a state-wide basis in order to establish a volumetric management system which allows water extractions to be fairly and effectively restricted. It aims to ensure that both the Murray-Darling Basin Cap and state-wide environmental outcomes are achieved.

In those sub-catchments that are located within Murray-Darling Basin the estimate of irrigated areas used in the volumetric conversion will be the area irrigated in 1993/94. Where 1993/94 data is unavailable an estimate will be made based any data available since 1993/94.

## **12.3 Victoria**

### **12.3.1 1997/98 Water Use Capping Measures**

The review of the 1996/97 Irrigation Season, and in particular the high delivery rates experienced, gave cause for concern that usage may still be increasing. Further changes to trading and off-quota (off allocation) policies were therefore introduced for the 1997/98 season, as outlined below. The nature of the seasonal allocation process also limits diversions due to its consideration of the resource position.

- ***Trading***

A new trading rule introduced for the 1997/98 season restricted the activation of unused sales water in the gravity irrigation districts by limiting the temporary trading in sales water. Temporary trading of above 30 % sales entitlement in the gravity irrigation districts

was not allowed, and no irrigator was allowed access to sales entitlement above 30 % if any of their water entitlement is temporarily traded (temporary sales trading by private diverters has not been permitted since 1995/96).

The aim of this rule was to prevent the activation of previously unused sales allocations through trading, which would increase usage and therefore restrict allocations in future years due to the Cap.

- ***Off-Quota***

From 1997/98, off-quota for the Murray System, including Torrumbarry and the Mitta Mitta River, will only be made available when surplus flow is declared in the Hume to Yarrawonga reach of the River Murray. In addition, maximum usage under off-quota allocations is to be limited to 30 % of water right or licence volume. The aim of this policy is to protect the security of supply to existing water users, as well as limiting growth in diversions through use of off-quota water.

### **12.3.2 Outlook for 1997/98 Season**

The process used to determine the allocation in a given season takes into account the resource position at the start of that season. The low storage levels at the end of the 1996/97 irrigation season set the scene for a low initial allocation for the 1997/98 season. If allocations remain less than maximum, any significant over use in 1996/97 will be reflected in lower allocations in 1997/98, correcting any over use. In addition, releases from Hume Dam in October 1996 are expected to have resulted in lower than Cap water use in 1997/98.

### **12.3.3 Longer Term Capping Measures**

In the short term, water use will continue to be reviewed each year and water management rules adjusted as necessary. However, emphasis is now on reviewing water entitlements and allocation processes under the Victorian Bulk Entitlement development process to establish long term Cap management arrangements.

## 12.4 South Australia

As water usage in 1996/97 in South Australia was below the Cap limit, South Australia does not need, and thus does not plan, to adjust its approach to water management at this stage.

## 12.5 Queensland

### 12.5.1 Management Planning

Valley based water management planning processes have been initiated for the Condamine Balonne and Border Rivers catchments. The majority of water development is associated with these valleys.

The Water Allocation and Management Planning (WAMP) process continues for the Condamine Balonne system as does development of the Flow Management Plan (FMP) for the Border Rivers (a joint initiative with the DLWC in NSW).

Water Management Plans (WMP's) will be developed for the remainder of the major stream systems ie, Warrego, Paroo, and Moonie Rivers. Water Management Plans are being developed where there is an identified need to limit water extraction to preserve delicate environmental balances in the river ecosystem. They do not involve the same complexity of hydrologic modelling as is required for the WAMP.

These planning initiatives aim to:

- achieve a balance between environmental and consumptive uses of water;
- improve planning confidence for water users;
- increase community involvement in the way water is used;
- provide healthier river systems; and
- provide a basis for the introduction of water trading opportunities.

The WAMP for the Condamine Balonne and the FMP for the Border Rivers are expected to provide new river management directions in 1999. It is expected that implementation of these plans will

require consideration of allocation and operational changes including:

- The development of 'end of valley' flow regimes which will act as target flows for the river managers;
- Conversion of hectare based irrigation licenses to a volumetric entitlement where this has not already occurred;
- Volumetric accounting of water harvesting diversions;
- Conversion of pump size to daily diversion rates on extraction licenses;
- Event based flow management approaches where diversion access announcements will recognise prevailing climatic and river health conditions;
- The installation of additional gauging station sites to assist in more responsive and accurate flow sharing decision making. Related to this will be the development of multi-criteria decision-making approaches to river management. The establishment of a more extensive monitoring network will support more accurate and detailed water audit monitoring;
- The introduction of permanent transfer of allocations and related trading rules. Completion of the hydrologic flow models for the two major systems will be a precursor to the introduction of permanent transfers. The flow models will allow more balanced consideration of the effect on other users and the environment in transferring allocation; and
- More comprehensive metering of diversions including time and event recording to improve diversion accountability. Currently 30 % of diversion is not metered.

### 12.5.2 Water Efficiency

Natural Heritage Trust (NHT) and Cotton Research and Development Corporation (CRDC) supported projects targeting water use efficiency are underway in the Basin. These projects aim to make

water users more aware of their extraction from the system and to promote the more efficient use of water on the farm. One project is promoting the voluntary installation of meters to both assist in efficiency of use, and to ensure the irrigation industry remains open and accountable in reporting extractions from the system.

Further projects and initiatives promoting water use efficiency improvements are likely to result from this activity.

### **12.5.3 Floodplain Management**

There is increasing community concern regarding water-related development on the floodplain. Projects have been initiated to develop coordinated strategies, in consultation with all stakeholders, for management of the floodplains, especially in the upper Condamine, lower Balonne and Border Rivers. As with Cap measures in place on the river systems, management directions may include controls on floodplain development.

### **12.6 Australian Capital Territory**

Currently the only effective legislation covering water resources management in the ACT deals with

water quality protection. There are no effective arrangements controlling water abstraction.

The government has introduced legislation to provide for a comprehensive water allocation and licensing scheme covering all waters (including groundwater and stormwater) under the control of the Territory Executive. It is hoped that the legislation will be passed by the end of 1998.

It is the intention that all water withdrawals from surface water and groundwater including that by Australian Capital Territory Electricity and Water (ACTEW) and all private diverters will be licensed (except surface water used for stock and domestic purposes). It will be through this licensing scheme that water withdrawals will be managed to ensure the achievement of the environmental flows specified in the ACT Environmental Flow Guidelines which will be formalised as part of the legislation.

The ACT expects to begin developing its approach to the Murray-Darling Basin water Cap soon. As the ACT is entirely within the larger Murrumbidgee Valley (administered throughout NSW by DLWC), the ACT approach to the Cap will involve negotiation with NSW.



# Glossary

<b>ACTEW</b>	Australian Capital Territory Electricity and Water.
<b>announced allocation</b>	The percentage of water entitlement declared available for diversion from a regulated stream in a season.
<b>annual allocation</b>	The annual volume of water available for diversion from a regulated stream by an entitlement holder.
<b>authorised use</b>	Total of the water allocated in the valley plus off-allocation and water harvesting use plus unregulated stream use not in allocation and system losses not in allocation (see Table 13).
<b>Border Rivers</b>	The rivers and tributaries forming, or intersecting the border between NSW and Queensland.
<b>bulk entitlement</b>	A perpetual entitlement to water granted to water authorities by the Crown of Victoria under the Water Act 1989.
<b>carryover</b>	An unused entitlement from one season that can be used in the next year.
<b>channel capacity</b>	The maximum rate at which water can be delivered through a river reach or an artificial channel.
<b>COAG</b>	Council of Australian Governments.
<b>diversion</b>	The movement of water from a river system by means of pumping or gravity channels.
<b>diversion licence</b>	Specified licences issued for a specified annual volume and diversion rate.
<b>DLWC</b>	The Department of Land and Water Conservation (of NSW).
<b>dozer allocation</b>	An allocation that is not fully utilised.
<b>EC (unit)</b>	Electrical conductivity unit 1 EC = 1 micro-Siemen per centimetre measurement at 25° Celsius. Commonly used to indicate the salinity of water.
<b>end-of-valley flows</b>	The flow regime at the end of a valley.
<b>FMIT</b>	First Mildura Irrigation Trust.
<b>gigalitre (GL)</b>	One thousand million or 10 <sup>9</sup> litres.

<b>GL</b>	Gigalitre: one thousand million or 10 <sup>9</sup> litres.
<b>G-MW</b>	Goulburn-Murray Water (of Victoria).
<b>gravity districts</b>	Districts which use gravity to divert the flow of water from the river.
<b>high security entitlement</b>	An entitlement which does not vary from year to year and is expected to be available in all but the worst droughts.
<b>IAG</b>	Independent Audit Group.
<b>irrigation</b>	Supplying land or crops with water by means of streams, channels or pipes.
<b>MDBC</b>	Murray-Darling Basin Commission.
<b>MDBMC</b>	Murray-Darling Basin Ministerial Council.
<b>megalitre (ML)</b>	One million litres. One megalitre is approximately the volume of an Olympic swimming pool.
<b>Ministerial Council, the</b>	Murray-Darling Basin Ministerial Council.
<b>ML</b>	Megalitre: one million litres. One megalitre is approximately the volume of an Olympic swimming pool.
<b>Murray-Darling Basin Agreement</b>	The agreement between the Governments of the four Basin States and the Commonwealth. The current Agreement is the 1992 Agreement.
<b>off-allocation</b>	When unregulated tributary inflows or spills are sufficient to supply irrigation needs and downstream obligations.
<b>on-farm storage</b>	Privately owned storages used to harvest surplus flows or to store unused allocations for use in the following season.
<b>overdraw</b>	Water diverted in one season against a prospective allocation in the subsequent year.
<b>permanent transfer</b>	The transfer of water entitlements on a permanent basis. The right to permanent transfers allows irrigators to make long term adjustments to their enterprise and enables new operators to enter the industry.
<b>private diverters</b>	Licensed to operate privately owned pumps or diversion channels; includes river pumpers and diverters as well as town water supplies.

<b>property right</b>	In this context, the right to ownership of allocated volumes or water.
<b>RAMSAR wetland</b>	A wetland listed on the Register of internationally significant wetlands established by the Convention at Ramsar.
<b>regulated streams/waterways</b>	Streams where users are supplied by releases from a storage. A water licence for a regulated stream specifies a base water entitlement defining the licence holder's share of the resources from a stream.
<b>riparian</b>	Of, inhabiting or situated on the bank and floodplain of a river.
<b>RIT</b>	Renmark Irrigation Trust.
<b>sales water</b>	In Victoria, water that may be purchased by an irrigator in addition to the basic water right. Access to sales water is announced each season as a percentage of water right depending on the available resource.
<b>salinity</b>	The concentration of dissolved salts in groundwater or river water usually expressed in EC units.
<b>sleeper allocation</b>	An allocation that does not have a history of water usage.
<b>temporary transfer</b>	Water entitlements transferred on an annual basis.
<b>unregulated streams</b>	Streams that are not controlled or regulated by releases from major storages.
<b>utilisation</b>	The amount of water available for diversion that is actually diverted.
<b>water entitlement</b>	The legal right of a user to access a specified amount of water in a given period.
<b>water harvesting</b>	Diversion of flow into private storages in Queensland under licences which specify the maximum diversion rate and the minimum flow in the stream at which diversion can commence.
<b>WAMP</b>	Water Allocation and Management Planning. It is a process currently underway in Queensland to enable the acceptable level of allocatable water to be determined for a river system. This methodology will determine what part of the flow regime should be preserved for environmental flows, and what part can be made available for consumptive use.
<b>WMRWG</b>	Water Market Reform Working Group.

