Water Availability in the Wimmera
Summary of a report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project

October 2007
Project framework

The project framework begins with definition of subcatchments for modelling and regions for reporting, and with definition of the climate and development scenarios to be assessed (including generation of the time series of climate data that describe these scenarios). The climate data form inputs to spatio-temporal modelling of the implications of these climate scenarios for catchment runoff and groundwater recharge. The catchment development scenarios (farm dams and forestry) are modifiers of the resulting modelled runoff time series. The runoff implications are then propagated through existing river system models. The recharge implications are propagated through groundwater models – for the major groundwater resources – or considered in simpler assessments for the minor groundwater resources. The connectivity of surface and groundwater is assessed and the actual volumes of surface-groundwater exchange under current and likely future groundwater extraction are quantified. Monthly water balances for the last 10 to 20 years are analysed using all relevant existing data and remotely-sensed measures of irrigation and floodplain evapotranspiration, and are compared to the river modelling results. The implications of the scenarios for water availability and water use under current water sharing arrangements are then assessed and synthesised.

The uncertainty in the assessments is considered from the perspective of ‘IF this future (of climate and development) ‘THEN’ these hydrologic implications’. There is uncertainty in both the ‘IF’ and the ‘THEN’. The uncertainty in the IF is typically large, since the degree of future global warming cannot be accurately predicted. Additionally, there is still considerable uncertainty in predictions of rainfall change resulting from global warming. The uncertainty in the THEN stems from the adequacy of hydrologic and meteorologic data and the imperfect predictions of hydrologic response to climate change given current understanding.

Acknowledgments

Prepared by CSIRO for the Australian Government under the Raising National Water Standards Program of the National Water Commission. Important aspects of the work were undertaken by Sinclair Knight Merz Resource & Environmental Management Pty Ltd; Department of Water and Energy (New South Wales); Department of Natural Resources and Water (Queensland); Murray-Darling Basin Commission; Department of Water, Land and Biodiversity Conservation (South Australia); Bureau of Rural Sciences; Salient Solutions Australia Pty Ltd; eWater Cooperative Research Centre; University of Melbourne; Webb, McKeown and Associates Pty Ltd and several individual sub-contractors.

Disclaimers

Derived from or contains data and/or software provided by the Organisations. The Organisations give no warranty in relation to the data and/or software they provided (including accuracy, reliability, completeness, currency or suitability) and accept no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use or reliance on that data or software including any material derived from that data and software. Data must not be used for direct marketing or be used in breach of the privacy laws. Organisations include Department of Water and Energy (New South Wales); Department of Sustainability and Environment (Victoria), Department of Water, Land and Biodiversity Conservation (South Australia); Department of Natural Resources and Water (Queensland); Murray-Darling Basin Commission.

CSIRO advises that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, CSIRO (including its employees and consultants) excludes all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it. Data is assumed to be correct as received from the Organisations.

Photos courtesy of the Wimmera Catchment Management Authority (CMA) Victoria.

© CSIRO 2007 all rights reserved. This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from CSIRO.

Scenarios assessed

The assessments of current and potential future water availability are undertaken by considering four scenarios of historical, recent and future climate and current and future development. All scenarios are defined by daily time series of climate variables based on different scalings of the 1895–2006 climate. The first scenario is for historical climate and current development and is used as a baseline against which other scenarios are compared. The second scenario is for recent climate and current development and is intended as a basis for assessing future water availability should the climate in the future prove to be similar to that of the last ten years. The third scenario is for future climate and current development and evaluates three global warming scenarios using 15 global climate models to provide a spectrum of possible climates for 2030. From this spectrum three variants are reported: a median or best estimate, a wet variant and a dry variant. The fourth scenario is for future climate and future development and considers the effects of both a 2030 climate and the expansions in farm dams and commercial plantation forestry expected under current policy, and the changes in groundwater extractions anticipated under existing groundwater plans.
The Wimmera

The Wimmera region is in western Victoria and represents 3 percent of the total area of the Murray-Darling Basin (MDB). The region is based around the terminal Wimmera River, Avon River and Yarriambiack Creek. The population is around 50,000 or 2.5 percent of the MDB total, concentrated in the major centres of Horsham, Stawell and Ouyen. The dominant land use is broadacre cropping of cereals, pulses and oilseeds in the central and northern areas, and dryland livestock grazing in the south. There are currently 6000 ha of irrigated cropping with the major enterprises being vines, pastures and orchards. The area of commercial plantation forestry in the region is small and farm dams are predominantly for stock and domestic use. Native vegetation covers over 16 percent of the region. The region includes the nationally significant terminal lakes Albacutya (Ramsar-listed) and Hindmarsh.

The region uses 1 percent of the surface water diverted for irrigation and urban use in the MDB and uses less than 0.1 percent of the MDB groundwater resource. There are major water storages at the foothills of the Grampians Ranges. Surface water diversions are primarily for stock and domestic use, but also for urban supply and limited irrigation. There are three groundwater management units (GMUs) in the western part of the region. Groundwater extraction is primarily for stock and domestic use, as well as some urban supply and limited irrigation.
Key findings

There is a very high level of surface water diversion in the Wimmera and large losses in the distribution system. This has caused major changes to the water regimes of the terminal lakes. Climate change is likely to result in substantial reductions in the volumes of surface water available – the best estimate is that water availability will reduce by about one-fifth. This would reduce the reliability of non-urban water supply and would impact further on the terminal lakes.

- **Current** average surface water availability is 206 GL/year and 59 percent of this is diverted for use. Actual use is much lower as system losses are high. Groundwater use is low and does not impact on streamflow.
- **If the recent climate** (1997 to 2006) were to continue for the long-term both average surface water availability and use would decline by about 50 percent.
- **The best estimate of climate change by 2030** is less severe than the recent past: average surface water availability would be 163 GL/year. There is however, a wide range in the potential impacts of climate change: from 6 percent reduction in average surface water availability to conditions similar to the last ten years.
- **Significant future development** of commercial plantation forestry and farm dams is unlikely. Groundwater resources in the region are in confined aquifers with limited potential for extraction. Licensed extraction is likely to increase by 20 percent in the future; however, this level of use is considered sustainable.

For historical climate and current development

The long-term average annual rainfall for the Wimmera region is 403 mm and modelled average annual runoff is 16 mm, or less than 2 percent of the total runoff for the MDB.

The assessments reported here include consideration of only Supply System 1 of the Wimmera-Mallee Pipeline – the western Dooen to Yaapeet line. For these conditions average annual surface water availability is 206 GL/year and current water use represents 20 percent of this available water. However, on average, 59 percent of the available water is diverted for use, as losses in the distribution system are high. Currently, allocations are less than the maximum defined surface water Bulk Entitlements in 26 percent of years. Modelling of other Supply Systems of the Wimmera-Mallee Pipeline would be expected to lead to different results.

Average annual groundwater recharge (via through-flow) is about 12 GL/year and total groundwater use is 1.84 GL/year. Groundwater extractions do not affect the Wimmera River as they are distant from the river. Licensed extraction is limited to one of the three GMUs in the region and represents around 40 percent of the GMU recharge. Groundwater here is not recharged by local rainfall, thus climate change will not affect recharge directly.

The water regimes of lakes Hindmarsh and Albacutya have been dramatically altered by water resource development. The fraction of time these lakes are full has been reduced from 65 to 15 percent for Hindmarsh and from 24 to 2 percent for Albacutya. The maximum duration of shallow conditions has increased in Lake Hindmarsh from 3 to 8 years and in Lake Albacutya from 8 to 33 years. These changes are likely to have caused and may continue to cause considerable ecological change in these ecosystems.

For recent climate and current development

The average annual rainfall for 1997 to 2006 was 13 percent lower than the long-term average. Runoff was 51 percent lower. Long-term continuation of conditions similar to these would reduce average surface water availability by 53 percent and surface water use by 50 percent. Under these conditions water allocations under existing Bulk Entitlements would be less than the maximum in 95 percent of years, however, impacts would differ between user groups. On average, stock and domestic use would receive an increased share of the reduced surface water resource; the irrigation share would fall from 12 to 4 percent and the environmental share would fall from 22 to 15 percent. The dry-year irrigation share would fall from 9 percent to zero and the dry-year environmental share would fall from 23 to 4 percent of the available resource.

A long-term continuation of the climate of the last ten years would cause major additional changes in the hydrology of lakes Hindmarsh and Albacutya. Hindmarsh would almost never fill and would experience continually shallow conditions for periods of up to 32 years – four times longer than at present. Albacutya would be unlikely to ever fill and would be nearly always shallow. Such changes would have considerable ecological consequences.

For future climate and current development

Almost all global climate models considered indicate reductions in rainfall and thus runoff by 2030. The best estimate (median) is a 17 percent reduction in long-term average annual runoff. For high global warming the range is from a 47 percent
reduction to a 1 percent increase in long-term average annual runoff; for low global warming the range is from a 16 percent reduction to no change.

Under the best estimate 2030 climate average surface water availability would be reduced by 21 percent or about 43 GL/year. This would reduce total diversions by 11 percent and total water use by 14 percent although urban use would be largely unaffected. Allocations would be less than the current maximum in 56 percent of years – less severe than under a continuation of the climate of the last ten years. Changes in the proportional sharing of surface water (assuming current sharing arrangements) would be less substantial.

The best estimate 2030 climate would be likely to lead to major changes to the water regimes of lakes Hindmarsh and Albacutya and hence considerable additional ecological change. Hindmarsh would be expected to be full only 4 percent of the time, while Albacutya would be unlikely to ever fill.

The wide range in climate possibilities by 2030 leads to considerable uncertainty in future water availability and hydrologic changes for the major lakes. At the dry extreme, average surface water availability and use would be similar to the last ten years. At the wet extreme, average surface water availability would reduce by 6 percent.

### For future development

MDB-wide projections for commercial forestry plantations suggest growth in the Wimmera region by 2030 is unlikely to be sufficient to significantly affect runoff volumes. Expansion in farm dams by 2030 is also expected to be small, and not sufficient to significantly affect runoff volumes. For the one GMU with licensed entitlements, groundwater extraction is expected to grow by around 20 percent by 2030, increasing the relative level of licensed extraction from about 40 to 50 percent of the lateral recharge.

### Limitations

The runoff estimates in the southern parts of the Wimmera where most of the runoff comes from are reasonably good because there are many calibration catchments from which to estimate the model parameter values. The runoff estimates in the northern parts of the Wimmera are relatively poor because there are no calibration catchments. The largest sources of uncertainty in the assessments of future water availability are the climate changes projections (global warming level) and the predicted implications of global warming on rainfall.

The river model is well suited to evaluate changes in the characteristics of high flows as a consequence of climate scenarios, and probably adequate to evaluate changes in the long-term water balance. The river model is unsuitable to evaluate changes in low flows, which may be a problem for assessing baseflow maintenance for ecological purposes. Considerable external uncertainty in projected flow patterns is caused by the high level of regulation, including transfers between basins, reservoirs and a complex system of natural and artificial channels and pipelines, and the transmission losses that may occur in these.
Rainfall and Runoff

The average annual rainfall for the entire Wimmera region is 403 mm and modelled average annual runoff is 16 mm. Rainfall is generally higher in the winter half of the year and most of the runoff occurs in winter and early spring. The Wimmera region covers 3 percent of the MDB and contributes about 1.7 percent of the total runoff in the MDB.

The average annual rainfall and runoff over the past ten years (1997 to 2006) are 13 percent and 51 percent lower respectively than the historical averages. The 1997 to 2006 rainfall is significantly different to the 1895 to 1996 long-term average (at a statistical significance level of 0.05) and the 1997 to 2006 runoff is very significantly different to the 1895 to 1996 long-term average (at a significance level of 0.01).

Rainfall-runoff modelling with climate change projections from global climate models indicates that future runoff in the Wimmera is likely to decrease. Under the best estimate 2030 climate there is a 17 percent reduction in average annual runoff. The extreme estimates, which come from the high global warming scenario, range from a 47 percent reduction to a 1 percent increase in average annual runoff. By comparison, the range from the low global warming scenario is a 16 percent reduction to no change in average annual runoff.

The negligible projected growth in commercial forestry plantations and the small projected increase in farm dams has little impact on modelled future runoff in the Wimmera.

<table>
<thead>
<tr>
<th>mm</th>
<th>Percent change from Historical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>403</td>
</tr>
<tr>
<td>Runoff</td>
<td>16</td>
</tr>
<tr>
<td>Evapotranspiration</td>
<td>387</td>
</tr>
</tbody>
</table>
Rainfall

Annual rainfall (1895–2006) spatially averaged across the region (based on SILO data) with low-frequency smoothed line shown to indicate longer-term variations.

Average (1895–2006) monthly rainfall averaged across the region and range (shaded) of potential changes in mean monthly rainfall due to climate change by 2030.

Runoff

Annual runoff (1895–2006) spatially averaged across the region (based on daily modelling) with low-frequency smoothed line shown to indicate longer-term variations.

Average (1895–2006) monthly runoff averaged across the region and range (shaded) of potential changes in mean monthly runoff due to climate change and development by 2030.
Surface water

Average annual surface water availability in the Wimmera region is 206 GL/year including 58 GL/year of water transferred from outside the region, mainly from the Glenelg catchment to the south. Diversions and water use are 120.8 and 41.2 GL/year or 59 and 20 percent of the surface water available, respectively. Losses from storages due to evaporation and in the distribution system are very high compared with water use. The majority of water use is for stock and domestic purposes; 17 percent is supplied to urban centres and small volumes are used for irrigation.

The maximum allocation for all users (including the environment) under surface water Bulk Entitlements is 206 GL/year. Currently, allocations are below this maximum in 25 percent of years.

If the climate of the last ten years persists, the average values for river inflows, water availability, diversions, water use and end-of-system outflows would be about half of the values for the historical climate period. Urban supply would be reduced to a lesser extent.

Reliability of supply would be severely degraded, with available water for all users being less than the current maximum allocation volume in 95 percent of years.

Climate change is likely to reduce average water availability by 2030. Under the best estimate 2030 climate, average values for the following would reduce: water availability (21 percent or 43.3 GL/year), river inflows (17 percent), diversions (11 percent), water use (14 percent) but urban water users supplied directly from headworks would be largely unaffected. End-of-system outflows would reduce by around 25 percent.

Transfers from outside the region would reduce by 4 percent. Spills from the Wimmera head-works storages would not occur under this climate, compared to spills every 5 years on average for the historical climate.

Available water for all users would be less than the current maximum allocation volume in 56 percent of years.

Reduction in inflows under future climate scenarios results in a smaller share of water for the environment. In a 90th percentile dry year under the best estimate 2030 climate, the environment’s share of water would reduce from 23 to 11 percent.

The percentage of time with no outflows from the Wimmera River, Yarriambiack Creek and Avon River to receiving lakes and floodplains would not be changed significantly under future climate. However, flow volumes would be significantly lower.

Under the wet extreme 2030 climate inflows would be around 5 percent lower than the long-term historical average but with little impact on the reliability of supply. Under the dry extreme 2030 climate inflows and the reliability of supply would be similar to those under a continuation of the climate of the last ten years.

Future development of plantation forestry, farm dams or groundwater is not expected to be significant and thus was not modelled.
Groundwater

Licensed groundwater extraction from the three GMUs in the Wimmera region in 2004–05 was 0.41 GL/year (excluding use from unincorporated areas and unlicensed stock and domestic use). Most of the current entitlements cover unincorporated areas and licensed extraction from these areas for 2004–05 was 1.03 GL/year. Requests for increases in entitlements in these areas prompted a proposal for a new Gymbowen GMU in the region’s south west. Information on stock and domestic use is poor but this use appears to be comparable to licensed entitlements.

The level of groundwater use in the Wimmera is indicated by the ratio of extraction to permissible consumptive volume (PCV). Groundwater use from the Balrootan GMU is moderate, at 41 percent of PCV. The PCV estimate in this case is comparable to the estimated through-flow. There is no development for two of the GMUs (Nhill and Goroke) as these cover the deep Renmark Group Aquifer.

The current level of groundwater use is not regarded as a threat to the Wimmera River, primarily because extractions occur in the far west of the region at a considerable distance from the river.

Projected growth in groundwater use to 2030 for the Balrootan GMU would increase use to 50 percent of PCV.

Future development is unlikely to affect the Wimmera River, although development in some upland areas may have significant impact.

<table>
<thead>
<tr>
<th>Code</th>
<th>GMU</th>
<th>Extraction 2004–05</th>
<th>Licensed entitlement</th>
<th>Permissible consumptive volume</th>
<th>Rainfall recharge</th>
<th>Projected 2030 use</th>
</tr>
</thead>
<tbody>
<tr>
<td>V47</td>
<td>Balrootan GMU</td>
<td>0.41</td>
<td>1.52</td>
<td>0.98</td>
<td>**</td>
<td>0.5</td>
</tr>
<tr>
<td>V62</td>
<td>Goroke GMU</td>
<td>0</td>
<td>0</td>
<td>2.2</td>
<td>**</td>
<td>0</td>
</tr>
<tr>
<td>V61</td>
<td>Nhill GMU</td>
<td>0</td>
<td>0</td>
<td>1.2</td>
<td>**</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Unincorporated area</td>
<td>1.03</td>
<td>1.61</td>
<td>na</td>
<td>**</td>
<td>1.31</td>
</tr>
<tr>
<td></td>
<td>Stock and domestic *</td>
<td>0.4</td>
<td>na</td>
<td>na</td>
<td>**</td>
<td>0.4</td>
</tr>
</tbody>
</table>

* Based on limited information
** Aquifers are confined and are not recharged by local rainfall.
na – not applicable
The water regimes of lakes Hindmarsh and Albacutya have been dramatically altered by water resource development. The fraction of time that these lakes are full has been reduced from 65 to 15 percent for Lake Hindmarsh and from 24 to 2 percent for Lake Albacutya. The maximum duration of shallow conditions in Lake Hindmarsh has increased from 3 to 8 years. The maximum duration of shallow conditions in Lake Albacutya has increased from 8 to 33 years. These changes are likely to have caused and may continue to cause considerable ecological change in these ecosystems.

A long-term continuation of the conditions experienced over the last ten years would also lead to major additional changes in the hydrology of lakes Hindmarsh and Albacutya. Lake Hindmarsh would almost never fill and would experience continually shallow conditions for periods of up to 32 years, four times longer than at present. Lake Albacutya would be unlikely to ever fill; water levels would be expected to nearly always be shallow.

Climate change is likely to cause major changes to the water regimes of Lakes Hindmarsh and Albacutya and lead to considerable ecological change. Lake Hindmarsh would be full only 4 percent of the time under the best estimate 2030 climate, while Lake Albacutya would be unlikely to ever fill. Even the wet extreme 2030 climate reduces inflows.

Lake Hindmarsh has national significance and is the largest freshwater lake in Victoria, covering some 15,600 ha with a volume of around 630,000 ML when full. It starts to overflow into Lake Albacutya when its volume reaches about 378,000 ML. The lake receives inflows from the Wimmera River, is a popular recreational area, and the surrounds are used for grazing and cropping. The Lake environment includes geological features of State and regional significance — particularly the eastern sand dunes. The flora of the lake is characterised by fringing River Red Gum and Black Box woodland. Several threatened plant species are found at the lake. Birds dominate the lake fauna with over 50 waterbird species recorded, some numbering in the thousands. Breeding populations include Pelicans, Great Cormorants, Pied Cormorant and Pacific Heron. Threatened water bird species include the Great Egret, Freckled Duck and Blue-billed Duck.

Lake Albacutya is just downstream of Lake Hindmarsh and is a wetland of international importance under the Ramsar Convention. It receives water via Outlet Creek after Lake Hindmarsh reaches around 378,000 ML. Lake Albacutya receives water much less frequently than Lake Hindmarsh and is dry for long periods. The lake is part of Wyperfield National Park. When flooded, Lake Albacutya becomes a major aquatic ecosystem retaining water for several years and supporting significant breeding bird and fish populations with extensive aquatic plant communities. When full the lake has a maximum depth of about 5.2 m and a maximum volume of around 230,000 ML. The flora of the lake and surrounds is a mixture of riverine and Mallee vegetation communities. The riverine community is similar to that of Lake Hindmarsh. The Mallee community has Callitris pine woodland and heath communities. Green saltbush prevails. These vegetation communities provide a wildlife corridor between the lakes and the nearby Wirrengren Plain. Waterbird species frequenting Lake Albacutya are similar to those of Lake Hindmarsh. Internationally significant populations of some 10,000 Banded Stilt have been recorded.

<table>
<thead>
<tr>
<th></th>
<th>Pre-development</th>
<th>Historical</th>
<th>Recent</th>
<th>Dry</th>
<th>Best estimate</th>
<th>Wet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lake Hindmarsh indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of time above ‘lake-full’ (&gt;378,000 ML)</td>
<td>64%</td>
<td>15%</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>4%</td>
<td>7%</td>
</tr>
<tr>
<td>Percentage of time above ‘shallow’ (&gt;80,000 ML)</td>
<td>97%</td>
<td>69%</td>
<td>10%</td>
<td>6%</td>
<td>41%</td>
<td>63%</td>
</tr>
<tr>
<td>Longest period below ‘shallow’</td>
<td>3</td>
<td>8</td>
<td>32</td>
<td>32</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Lake Albacutya indicators</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of time above ‘lake-full’ (&gt;230,000 ML)</td>
<td>24%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Percentage of time above ‘shallow’ (&gt;25,000 ML)</td>
<td>76%</td>
<td>16%</td>
<td>3%</td>
<td>3%</td>
<td>5%</td>
<td>13%</td>
</tr>
<tr>
<td>Longest period below ‘shallow’</td>
<td>8</td>
<td>33</td>
<td>107</td>
<td>108</td>
<td>76</td>
<td>58</td>
</tr>
</tbody>
</table>
The Wimmera region

The Wimmera region is located within western Victoria and covers 30,640 km$^2$ or 3 percent of the MDB. Terrain varies from the Grampians Ranges in the south to the wide dune fields of the Little Desert in the north. The regional population is approximately 50,000, or 2.5 percent of the MDB population. The major centres are Horsham and Stawell in the south and Ouyen in the north. The dominant land use is broadacre cropping of grains, pulses, oilseeds and pasture seed in the central and northern areas and dryland livestock grazing in the south. There is limited irrigated cropping of vine fruits, pastures and orchards. There is minimal commercial plantation forestry in the region and farm dams are predominantly for stock and domestic use.

Broad land use in the year 2000 within the Wimmera region

<table>
<thead>
<tr>
<th>Land use</th>
<th>Area</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dryland crops</td>
<td>1,240,600</td>
<td>40.6%</td>
</tr>
<tr>
<td>Dryland pasture</td>
<td>1,251,300</td>
<td>41.1%</td>
</tr>
<tr>
<td>Irrigated crops</td>
<td>6,000</td>
<td>0.2%</td>
</tr>
<tr>
<td>Cereals</td>
<td>100</td>
<td>1.6%</td>
</tr>
<tr>
<td>Horticulture</td>
<td>400</td>
<td>6.6%</td>
</tr>
<tr>
<td>Orchards</td>
<td>1,200</td>
<td>19.8%</td>
</tr>
<tr>
<td>Pasture &amp; Hay</td>
<td>2,900</td>
<td>47.8%</td>
</tr>
<tr>
<td>Vine fruits</td>
<td>493,000</td>
<td>16.2%</td>
</tr>
<tr>
<td>Native vegetation</td>
<td>2,000</td>
<td>0.1%</td>
</tr>
<tr>
<td>Plantation Forestry</td>
<td>8,100</td>
<td>0.3%</td>
</tr>
<tr>
<td>Urban</td>
<td>44,200</td>
<td>1.5%</td>
</tr>
<tr>
<td>Water</td>
<td>0</td>
<td>1.7%</td>
</tr>
<tr>
<td>Total</td>
<td>3,045,200</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: BRS (2000)

> Wimmera River, Horsham, Vic

> Revegetation on Hateley Lake, Mitre, Vic

> Waterway fencing, Navarre, Vic
About the project

The CSIRO Murray-Darling Basin Sustainable Yields Project resulted from the Summit on the Southern Murray-Darling Basin (MDB), convened by the Prime Minister on 7 November 2006. The project provides governments with a robust, MDB-wide estimate of water availability on an individual catchment and aquifer basis taking into account climate change and other risks. The project will report progressively to early 2008. The project is the most comprehensive MDB-wide assessment of water availability undertaken to-date. For the first time:

- daily rainfall-runoff modelling is being undertaken at high spatial resolution for a range of climate change and development scenarios in a consistent manner for the entire MDB
- the hydrologic sub-catchments required for detailed modelling have been precisely defined across the entire MDB
- the hydrologic implications for water users and the environment by 2030 of the latest Intergovernmental Panel on Climate Change climate projections, the likely increases in farm dams and commercial forestry plantations and the expected increases in groundwater extraction are being assessed in detail
- the assessments employ all existing river system and groundwater models as well as new models developed within the project
- the modelling includes full consideration of the downstream implications of upstream changes between multiple models and between different States, and quantification of the volumes of surface-groundwater exchange, and
- detailed analyses of monthly water balances for the last 10 to 20 years are being undertaken using available streamflow and diversion data together with additional modelling including estimates of wetland evapotranspiration and irrigation water use based on remote sensing imagery. These analyses provide an independent cross-check on the performance of river system models.

The assessments are reviewed by a Steering Committee and a Technical Reference Panel both with representation from Commonwealth and State governments and the Murray-Darling Basin Commission.

Information on how these results may be used in the development of a new sustainable diversion limit for the Murray-Darling Basin can be found at www.environment.gov.au/water/mdb/yields.html.

Enquiries

More information about the project can be found at www.csiro.au/mdbsy. This information includes the full terms of reference for the project, an overview of the project methods and the project reports that have been released to-date, including the full report for this region.

This document is printed on recycled paper.