NSW GOVERNMENT

State of the catchments 2010

# Riverine ecosystems

## Murrumbidgee region

## State Plan target

By 2015 there is an improvement in the condition of riverine ecosystems.

## Background

The Murrumbidgee region is bounded by Cooma in the east, Balranald in the west, Temora to the north and Henty to the south (Figure 1). The catchment covers an area of about 84,000 km$^2$. The Murrumbidgee River starts in the Kosciuszko National Park on the Long Plain and flows 1600 km westward to its confluence with the Murray River near Balranald. It has average annual flows of around 4.4 million megalitres and is the third largest river in the Murray–Darling Basin. Major streams in the Murrumbidgee catchment are the Bredbo River, Numeralla River, Goodradigbee River, Cotter River, Goobarragandra River, Tumut River and Yass River in the upper catchment; Tarcutta Creek and Jugiong Creek in the mid catchment; and Old Man Creek, Mirrool Creek, Yanco Creek and Colombo Creek in the lower catchment.

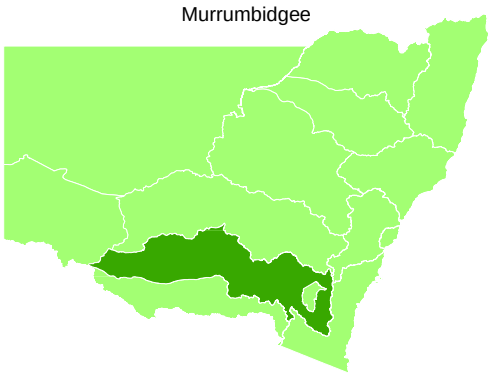
The Murrumbidgee River is a regulated system and has 14 dams and eight large weirs. The large dams include Burrinjuck Dam near Yass, with a capacity of 1.026 million megalitres, and Blowering Dam near Tumut, holding 1.628 million megalitres. These dams control water for the Murrumbidgee Irrigation Area and the Coleambally Irrigation Area situated in the lower Murrumbidgee catchment. More than 10,000 km of irrigation channels supplied by the two storages provide the irrigation area with water.

A detailed technical report describes the methods used to derive the information contained in this report. At the time of publication of the *State of the catchments (SOC) 2010* reports, the technical reports were being prepared for public release. When complete, they will be available on the NOW website: www.water.nsw.gov.au.

**Note: All data on natural resource condition, pressures and management activity included in this SOC report, as well as the technical report, was collected up to January 2009.**

West of Gundagai, the Murrumbidgee River meanders across the floodplain where numerous floodplain wetlands rely on periodic connectivity to the river. The Murrumbidgee River encounters a number of regulatory structures in its headwaters and on the lowland floodplain. The process of river regulation has led to a major alteration of the natural flow regime of the Murrumbidgee River. Artificially high flow regimes and the historical removal of natural instream structures have resulted in stream bank instability and have significantly changed the instream habitat and associated floodplain.

## Map of the catchment



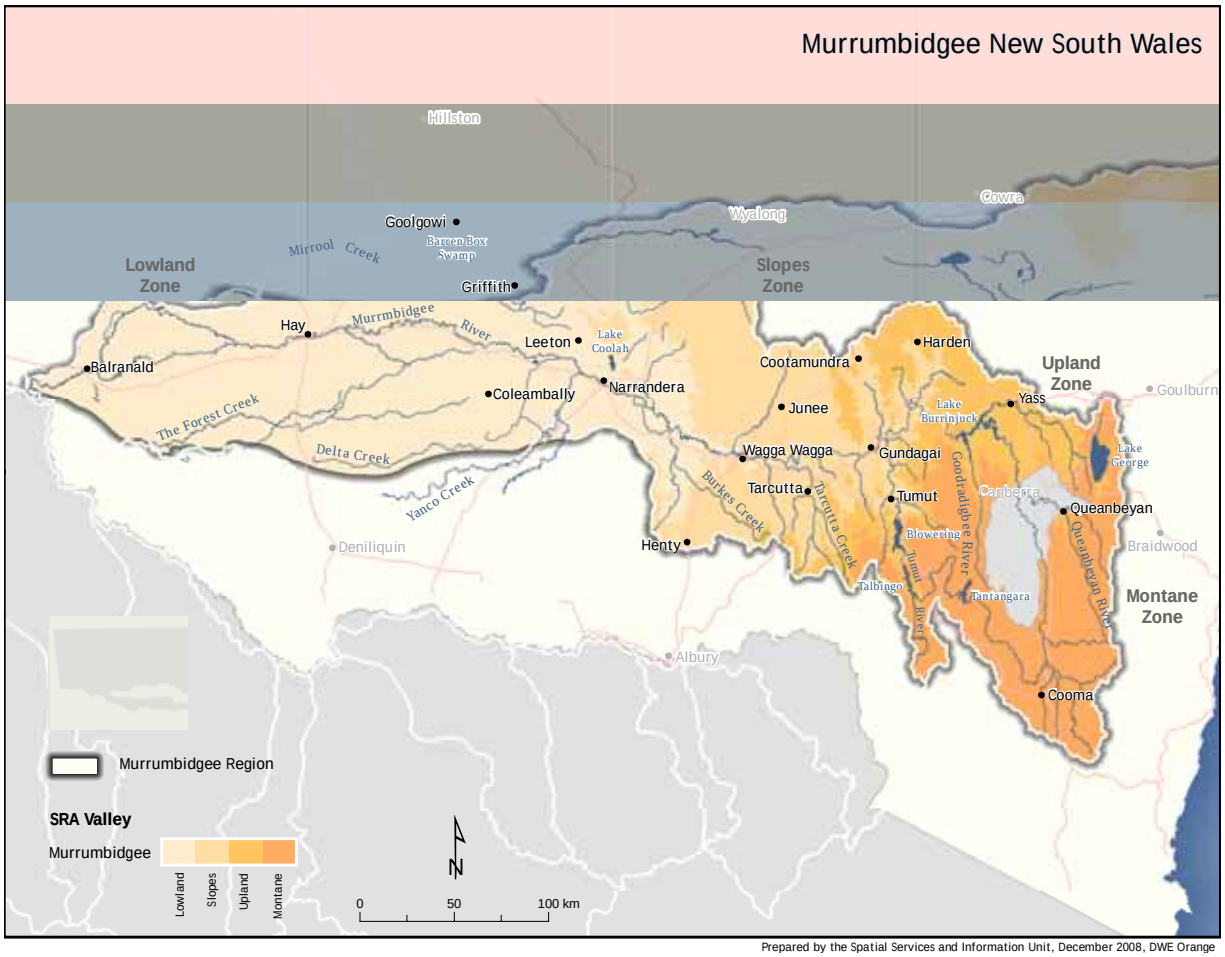




**Figure 1 The Murrumbidgee region**

## Assessment

Riverine ecosystem condition has been assessed using water quality, macroinvertebrate, fish and hydrology indicators. Water quality condition is described as the percentage of samples exceeding the ANZECC water quality guidelines for turbidity and total phosphorus (ANZECC & ARMCANZ 2000). Condition for macroinvertebrates, fish and hydrology is based on the Sustainable Rivers Audit (SRA) and is described using a five point scale (Davies et al 2008). Trend information is provided for the water quality indicators: electrical conductivity, turbidity and temperature.

For macroinvertebrate, fish and hydrology condition indicators, the maps show both an overall condition rating for the entire Murrumbidgee region and the condition in greater geographical detail based on SRA within-valley zones.

### Condition

#### *Water quality*

Condition was determined for the following indicators of water quality in the Murrumbidgee region:

- **turbidity**, which is a measure of the effect of suspended sediment on water clarity and a potential indicator of sedimentation and erosion
- **total phosphorus (TP)**, which is a measure of all forms of phosphorus, some of which can occur naturally or via inputs from other factors including erosion, sedimentation and grey water (all non-toilet household wastewater). High levels may cause eutrophication, resulting in excessive growth of aquatic plants.

Data was analysed for the period 2005–2008. For turbidity in inland rivers, the upper limit of the guideline was adopted (ie 25 and 50 nephelometric turbidity units [NTU] for upland and lowland rivers respectively). The guidelines for total phosphorus are <0.02 mg/L for upland rivers and <0.05 mg/L for lowland rivers. The classification of sites as belonging to upland or lowland rivers was based on altitude as recommended by the ANZECC guidelines (upland >150 m and lowland <150 m above sea level).

The map (Figure 2) shows the percentage of water quality samples at each site that exceeded the above guidelines. In general terms, the higher the percentage of exceedance, the higher the priority the site (and its catchment) would be for further investigation.

For water quality condition, data confidence bands were applied based on the degree that data met two criteria: first, the completeness of records over the three-year period of sampling and second, the regularity of sampling intervals. A high confidence rating was given when data satisfied – or nearly satisfied – the ideal situation of a complete three-year sampling period and regular sampling intervals every month. Conversely, a lower rating was given when data departed further from the ideal, with the lowest confidence being for data collected over less than a year and/or with sampling intervals of six months or greater.

Trends (Figure 3) were determined for the following indicators of water quality in the Murrumbidgee region:

- **water temperature,** which is affected by altitude, shading, channel width and depth, flow, water impoundment, groundwater discharge and climate
- **electrical conductivity (EC)**, which measures the ability of water to carry an electrical current. This ability depends on a number of factors including the presence and concentration of salts

- **turbidity**, which is a measure of the effect of suspended sediment on water clarity and a potential indicator of sedimentation and erosion.

The period of record for EC ranges from 1967 through to 2008; for temperature from 1965 to 2008; and for turbidity from 1977 to 1978.

The New South Wales discrete water quality data archive (Triton database managed by NSW Office of Water [NOW]) was evaluated using a long-term trend analysis (30–35 years), providing a preliminary understanding of the behaviour of EC, water temperature and turbidity trends within the study area. This understanding is vital for providing the context for future data collection, analysis and reporting.

To quantify the level of confidence in the trend results, a debit point system was used to assess operational issues, excessive data gaps, data collection and archival issues (NOW in prep.). This provided the basis for applying a low, medium or high data confidence ranking.

There were many water quality monitoring sites in the Murrumbidgee River catchment relative to other regions. The percentage of samples that exceeded total phosphorus guidelines varied greatly between sites and ranged from very low to very high across the region. Turbidity results across the region ranged from sites with no exceedances through to sites with a moderate percentage of exceedances (Figure 2).

| Data confidence | Commentary |
|---|---|
| TP – medium | For TP, sites generally have on average 30 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is medium to high. The sampling periods and intervals vary considerably between years. |
| Turbidity – high | For turbidity, sites generally have on average 195 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is high. High confidence rating was given when data satisfied – or nearly satisfied – the ideal situation of the sampling period and sampling intervals of three years and once a month, respectively. |

### *Water quality trend*

Over half the results showed stable trends in water quality. Water temperature was stable across the upper half of the catchment and unclear at the lower sites due to insufficient data. One site in the upper catchment showed a decreasing trend in electrical conductivity since the early 1990s; it will be interesting to see how levels respond during wetter conditions in the future as a result of climate change. Turbidity results were the least reliable; however, several sites across the region had rising trends.

For temperature, Goobarragandra River at Lacmalac has a historically stable trend with a recent episodic increase. For turbidity, Billabong Creek at Darlot had a falling trend in the very early record and has been historically stable since.

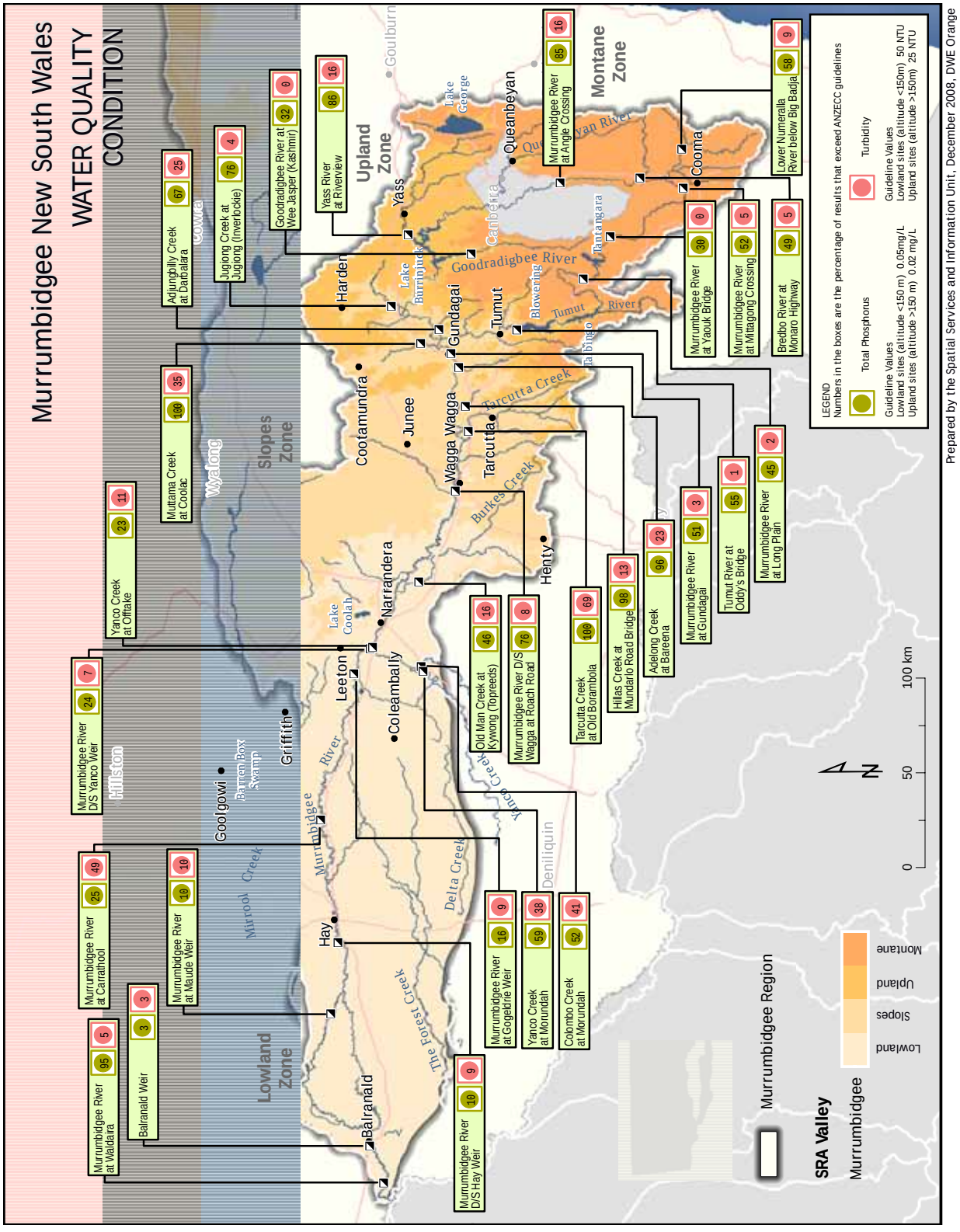



**Figure 2 Water quality condition across the Murrumbidgee region**

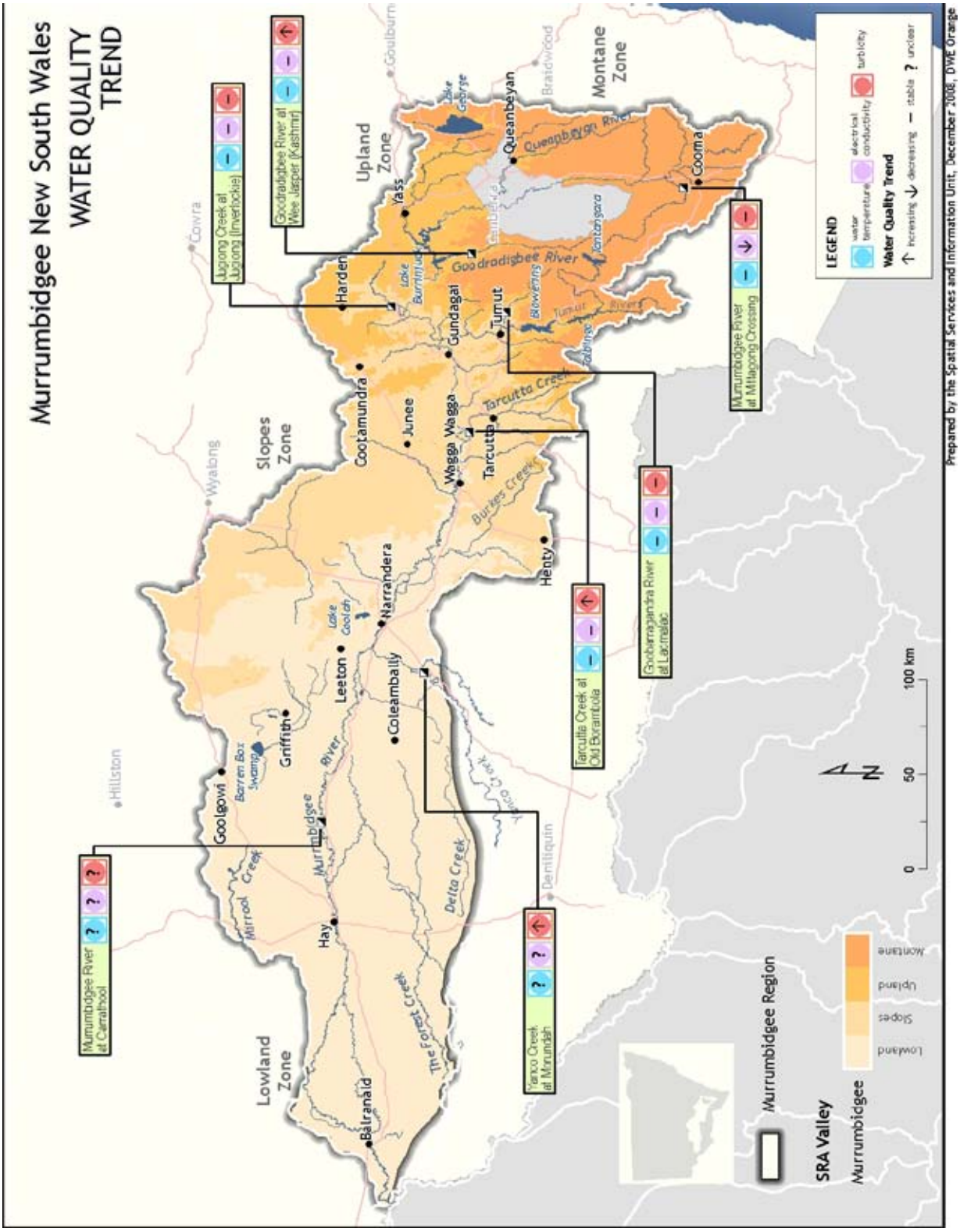



**Figure 3 Water quality trend across the Murrumbidgee region**

| Data confidence | Commentary |
|---|---|
| EC – low<br><br>Temperature – low<br><br>Turbidity – low | Data confidence at all sites and for all parameters was diminished for a number of reasons. There were large data gaps. Sampling times were not always recorded and were estimated for part of all of the records (12 noon was used as the default to match up with hourly instantaneous flow). In some cases, hourly instantaneous flow (ML/d) was unavailable so mean daily flow (ML/d) was used as the flow default. Sampling frequency was highly variable throughout all records. There were periods where the frequency was very low. Having more than one data source for each parameter made the data difficult and confusing to interpret. In some cases temperature readings were recorded to the nearest degree Celsius throughout the temperature records, which raised concerns regarding data precision. All sites had a period of record where the data source was listed as unknown or not recorded and the data quality was listed as unknown.<br><br>The sites at Goodradigbee River at Wee Jasper (Kashmir), Yanco Creek at Morundah, and Tarcutta Creek at Old Borambola each had a data gap in the middle of the turbidity record; however, the rising trend was still significant. |

### *Aquatic biota*

The condition of aquatic biota was assessed using the following measures of riverine ecosystem health:

- **macroinvertebrate assemblages**, which consist of larval and adult insects, molluscs, worms and crustaceans and are an important component of river ecosystems
- **fish assemblages**, which consist of native and introduced species.

#### *Macroinvertebrate assemblages*

The Macroinvertebrate Condition Index (Figure 4) integrates indicators of 'expectedness' (the proportion of expected families found) and the SIGNAL observed/expected (O/E) Score (a score based on the sensitivities of families to pollution or other disturbances). For more details on the method see Davies et al (2008).

#### *Fish assemblages*

The Fish Condition Index (Figure 5) integrates indicators of 'expectedness' (the actual presence of native species relative to the species expected under the reference condition) and 'nativeness' (proportion of fish population that is native rather than alien).

The site selection, sampling and analytical procedure used were largely as described in SRA Report 1 (Davies et al 2008).

Although the same analytical procedure was used, there are some slight variations between the results presented here and the results presented in Davies et al (2008). There are several possible reasons for this:

- in many cases, more data was available for this reporting than was used for SRA analysis; the extra samples resulted in slightly different median metrics from those reported by the SRA
- a state-wide stream network (5 ML day Stein stream network version 2.92: Fenner School of Environment and Society, Australian National University, unpublished) was used to weight zone

data when calculating valley and regional statistics. This varies slightly from the stream network used for the SRA.

| Data confidence | Commentary |
|---|---|
| Not assessed | Condition data derived from the Sustainable Rivers Audit (see www.mdbc.gov.au/SRA/river_health_check_-_sra_report_one). |

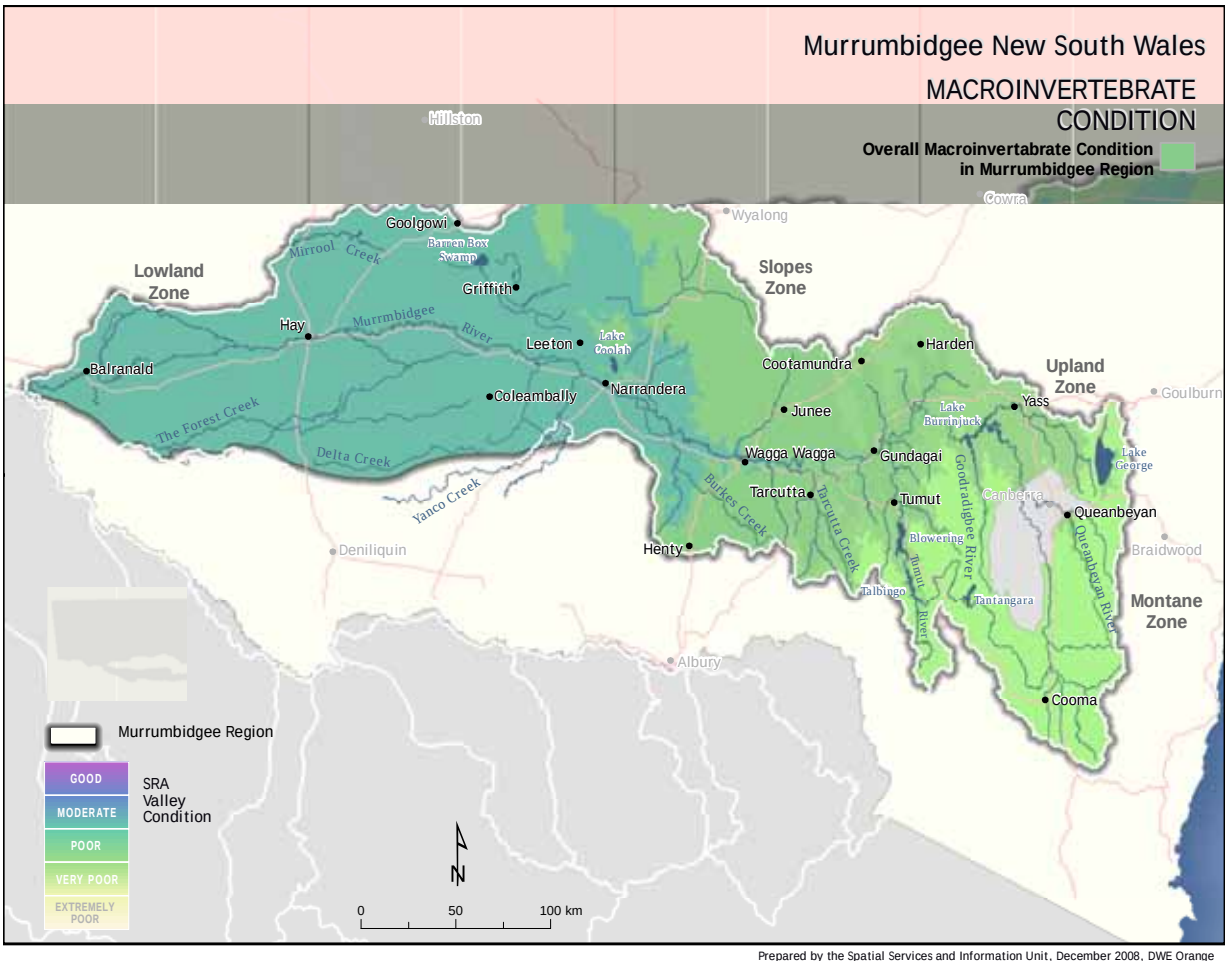
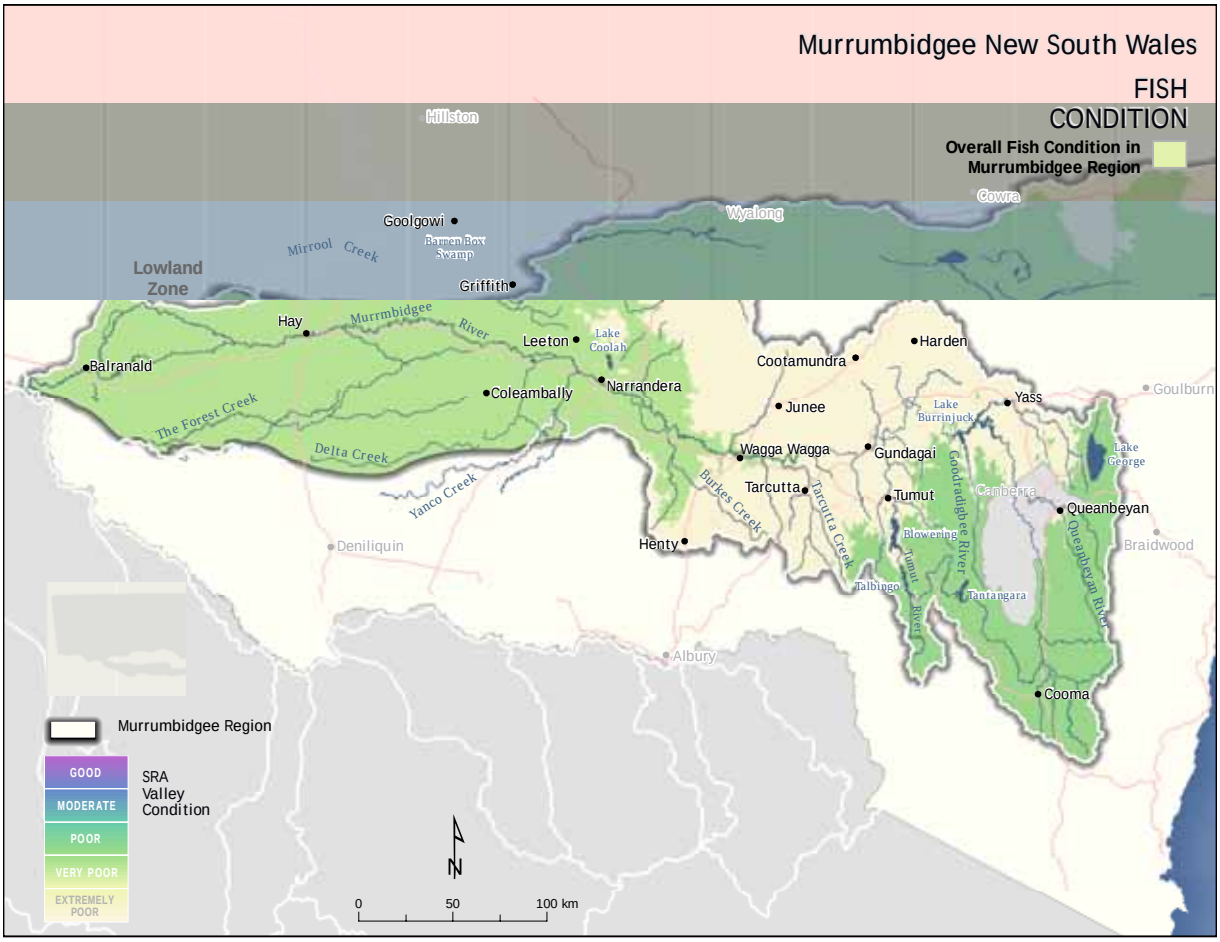



**Figure 4 Macroinvertebrate condition across the Murrumbidgee region**

### *Fish condition*

The overall fish condition was very poor (Figure 5), with both nativeness (the proportion of the fish assemblage that is native versus introduced fish) and expectedness (the proportion of species collected during sampling that were expected to have occurred in each basin zone before European colonisation) being very poor. Of the individual catchment zones, the highland zone was in poor condition, the lowland zone was in very poor condition and the upland and slopes zones were in extremely poor condition. Nativeness was poor in the lowlands, very poor in the highlands and extremely poor in the slopes and upland zones. Expectedness was poor in the highlands, very poor in the lowlands and extremely poor in the slopes and upland zones.




Prepared by the Spatial Services and Information Unit, December 2008, DWE Orange

**Figure 5 Fish condition across the Murrumbidgee region**

| Data confidence | Commentary |
|---|---|
| Medium to high | All data was collected within the three-year period between 1 January 2006 and 31 December 2008.<br><br>Data confidence within individual altitude zones is medium in the lowlands zone, where there is moderate variability across the sites within the zone, and high in the three other zones, where the fish condition score was more consistent. Data confidence in the overall CMA fish condition score is medium due to the moderate inter-site variability across sites at a catchment scale. |

## Hydrology

Hydrologic condition (Figure 6) measures the ecologically significant aspects of the flow regime including volume, variability, extreme flow events and seasonality. Changes to flow regimes have significant potential to influence riverine ecosystems.

> 'The Murrumbidgee Valley was in poor to moderate hydrological condition (Lowland Zone: poor to Moderate; Slopes Zone: poor to good; other zones unrated). Overall, the flow regime was typified by major changes in the magnitude of annual volumes and high flows and seasonality in the Murrumbidgee and Tumut Rivers, but little or no change from reference condition elsewhere' (MDBC 2008).

### *Hydrology condition*

| Data confidence | Commentary |
|---|---|
| Altitude zone condition – medium | Condition data derived from the Sustainable Rivers Audit (see www.mdbc.gov.au/SRA/river_health_check_-_sra_report_one). |
| Overall region condition – medium | Condition data derived from the Sustainable Rivers Audit (see www.mdbc.gov.au/SRA/river_health_check_-_sra_report_one). |

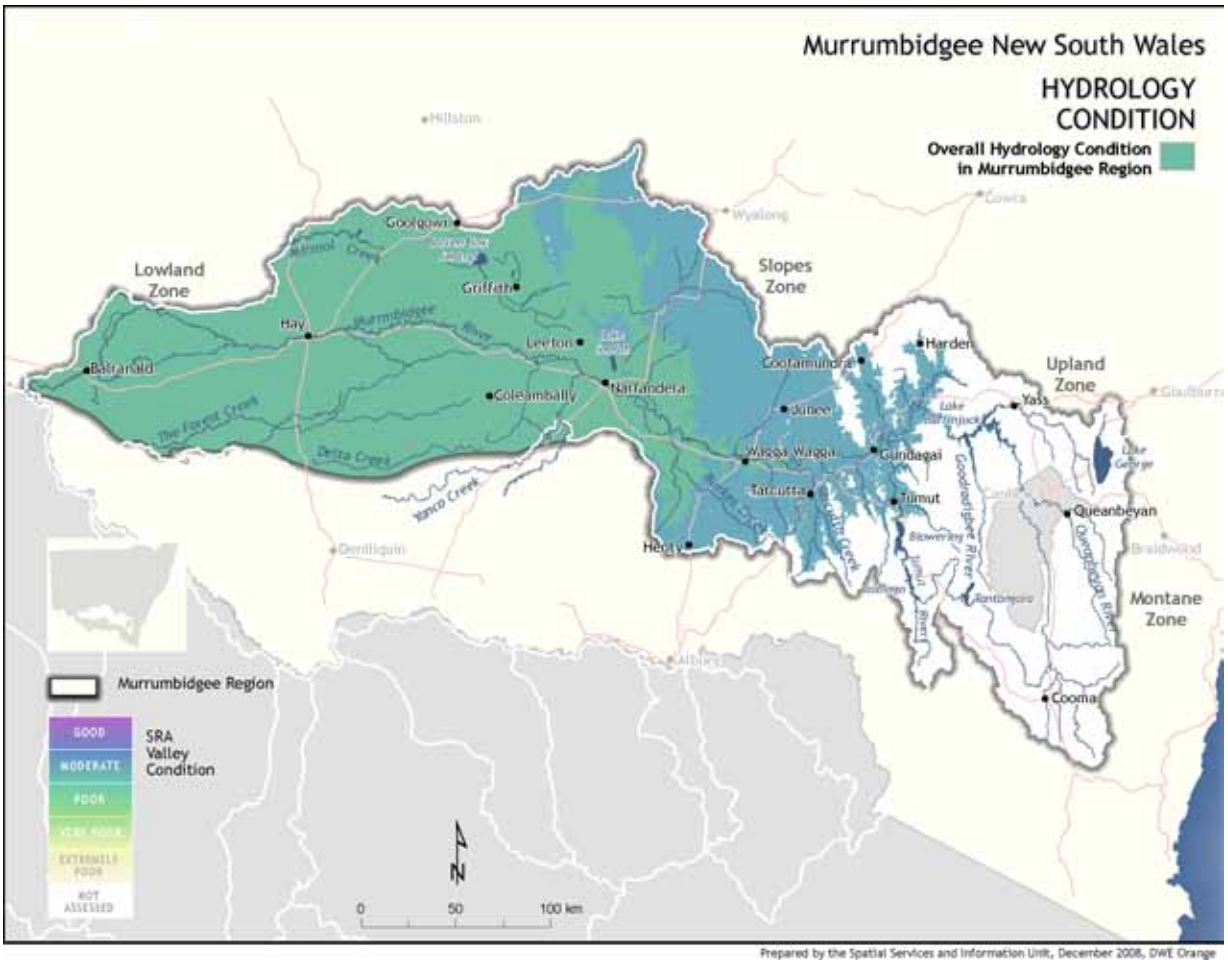



**Figure 6 Hydrologic condition across the Murrumbidgee region**

## Pressures

### *Introduction of pest species*

#### *Alien fish species*

Alien fish apply pressure to native fish species, populations and communities as they compete for available resources (habitat and food). Some alien fish also prey on native fish.

Alien fish species assessment is derived using the nativeness indicator output from SRA models (see Davies et al 2008). Nativeness comprises three metrics:

- proportion of total biomass of native species

- proportion of individuals that are native
- proportion of species that are native.

Rankings range from 0 to 100; the lower the number, the greater the pressure from alien fish. The nativeness ranking is the average score of sites within each zone.

| Valley name | Altitude zone | Nativeness ranking |
|---|---|---|
| Murrumbidgee | Lowlands | 43 |
| | Slopes | 2 |
| | Uplands | 0 |
| | Highlands | 26 |

### *Water management*

#### *Alteration of natural temperature patterns*

The temperature of water within aquatic environments, such as rivers, affects natural ecological processes. Water storages (dams) have the potential to release water that can be unseasonably cold during the warmer months. The change in water temperature in the river system downstream of dams is referred to as cold water pollution (CWP) (Preece 2004). The table below shows dams that are likely to be associated with CWP, their priority and to what extent downstream effects (>5ºC peak depression) will be detected (where available) (Preece 2004). It should be noted that the known extent downstream is still uncertain and further monitoring will improve those temperature profiles.

| Dam | Priority | Extent downstream | Impacted river |
|---|---|---|---|
| Blowering | High | *60 km (to the Murrumbidgee River confluence) | Tumut |
| Burrinjuck | High | *400 km | Murrumbidgee |
| Googong | Medium | Not available | Queanbeyan |

*The combined effects of Burrinjuck and Blowering Dams are estimated to persist for 400 km downstream.

Blowering Dam on the Tumut River provides regulated flow for summer irrigation. The dam has a large thermal stratification in the warmer months, causing severe CWP due to large water temperature reductions below the dam in the summer. Blowering Dam is the highest ranked structure across NSW for the cause of CWP (Preece 2004). Keenan and Buchan (unpub.) recognise that Blowering Dam appears more influential than Burrinjuck Dam in lowering downstream water temperatures.

Burrinjuck Dam on the Murrumbidgee River provides regulated flows for irrigation in the Murrumbidgee River. Thermal modification occurs downstream of the dam during discharges and the effect is still present hundreds of kilometres downstream; however, the influence largely dissipates before the Tumut River confluence (Preece 2004).

Googong Dam has sufficient depth to develop thermal gradients; however, small summer discharges result in only minor localised CWP (Preece 2004).

Tantangara Dam on the Murrumbidgee River diverts the headwaters of the Murrumbidgee River to Lake Eucumbene in the Snowy River drainage basin. It is currently rated as a low priority because there is no discharge; however, future releases in the warmer months will influence downstream water temperatures. A surface outlet has been constructed to minimise future CWP (Preece 2004).

The NSW Government is working with dam owners, community groups and environmental scientists to identify the areas most seriously affected, and to find methods to mitigate or prevent cold water pollution. NOW, in partnership with other key agencies, is implementing a strategy to control CWP from dams identified for priority action in NSW.

### *Artificial barriers to fish passage*

Many fish species migrate up and down rivers to breed or find alternate habitat during extreme events such as drought. Construction of weirs, dams, and road crossings can limit or prevent migration, resulting in loss or depletion of certain fish species upstream of such barriers.

In 2006, Industry & Investment NSW (I&I) undertook a detailed review of weir barriers to fish passage for each catchment management authority (CMA). Primary objectives included identification of high priority barriers that have major impact on fish passage and aquatic habitat condition, priority ranking for remediation, and recommendations for appropriate remediation action. Below is a summary of the findings, which have been updated by I&I in December 2008. It lists the priority ranking, and the increase in habitat area available to migratory fish, should the barrier be remediated.

| Rank | Barrier name | Watercourse | Potential increase in habitat area (km) |
|---|---|---|---|
| 1 | Berembed Weir | Murrumbidgee River | 425 |
| 2 | Yanco Weir | Murrumbidgee River | 95 |
| 3 | Gogeldrie Weir | Murrumbidgee River | 276 |
| 4 | Hay Weir | Murrumbidgee River | 298 |
| 5 | Maude Weir | Murrumbidgee River | 172 |
| 6 | Redbank Weir | Murrumbidgee River | 224 |
| 7 | Beavers Creek Weir | Beavers Creek/Old Man Creek | 90 |

Other pressures with the potential to impact on riverine ecosystem condition are listed below.

### *Agricultural and urban development*

- Polluted runoff from agricultural, industrial and domestic sources
- Livestock grazing.

***Loss of native vegetation***

- Clearing of riparian vegetation
- Clearing of catchment vegetation
- De-snagging of instream channels
- Decline in natural replenishment of instream wood.

***Introduction of pest species***

- Alien fish species
- Aquatic and riparian weeds.

***Water management***

- Alteration of natural flow patterns
- Alteration of natural temperature patterns
- Artificial barriers to fish passage.

***Climate change***

- Ability for biota to adjust to environmental changes
- Possible alterations to life cycle cues
- Unknown environmental tolerances of biota.

## Management activity

### State level

The State Plan natural resource management targets are being addressed through state, regional and local partnerships. The catchment action plans (CAPs) and the investment programs that support them are the key documents that coordinate and drive the effort to improve natural resources across NSW. The CAPs describe the whole-of-Government approach to address each of the state-wide targets at the regional level. The Murrumbidgee CAP can be found at www.murrumbidgee.cma.nsw.gov.au/publications/catchment-action-plan.html.

The riverine condition attributes have been grouped against management activities that are being applied to address associated pressures. Associating the management activities in this way identifies the actions being undertaken to address the specific pressures impacting on riverine condition.

At times, it is difficult to isolate the influence of individual and multiple pressures on some riverine condition attributes. Improvement of many condition attributes can also be derived from a single management activity. For example, riparian vegetation rehabilitation can influence the condition of water quality and the habitat for macroinvertebrates and fish. Managing altered river flow through water sharing plans (WSPs) can also improve water quality and then improve habitat for aquatic biota. Hence, the benefits from some of the listed management activities should not be considered in isolation. Where management activities clearly address a broad range of condition/pressure outcomes, these are listed against 'multiple condition/pressure actions'.

### *Hydrology*

The riverine ecosystems target is being addressed at the state level largely through improved water sharing between users and the environment through WSPs and water purchase for the environment.

WSPs have been the key mechanisms in NSW for balancing competing interests in water management. The WSPs:

- share water between users, and between users and the environment
- increase allocations for the environment and other public purposes
- provide longer term, more secure, and tradeable property rights to facilitate investment and increase business returns from the water used.

WSPs have resulted in notable improvements in the management of NSW water resources by limiting use in the regulated rivers to 200 GL below the Murray–Darling Basin cap, and by providing flow patterns that are more like natural flow regimes. The recovery of additional environmental water through programs such as RiverBank and The Living Murray Initiative has also helped to sustain or improve NSW wetlands.

However, many riverine ecosystems are still under stress from altered flow regimes, and from land-use practices that adversely affect water quality and aquatic habitat. The key initiatives being undertaken to meet this challenge are:

- completing the remaining WSPs in the Murray–Darling Basin by 2011 and elsewhere before 2013
- progressing the recovery of water for the environment in the short term through RiverBank and The Living Murray, and in the longer term in cooperation with the Australian Government through the Water for the Future initiative
- adjusting future WSPs to account for climate change impact and the Murray–Darling Basin Plan currently being prepared by the Murray–Darling Basin Authority.

### *Water quality*

The following actions are being undertaken to address water quality issues:

- progress strategies to maintain valued ecological processes such as the Cold Water Pollution Mitigation Strategy, protecting riparian zones in urban areas and the NSW Wetlands Policy
- maintain water quality that is 'fit-for-purpose' through the NSW Diffuse Source Water Pollution Strategy, stormwater management and regulation of point source pollution
- effectively implement the monitoring, evaluation and reporting strategy
- provide a framework for councils to develop stormwater management objectives
- provide decision support tools and information to land managers
- develop regional water quality guidelines
- undertake ongoing water quality monitoring at strategic locations to assess the long-term trends and changes in condition.

Some of the specific NSW Government actions to address the target in the Murrumbidgee region include the WSPs discussed earlier as well as NSW RiverBank, the Rivers Environmental Restoration Program and the Wetland Recovery Program, which have purchased 9883 ML of entitlements in the Murrumbidgee valley to be used to enhance wetland and river health (see www.environment.nsw.gov.au/environmentalwater/index.htm).

### *Multiple condition/pressure actions*

The Department of Planning (DOP) advocates that the planning system, in conjunction with relevant agencies and local government, has an important role in natural resource management (NRM) and protection of environmental values.

The planning process creates a strategic framework to identify, assess and prioritise land-uses and, to assist in the strategic investment for the revitalisation/management of natural resource values. These reflect two streams in the integration of NRM and environmental protection – a 'strategic planning stream' and an 'investment stream'. These connections occur at regional and local levels and are important in the delivery of regional strategies (prepared by DOP) and local growth management strategies, local environmental plans (LEPs) and state of the environment reports (prepared by local councils).

The DOP state level measures that may enhance riverine condition include state environmental planning policies (SEPPs) (eg Rural Lands SEPP).

DOP also provides a regional context for planning through the development of regional growth strategies to guide sustainable growth and protect valuable natural and cultural assets. The development of regional strategies is undertaken with the involvement of the CMAs.

## Regional level

At the regional level the Murrumbidgee CMA is undertaking the following activities in relation to the riverine ecosystems theme:

### *Multiple condition/pressure actions*

- 12,461 hectares (ha) of riparian native vegetation protected by fencing
- 3449 hectares of riparian native vegetation enhanced/rehabilitated
- 702 ha planted with riparian native species
- 1404 km of stream bank of riparian vegetation enhanced/rehabilitated
- 2000 m of stream bank stabilised with engineering works
- 65,960 ha of land where improved irrigation practices have been adopted
- 56,400 ha of land treated through surface drainage
- 800 ha of land treated through sub-surface drainage
- 15,400 ha of land treated through improvements to existing drainage systems.

### *Water quality*

- 100 off-stream (alternative) watering sites installed.

## Local level

DOP also provides for local planning measures and activities to address a number of pressures. These measures include:

- working with DECCW, NOW and I&I in developing standard NRM clauses for councils to incorporate into their new LEPs as part of the NSW Government's planning reform initiative
- preparing a practice note to provide guidance to councils on the environmental protection zones in the standard LEP instrument and how they should be applied in the preparation of LEPs. DOP is working on similar guidance for waterways and riparian corridors

- working with local councils as they develop their local strategic plans.

## Further reading

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