NSW GOVERNMENT

State of the catchments 2010

Riverine ecosystems

Lachlan region

State Plan target

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

Background

The Lachlan region is located in central western New South Wales and covers an area of approximately 84,700 km^2 (Figure 1). The Lachlan River rises near Lake George in the Central Tablelands and terminates in the Great Cumbung Swamp near Oxley, 1400 river kilometres to the west. There are a number of effluent streams along its lower section including Willandra, Merrowie and Middle creeks. These effluent streams flow intermittently from the Lachlan River, delivering water as far as 180 km west of the main channel. The Lachlan River intermittently connects to the Murrumbidgee River when both rivers are in flood. Major tributaries of the Lachlan River include the Abercrombie (186 km in length), Boorowa (134 km in length) and Belubula rivers (165 km in length).

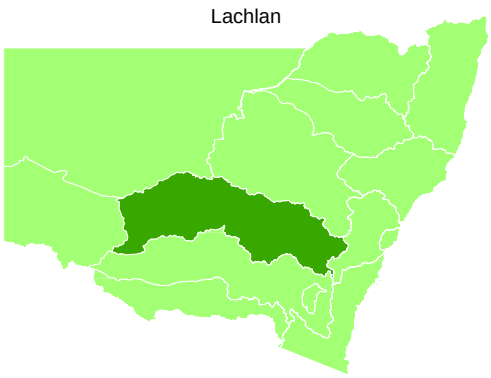
Similar to several other catchments in the Murray–Darling Basin, the Lachlan River terminates in wetlands and effluent (diverging) creeks in the lower part of the catchment. The catchment has a number of natural features that are listed as being of national importance including Lake Cowal, the Booligal wetlands and the Great Cumbung Swamp.

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.

The Lachlan River and its main tributaries have become regulated through dams and instream structures that regulate flow for land-use requirements, particularly irrigation. There are many instream regulatory structures along the Lachlan River. These structures have altered flow regimes causing constant flows (instead of a wetting and drying period), reduced high flow events, reduced fish migration, and contributed to the loss of connectivity between floodplains through reducing the intensity of floods.

Map of the catchment



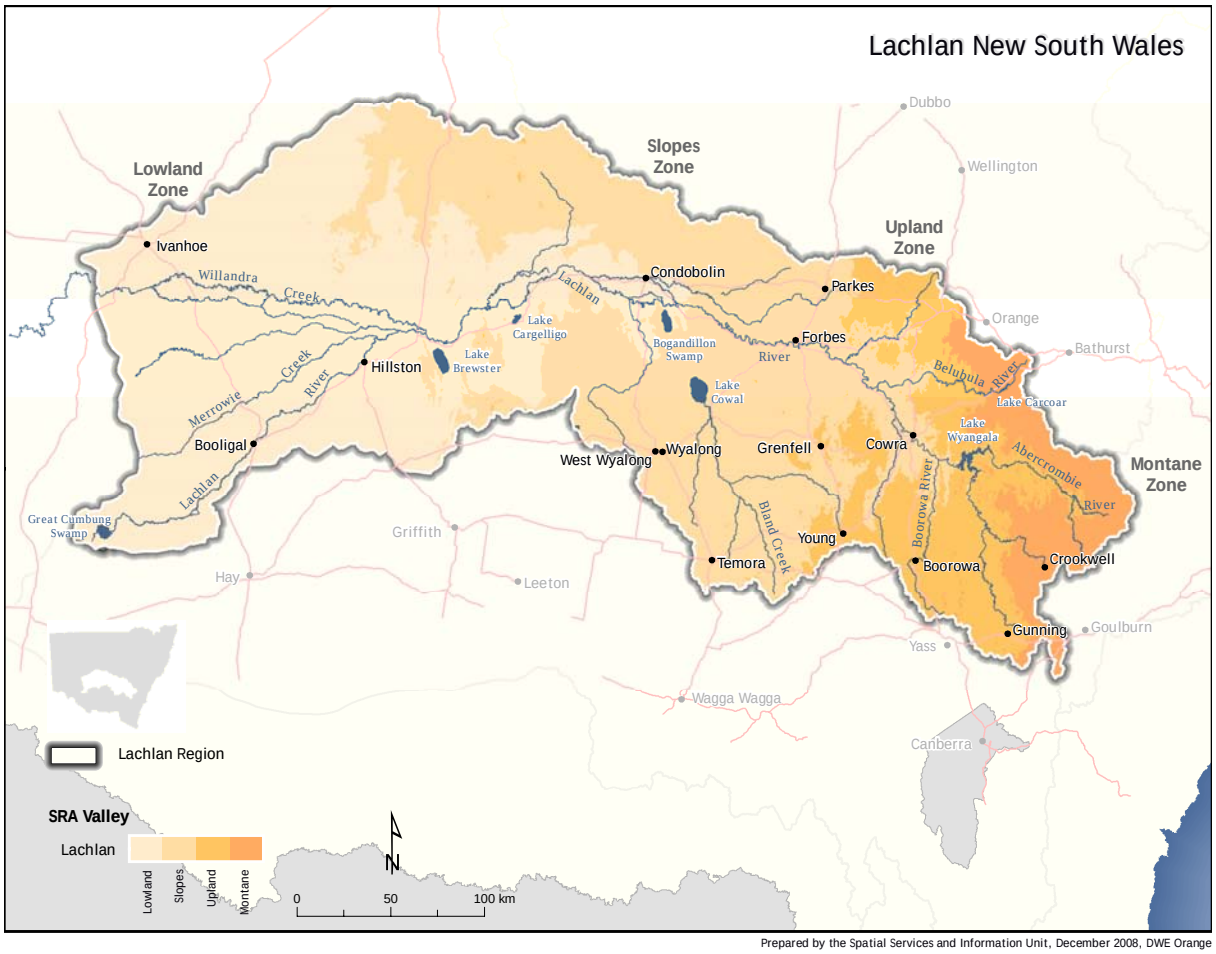


Figure 1 The Lachlan region

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 Lachlan region and 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 Lachlan 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 2007–2008. 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 Lachlan 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 1970 to 2008; and for turbidity from 1977 to 2008.

The NSW 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.

The percentage of samples that exceeded total phosphorus guidelines was high to very high at all sites across the region with the exception of one site (Figure 2). The percentage of samples that exceeded turbidity guidelines was moderate to high across the whole region, with the exception of two sites with insufficient data for analysis.

Data confidence	Commentary
TP – low	For TP, sites generally have on average seven samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is low. The sampling period was less than one year and some intervals were greater than one month.
Turbidity – low	For turbidity, sites generally have on average nine samples collected during the sample period. Confidence in the degree of representativeness of these for the period of record is low. The sampling period was less than one year.

Water quality trend

The lack of recent data at many sites meant that just over half the trend results could not be reported. No sites had a rising or falling trend in water temperature (Figure 3). One site had a rising trend in electrical conductivity, while the trend at the remaining sites was stable or unclear. Turbidity results were the least reliable; however, three sites in the upper catchment and the site at the end of the catchment had rising turbidity trends (Figure 3).

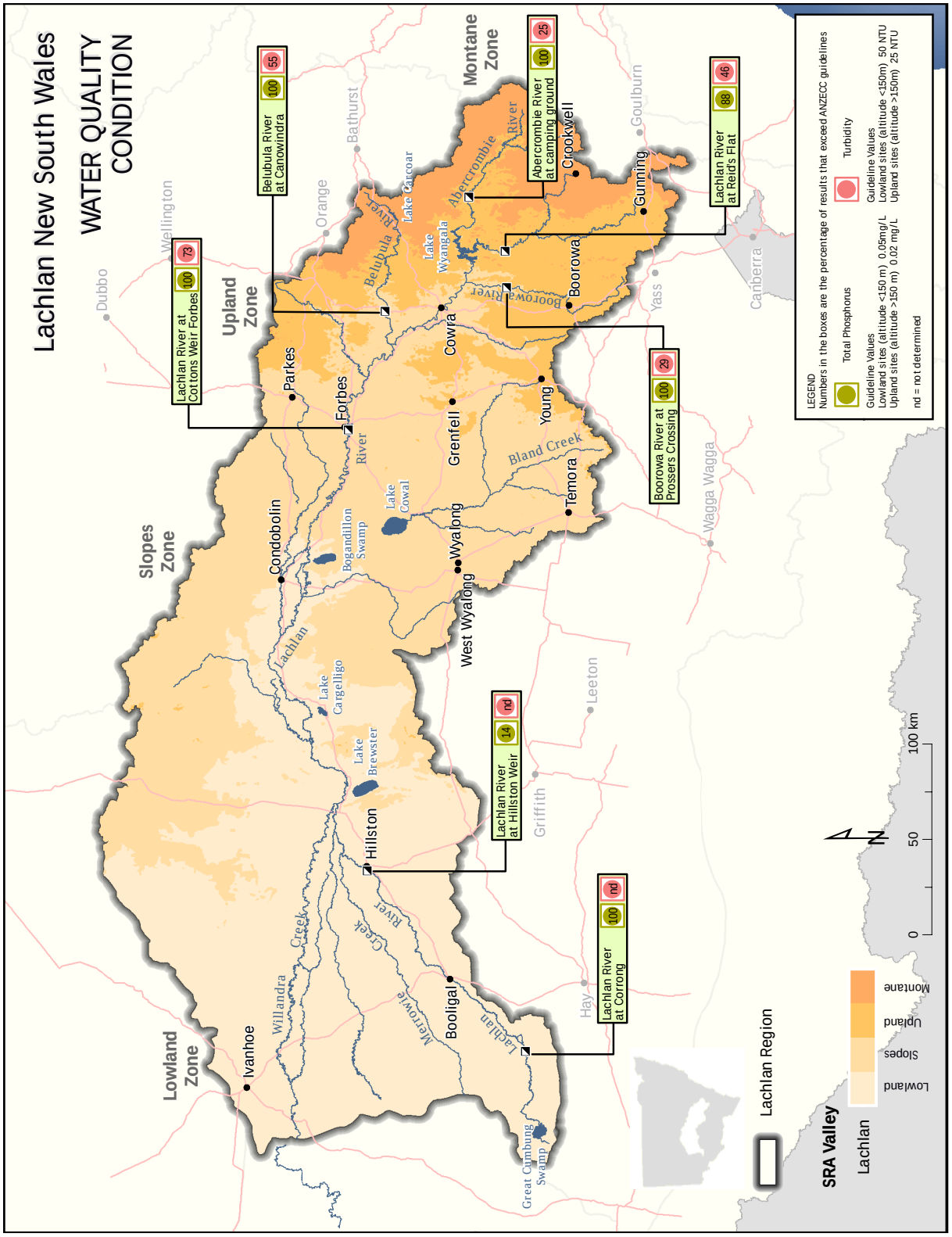


Figure 2 Water quality condition across the Lachlan region

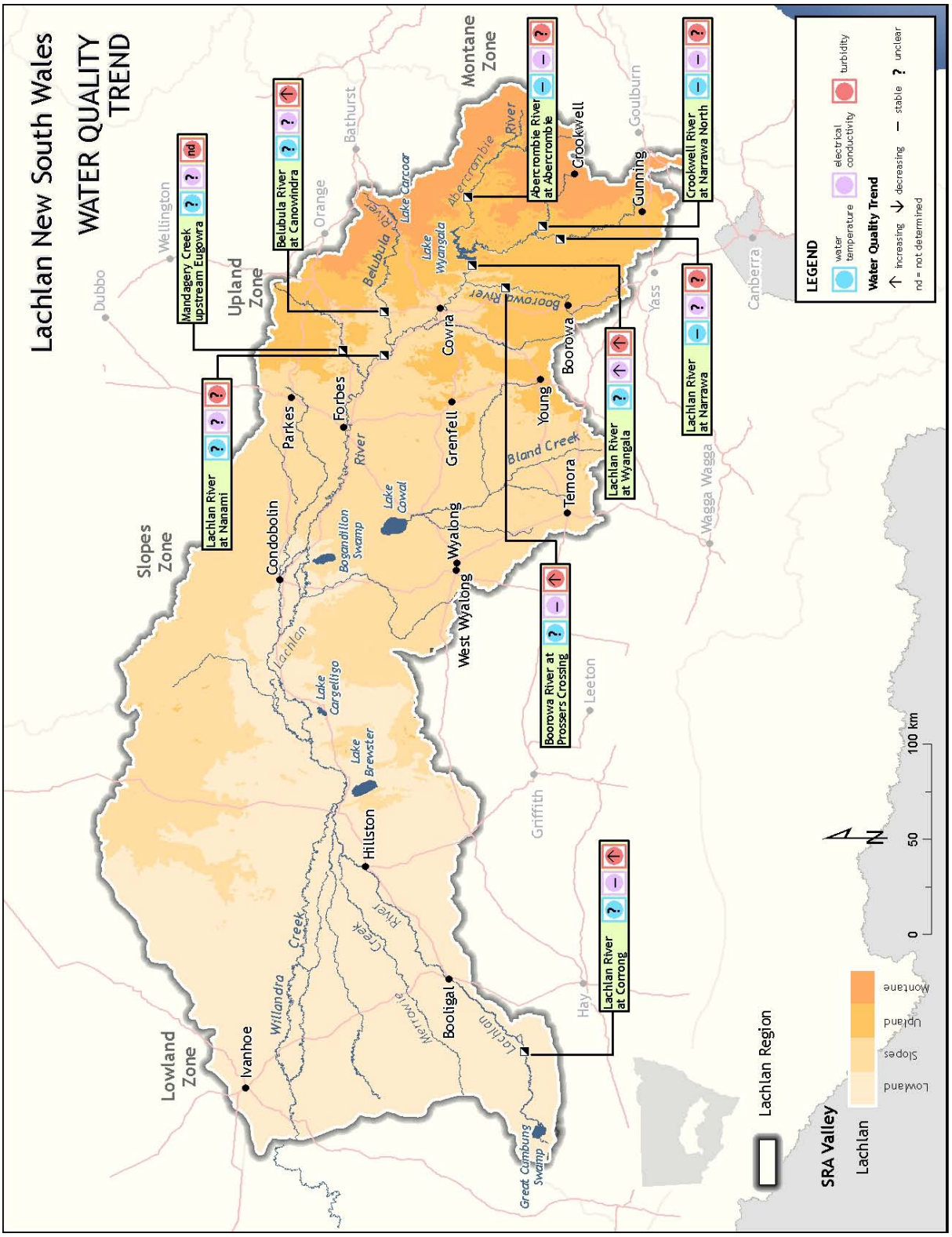


Figure 3 Water quality trend across the Lachlan region

Data confidence	Commentary
EC – low Temperature – low Turbidity – low	Data confidence at all sites and for all parameters was diminished for a number of reasons. There were large data gaps throughout, particularly for temperature. 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. The sites of Boorowa River at Prossers Crossing, Belubula River at Canowindra, Lachlan River at Corrong and Lachlan River downstream of Wyangala 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' (the proportion of fish population that is native rather than alien).

The site selection, sampling and analytical procedure used were largely as described in the SRA report (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:

- 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).

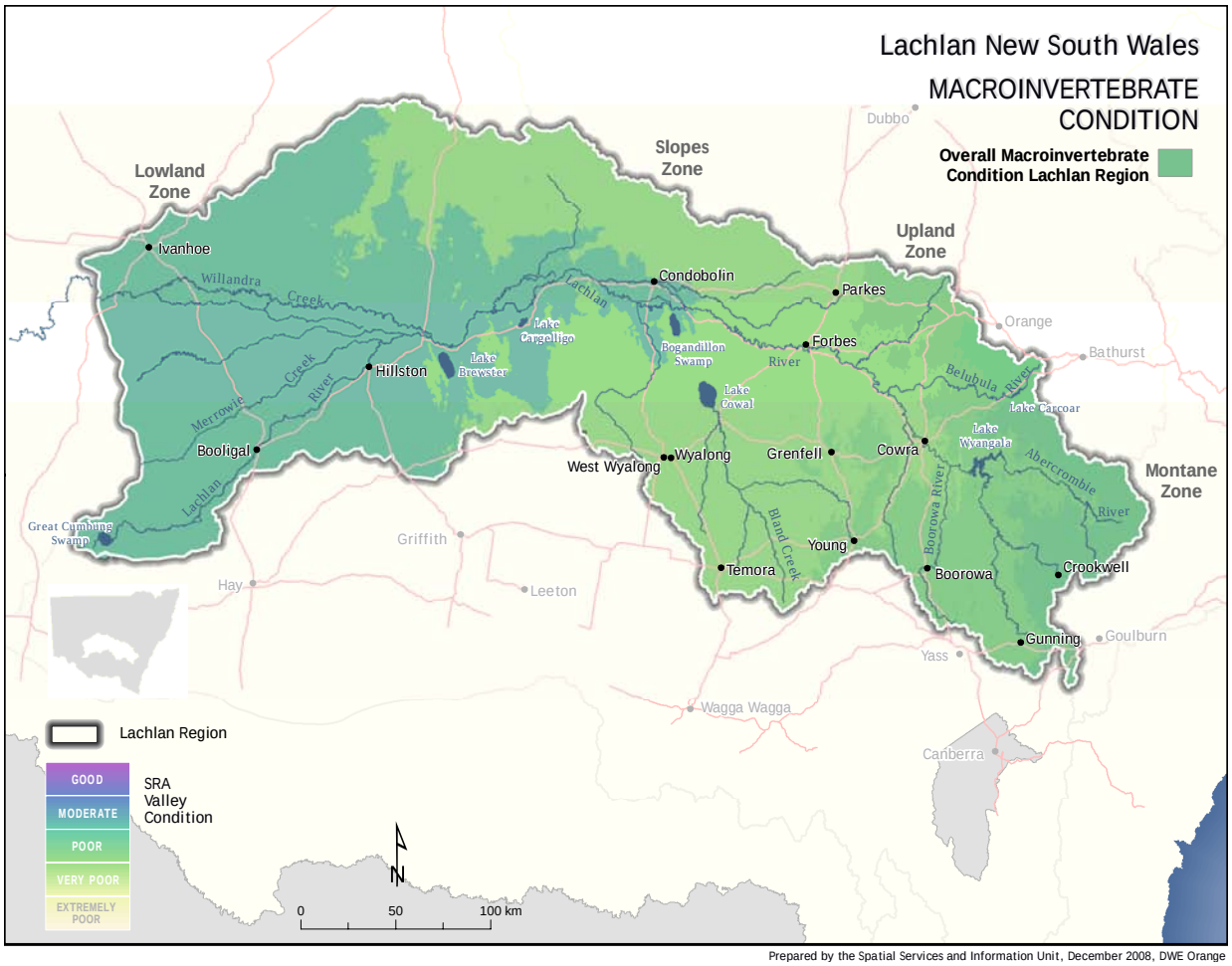


Figure 4 Macroinvertebrate condition across the Lachlan region

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 lowlands and uplands zones were in poor condition, the highlands were in very poor condition and the slopes zone was in extremely poor condition. Nativeness was moderate in the highlands, poor in the uplands, very poor in the lowlands and extremely poor in the slopes zone. Expectedness was poor

in the lowland zone, very poor in the upland zone and extremely poor in the slopes and highland zones.

Data confidence	Commentary
Medium to high	All data was collected within the three year period between 1 January 2006 and 31 December 2008. Data confidence within individual altitude zones ranges from medium in the lowlands zone, where there was moderate variability across sampling sites, to high in the remaining three zones, with limited inter-site variability. Data confidence in the regional fish community condition rating is medium given the moderate inter-site variability across the region.

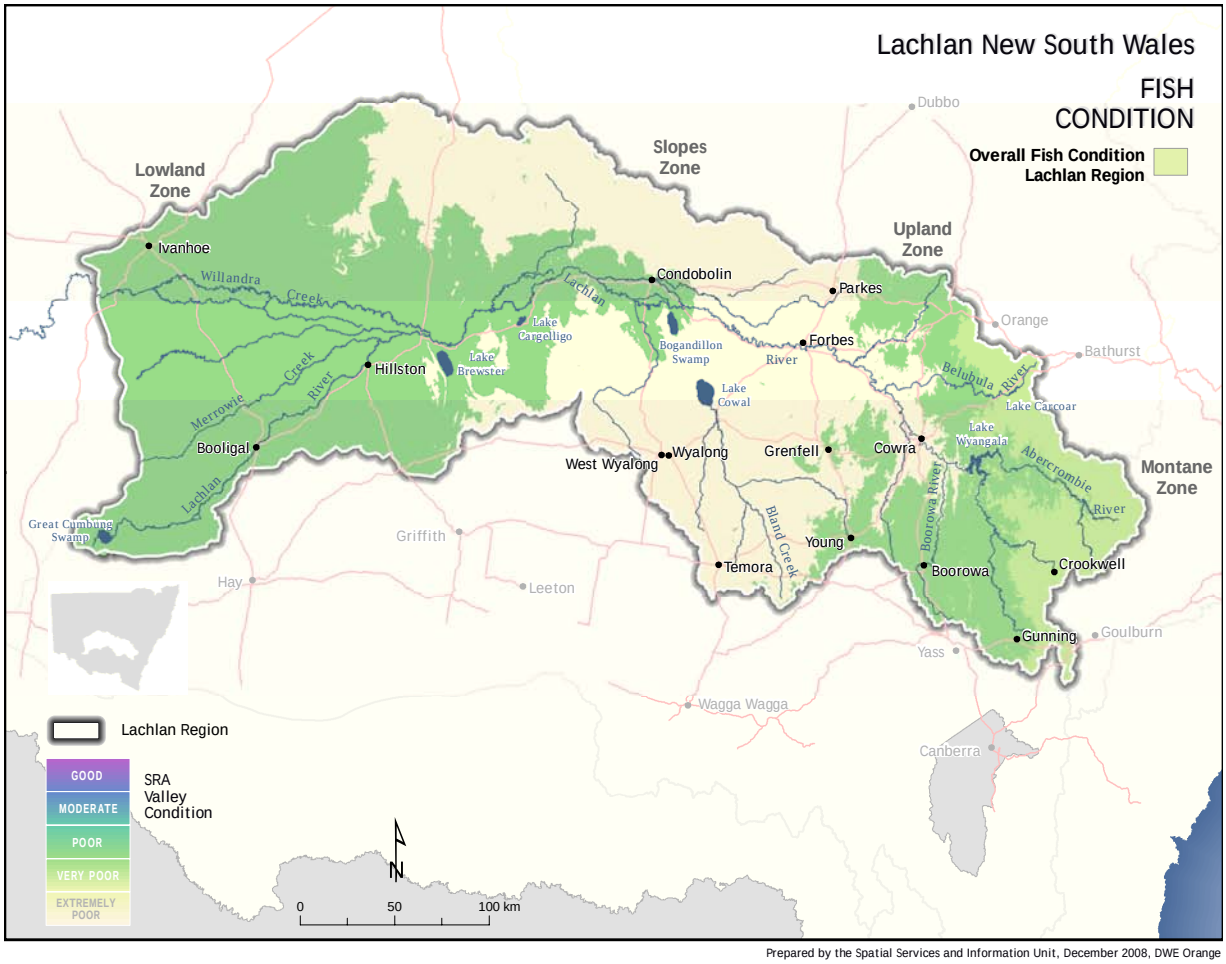


Figure 5 Fish condition across the Lachlan region

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 Lachlan Valley was in moderate to good hydrological condition (Lowland Zone: moderate; Upland, Montane Zones: good; Slopes Zone: moderate to good). Overall, the flow regime was similar to reference condition except for the Lachlan and Belubula rivers downstream of Wyangala and Carcoar storages, respectively, where there were changed magnitudes of high, low and annual flows, and changes in flow variability and seasonality' (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).

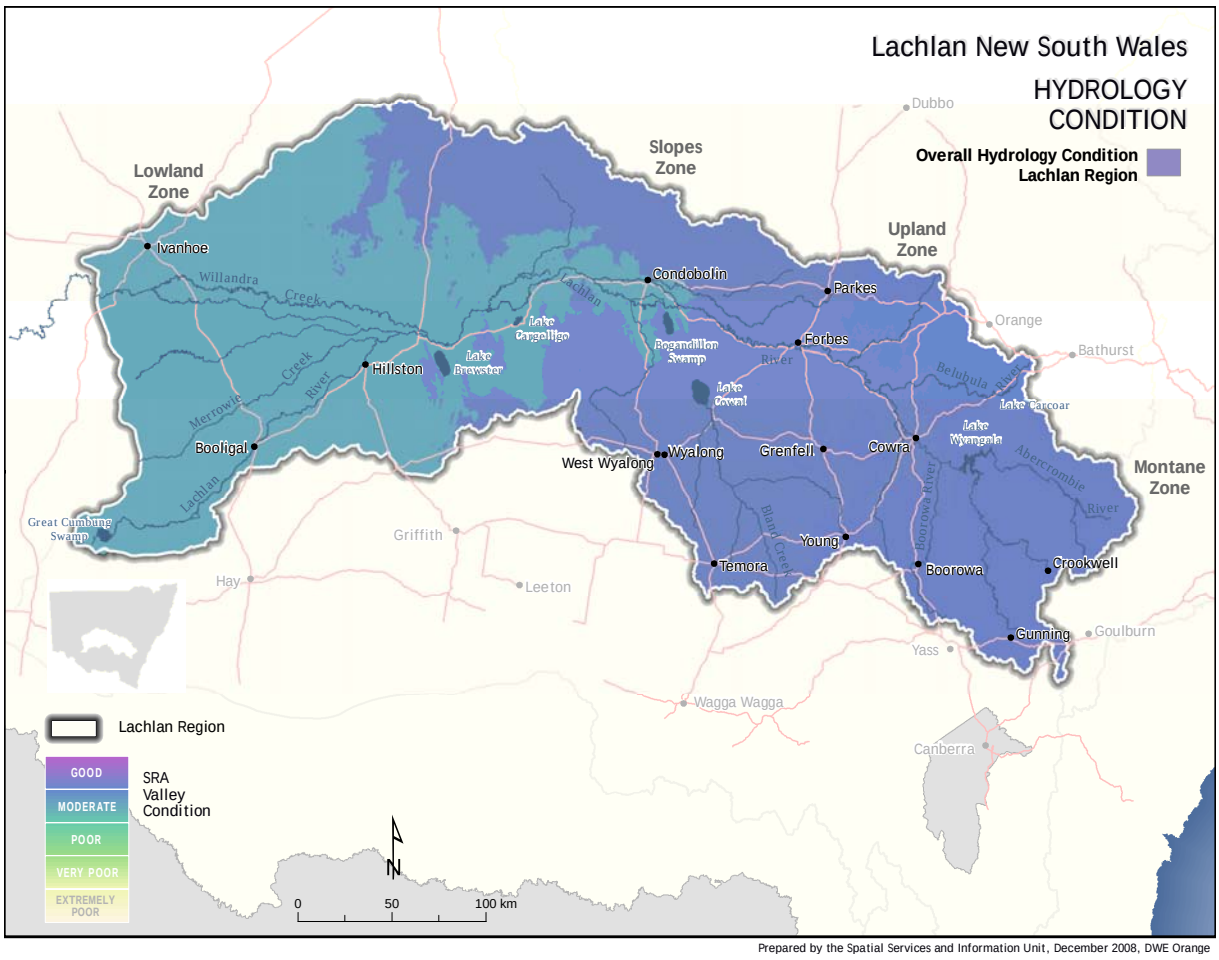


Figure 6 Hydrologic condition across the Lachlan region

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
Lachlan	Lowlands	36
	Slopes	16
	Uplands	37
	Highlands	64

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 a dam is referred to as cold water pollution (CWP) (Preece 2004). The table below shows storages 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
Wyangala	High	400 km	Lachlan
Carcoar	Medium	50 km	Belubula

Wyangala Dam on the Lachlan River regulates water flow downstream of the dam during the summer irrigation season. Thermal stratification within the storage has lead to lower temperatures in the river downstream of the dam (Preece 2004), making it a priority for CWP mitigation action.

Carcoar Dam on the Belubula River provides water for irrigation supply along the length of the river. There is a potentially large but localised disturbance below the dam due to thermal stratification (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 were 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	Lake Brewster Weir	Lachlan River	130
2	Willandra Weir	Lachlan River	110
3	Hillston Weir	Lachlan River	146
4	Tallawanta Weir	Lachlan River	135
5	West Condobolin Weir	Lachlan River	30
6	Booligal Weir	Lachlan River	186
7	Condobolin Weir	Lachlan River	97
8	Booberoi Weir	Lachlan River	80
9	Cottons Weir	Lachlan River	170
10	Micabil Weir	Lachlan River	45
11	Lachlan Shire Council Weir	Goobang Creek	13
12	Kiactoo Weir	Lachlan River	45
13	Burrawang West Weir	Bumbuggan Creek	30

14	TSR	Bumbuggan Creek	8
15	Kennedy's Weir	Goobang Creek	19
16	Brady's Weir	Goobang Creek	14

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

- Aquatic and riparian weeds.

Water management

- Alteration of natural flow patterns.

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 Lachlan CAP can be found at www.lachlan.cma.nsw.gov.au.

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 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 at the state level 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 impacts 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

Specific NSW Government actions to address the target in the Lachlan region include the WSPs discussed earlier, as well as NSW RiverBank, the Rivers Environmental Restoration Program and the Wetland Recovery Program, which have purchased 11,545 ML of entitlements in the Lachlan 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 with strategic investment in 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 Lachlan CMA is working with NRM partners, landholders and community groups to implement the following activities in relation to the riverine ecosystems theme:

Multiple condition/pressure actions

- The Boorowa River Recovery Project has restored about 58 km of stream in the upper Boorowa River Catchment through incentive funding for fencing, revegetation, willow control, and alternative watering, and improved fish passage and habitat.
- The Lachlan Riverine Working Group and Management Plan is ensuring the best use and management of environmental water to enhance the health and effective functioning of the riverine, wetland and floodplain ecosystems along and in the Lachlan River.
- The Bland Incentive Grants Project in the Bland Creek sub-catchment provided coordinated incentive grants to landholders to conserve and restore riparian native vegetation, control erosion, improve grazing management and cropping practices and undertake community monitoring of native birds.
- The Belubula River Restoration Project to rehabilitate riparian vegetation has improved riverine ecosystems along approximately 31 km of the Belubula River. Fifteen landholders carried out works including poisoning and removing willow species on the bed and banks of streams, fencing riparian areas where willows have been removed, revegetating using endemic native trees and shrub understorey species and providing an alternative water supply where fencing has restricted stock access to a permanent water supply.
- Native revegetation and conservation projects throughout the Lachlan (including those above) have conserved and revegetated about 500 important riparian vegetation sites along creeks and rivers.

Fish

- The Macquarie Perch Habitat Refuge project – four separate populations of the threatened native fish species, the Macquarie perch (*Macquaria australasica*), have been identified in the Upper Lachlan. To characterise the preferred habitat of the Macquarie perch, a survey of the Lachlan and Abercrombie rivers above Wyangala Dam was carried out in 2007. The presence of this species and other native fish populations was linked to a few key characteristics: the presence of snags and/or rock, shade minimising fluctuations in water temperature and low sediment loads. Re-snagging with logs and rocks has been carried out over 54 km of stream, combined with rehabilitation of riparian vegetation to reduce sediment from erosion gullies entering the river.
- A Bank Stability Project for the lower Lachlan, including the production of a Snag Management Plan (in partnership with I&I), aims to manage large woody debris in the lower Lachlan. Also in partnership with I&I, the CMA has developed the Fish Friendly Farms demonstration reach, involving bank stabilisation along 5 km of the river near Euabalong.
- The Fish on the Move Project will extend the connectivity of priority stream lengths by modifying or managing structures that are barriers to instream migration of native aquatic fauna. This will also improve instream habitat at many sites.

Hydrology

- The Water Use Efficiency Project is improving irrigation efficiency to allow for water for environmental purposes without further increasing the burden on the irrigation industry.

Water quality

- A Community Stream Sampling Project has been carried out by volunteers in the Belubula and Mandagery catchments since July 2007. This river salinity monitoring is increasing awareness and helping to target on-ground works in the Lachlan Salinity Action Project. It is also linked with the Belubula River Restoration Project.
- The Upper Lachlan Nutrient and Sediment Control Project targeted more than 150 severe soil erosion hotspots using large-scale structural earthworks, erosion, sediment and nutrient control structures combined with fencing and revegetation to stop these sites contributing excessive sediment to the Lachlan River, thus improving water quality and aquatic ecosystems.

The DOP regional planning measures in the Lachlan region include the Sydney–Canberra Corridor Regional Strategy (2008), which applies to part of the Lachlan region (refer to the Hawkesbury–Nepean region above).

Local level

The 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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