State of the catchments 2010

Riverine ecosystems

Lower Murray Darling region

State Plan target

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

Background

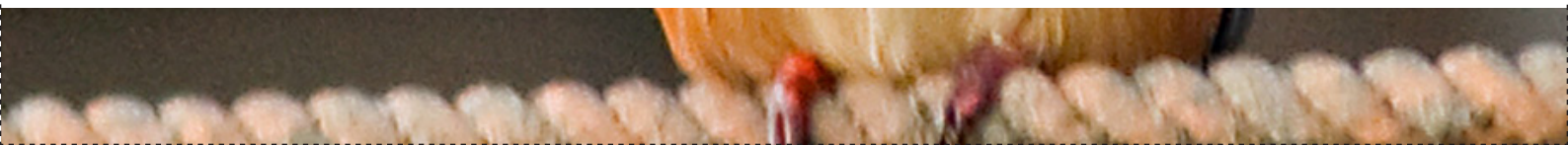
The Lower Murray Darling region covers an area of 6.3 million hectares, incorporating the entire local government areas of Wentworth and Broken Hill City, the majority of the Balranald Shire Council area, a section of the Central Darling Shire Council and the southern portion of the Unincorporated Area administered by New South Wales Land and Property Management Authority (Figure 1). The catchment extends from the edge of the Murray/Murrumbidgee Rivers (junction) floodplain to the South Australian border in the west.

There are three major river systems in the Lower Murray Darling region. The Murray River is the longest at 598 km, followed by the Darling River at 530 km and the Great Darling Anabranch at 460 km. The Darling River and the Great Darling Anabranch supply water to a number of large lakes, some of which are used as water storages.

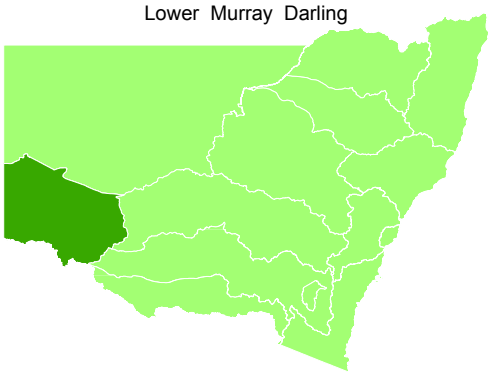
The Lower Murray Darling River system has been modified with a weir system that is highly regulated, making it difficult to return flow to pre-development conditions. Threats to the river system include flow regulation, over extraction of water for consumptive purposes, and the construction of structures that impede flooding. These threats are leading to a decline in the health of floodplain, wetland, lake and riverine ecosystems.

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.



Map of the catchment



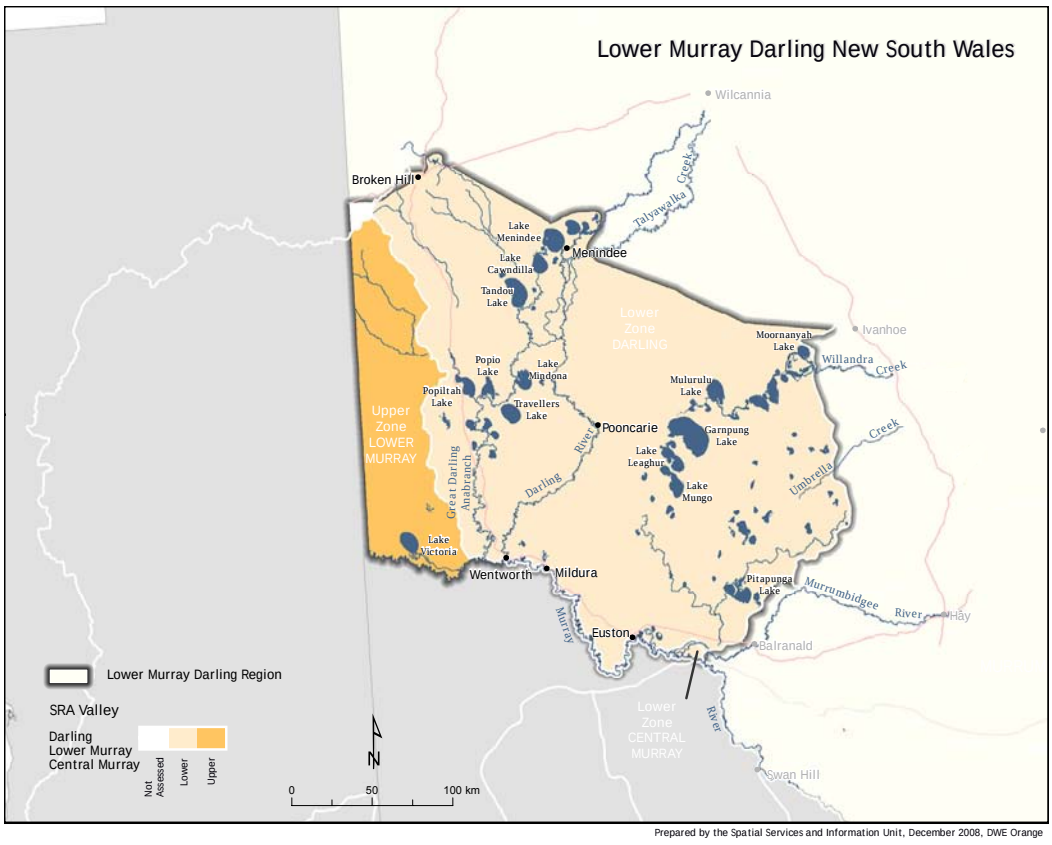


Figure 1 The Lower Murray Darling region

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 overall condition ratings for the

region were calculated using the Lower Murray Darling Catchment Management Authority (CMA) boundary, incorporating parts of the Central Murray, Darling and Lower Murray SRA Valleys, as labelled on the maps. The overall condition for the region as shown on the maps may therefore be slightly different from the overall condition presented for individual valleys in the SRA Report 1 (Davies et al 2008). The maps provide information on condition in greater geographical detail based on the SRA within-valley zones.

Condition

Water quality

Condition was determined for the following indicators of water quality in the Lower Murray Darling 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 Lower Murray Darling 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 was from 1964 through to 2008; for temperature was from 1971 to 2008; and for turbidity was from 1976 to 2008.

The NSW discrete water quality data archive (Triton database managed by the NSW Office of Water [NOW]) was evaluated using a long-term trend analysis (30–35 years), which provided 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 very high at the Darling River sites in the upper region and low to moderate in the Murray and Lower Darling sites (Figure 2). The percentage of samples that exceeded turbidity guidelines was moderate at the Darling River sites in the upper region and low in the Murray and Lower Darling sites (Figure 2).

Data confidence	Commentary
TP – high	For TP, sites generally have on average 77 samples collected during the sample period. Confidence in the degree of representativeness of these data for the period of record is medium to high.
Turbidity – high	For turbidity, sites generally have on average 146 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

The available data record was only sufficient for trend analysis at two sites. All the results showed stable trends with the exception of a rising EC trend in the upper Darling River site over the last decade; it will be interesting to see how these levels respond during wetter conditions.

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. 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.

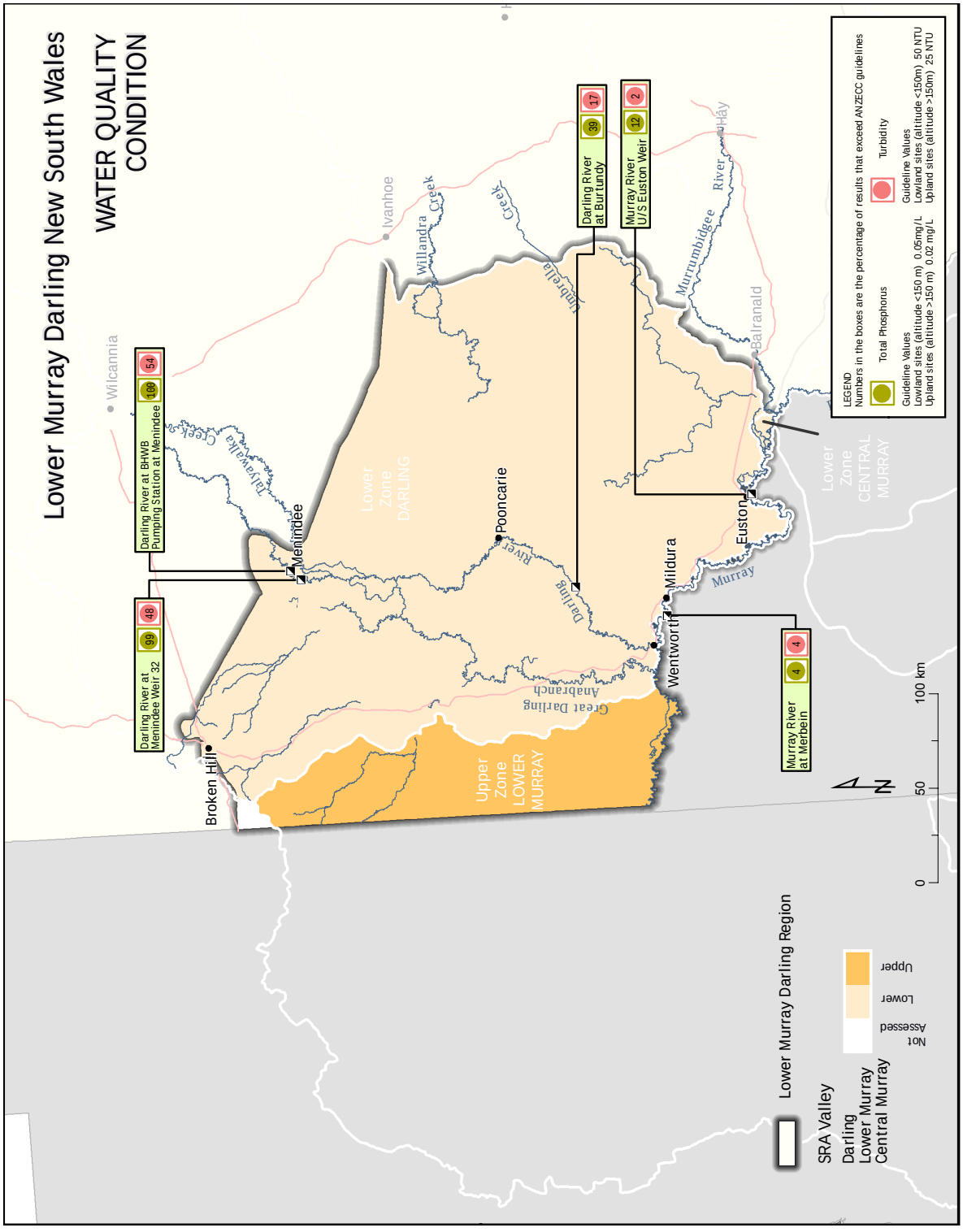


Figure 2 Water quality condition across the Lower Murray Darling region

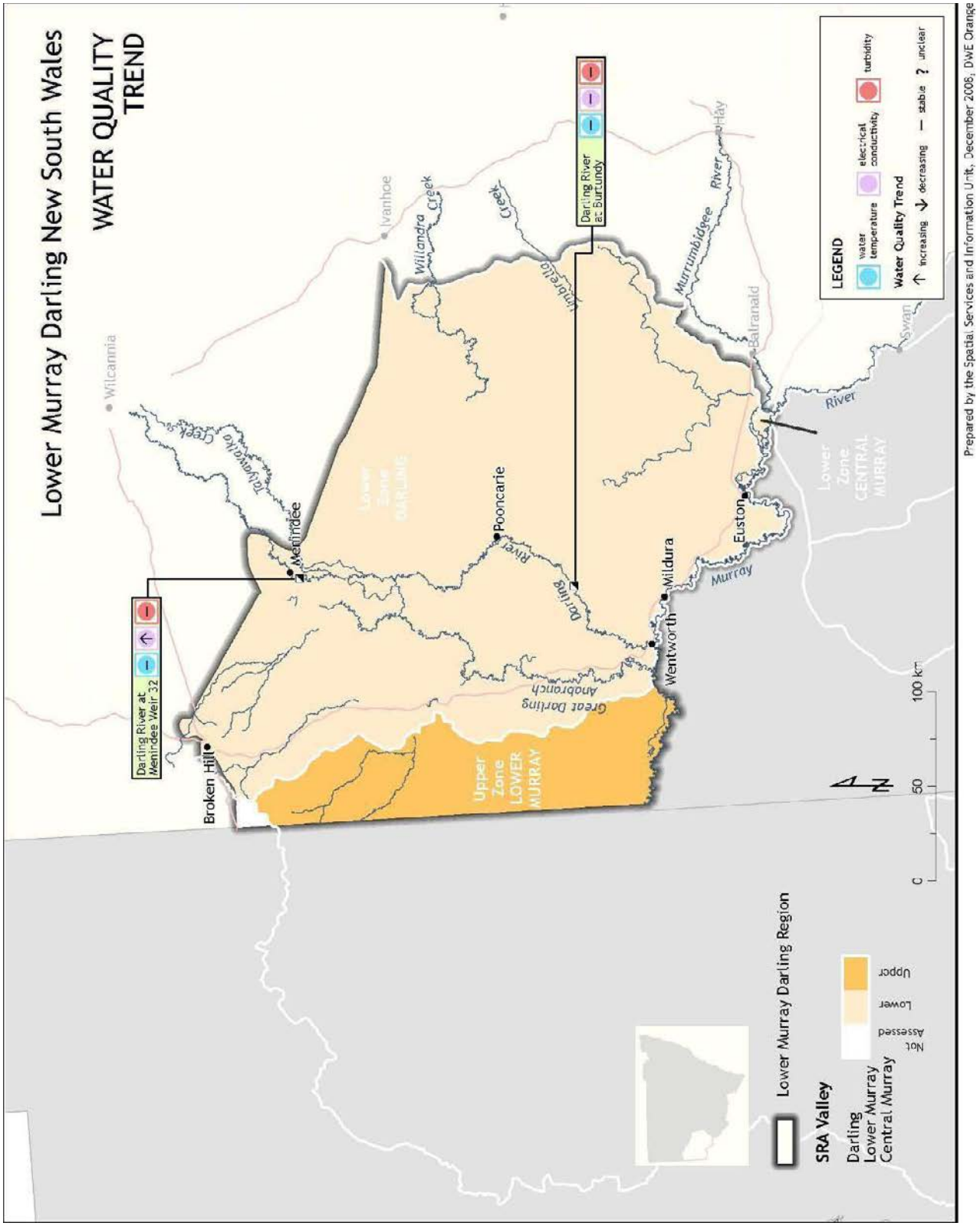


Figure 3 Water quality trend across the Lower Murray Darling region

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 the 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:

- the use of the most recent data (some of which has not yet been reported by the SRA program)
- the exclusion of data collected from neighbouring states for cross-border valleys, unless fewer than four data points occurred in the NSW section of each zone
- 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.

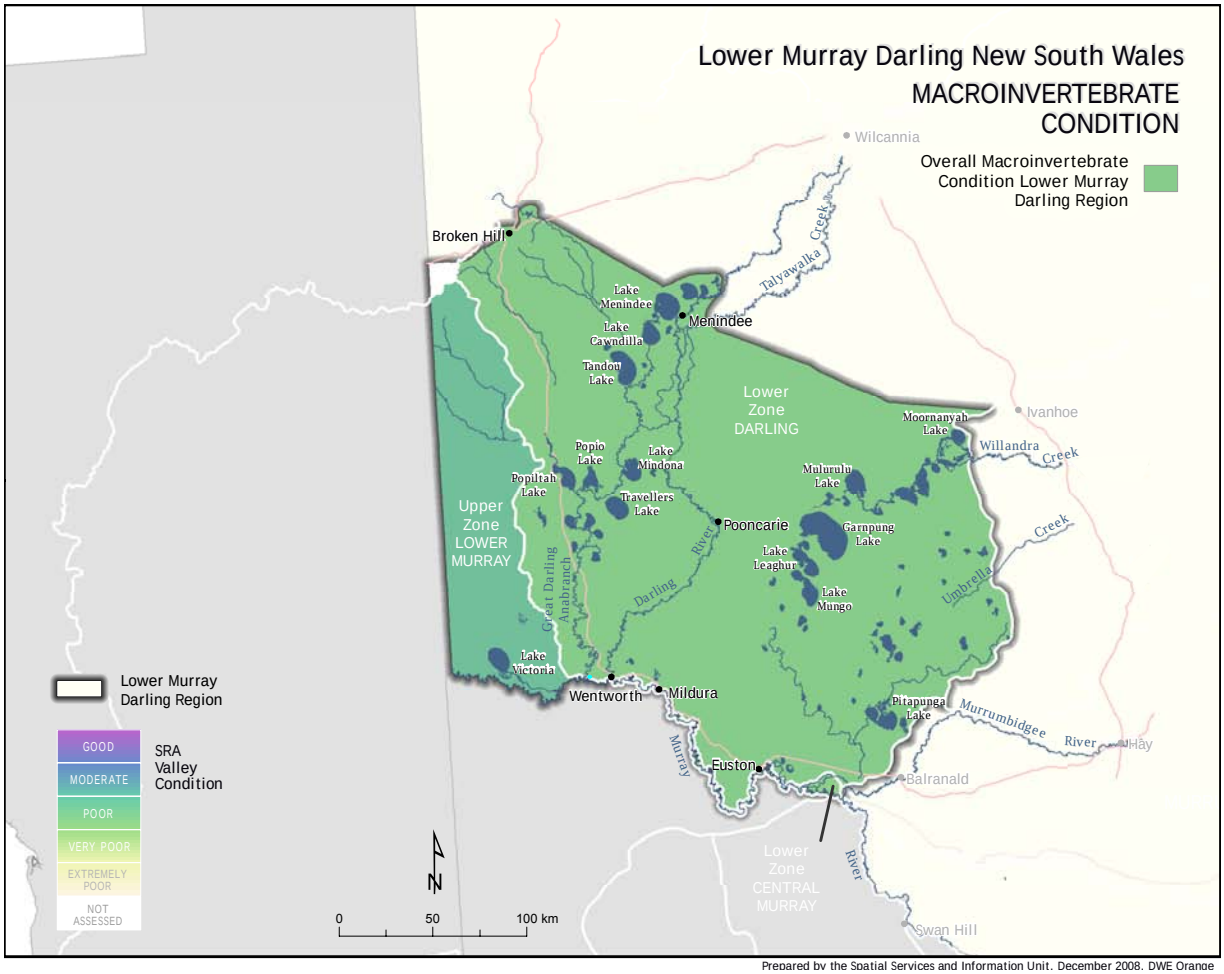


Figure 4 Macroinvertebrate condition across the Lower Murray Darling region

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).

Fish condition

The overall fish condition was 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 poor. Of the individual catchment zones, the lower Darling River and the Murray River upstream of the Darling junction were both in poor condition. However, the Murray River below the Darling junction was in very poor condition. Nativeness was poor across all catchment zones. Expectedness was poor in the Murray River above the Darling junction and in the Darling River and very poor in the Murray River below the Darling junction.

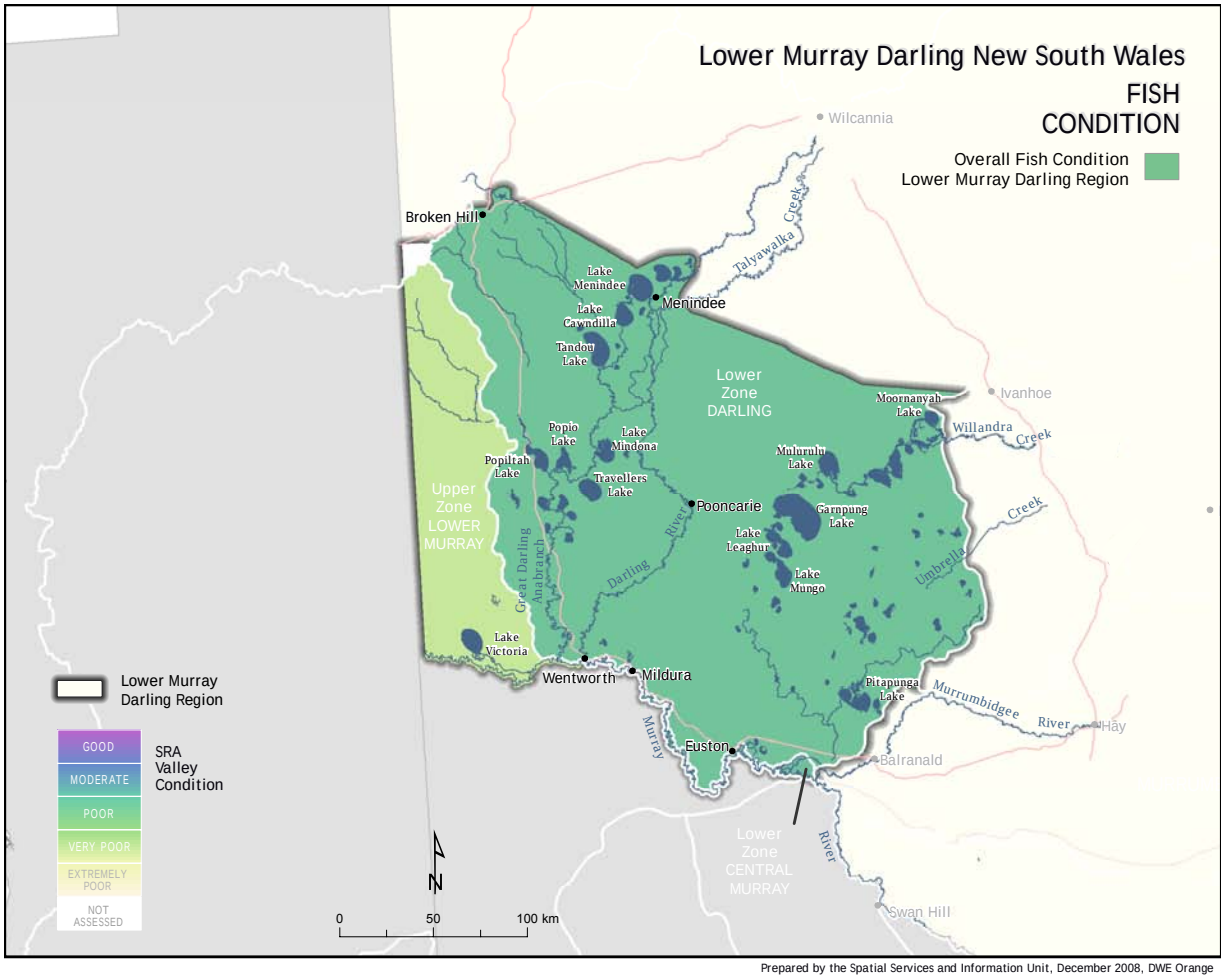


Figure 5 Fish condition across the Lower Murray Darling region

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 zones varies depending on the number of sites sampled within each, with higher confidence in the upper Murray and Darling zones, but only medium confidence in the lower Murray zone, where most of the data was collected on the South Australian side of the state border. Data confidence in regional scale values is high given the limited variability across sites overall. No data was collected from the Great Darling Anabranch as it has been dry for the past three years.

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 Lower zone in the Darling River was in poor hydrologic condition.

> 'Overall, the flow regime had fewer high flows, and reduced annual volumes and variability, with little change to low and zero flows and flow seasonality. This pattern reflects the diversion of a significant volume of water from the system and the effect of differentially harvesting high flows' (MDBC 2008).

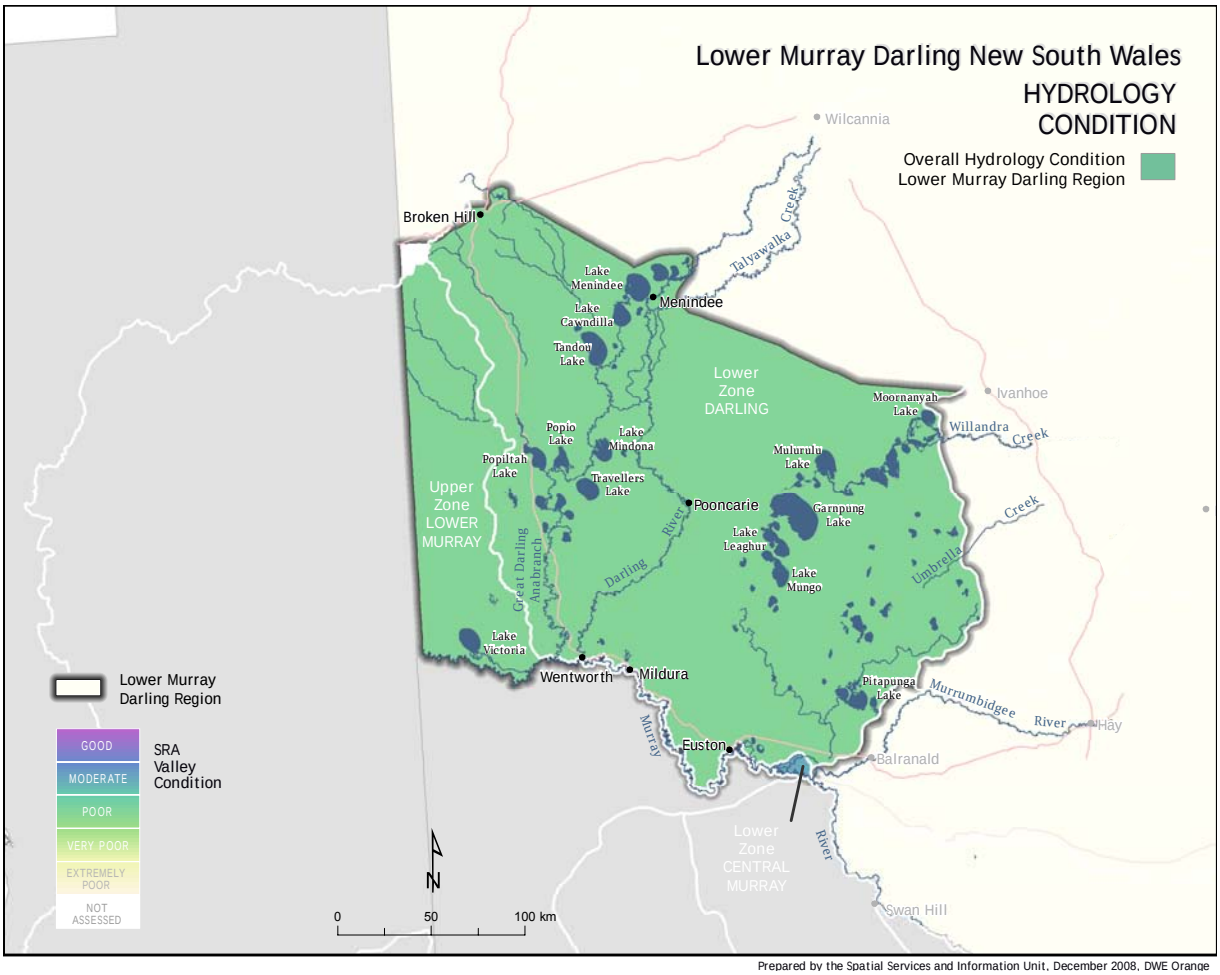


Figure 6 Hydrologic condition across the Lower Murray Darling region

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 interpreted from the Sustainable Rivers Audit combining the conditions of Central Murray, Darling and Lower Murray SRA valleys.

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
Lower Central Murray	Lowlands	64
Lower Murray	Coastal Plain	54
Lower Darling	Lowlands	59
Great Darling Anabranch	Lowlands	No data

Water management

Alteration of natural temperature patterns

There are no dams identified as causing cold water pollution in the Lower Murray Darling region.

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 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	Menindee Main Weir	Darling River	285
2	Weir 32	Lower Darling River	322
3	Pooncarie Weir	Lower Darling River	377
4	Weir 11	Lower River Murray Channel	213

5	Weir 15	Lower River Murray Channel	660
6	Lake Victoria Outlet Regulator	Frenchmans Creek	34

The design phase of Weir 32 is finalised and it is envisaged that work will be completed in 2009. Pooncarie Weir's design is finalised and Wentworth Shire Council is committed to building a new weir and fishway. Weir 11 (Mildura Weir) and Weir 15 (Euston Weir) are the next two weirs to be looked at for remediation work. Burtundy Weir had remediation works completed in mid 2008. Weirs 7–10 have also completed their remediation works.

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 (NRM) 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 Lower Murray Darling CAP can be found at www.lmd.cma.nsw.gov.au/catchment_plan/targets.shtml.

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 via 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 200GL 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 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 Lower Murray Darling region include the WSPs discussed earlier, as well as the Living Murray program, which aims to recover 500 GL of environmental water for six icon sites on the Murray River by June 2009. NSW has committed to recover 249 GL (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 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. The framework and investment 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

In the four years up to April 2008, the Lower Murray Darling CMA undertook the following activities at the regional level in relation to the riverine ecosystems theme:

Multiple condition/pressure actions

- 1.36 km of stream bank along two reaches of the lower Darling River (Lelma to Burtundy and Pomona) rehabilitated
- 19 gross pollutant traps installed
- one floodplain management plan written and implemented.

Hydrology

- 3437 ha improved irrigation practices
- 57 landholders accessing irrigation incentives for improved water use efficiency.

At the regional level, DOP has undertaken activities to address a number of pressures including:

- the *Murray Regional Environmental Plan (REP) No 2 – Riverine Land* (1994), which established policies for protecting and managing the region's important riparian areas

- *Willandra Lakes REP No 1* – World Heritage Property, which applies to the Willandra Lakes region. The REP aims to protect, conserve and manage this property in accordance with a strategic plan of management.

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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