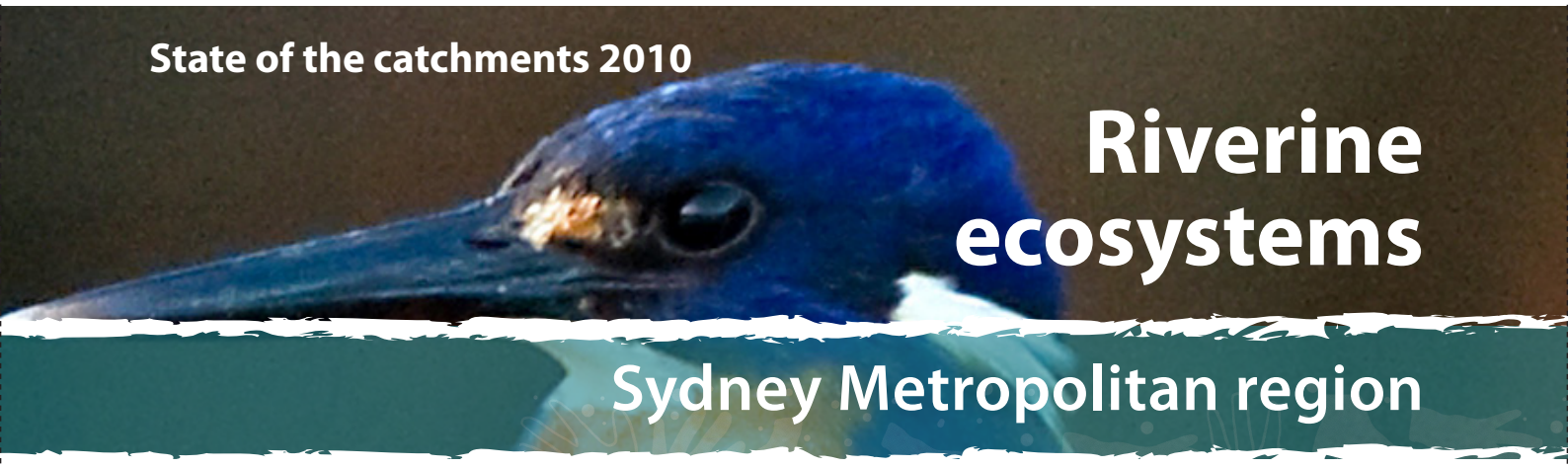


State of the catchments 2010

Riverine ecosystems

Sydney Metropolitan region

State Plan target

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

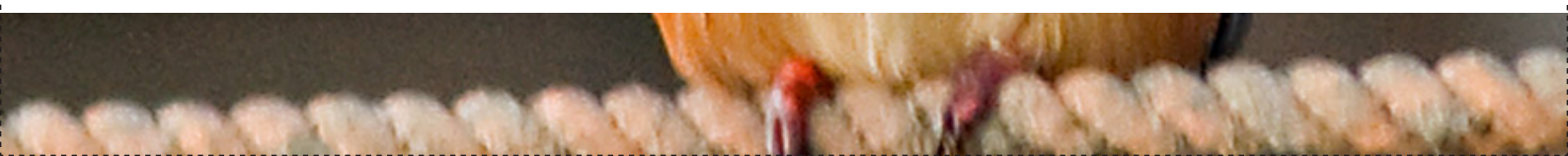
Background

The Sydney Metropolitan region covers an area of 1860 km^2 and is bounded by the Northern Beaches in the north, Prospect Reservoir in the west and the Royal National Park in the south (Figure 1). There are eight small catchments within the Sydney Metropolitan region, with Georges River the largest at 960 km^2 followed by the Parramatta River catchment (including its estuary) at 403 km^2.

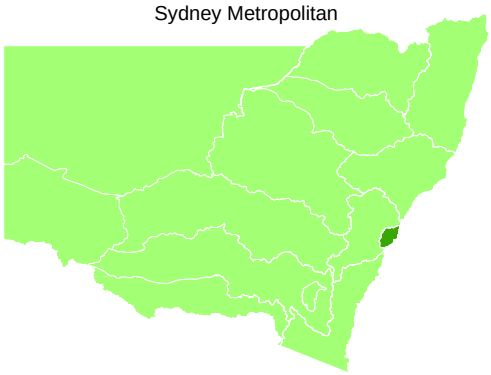
The catchment of the Georges River is relatively small compared to others along the coast. It rises near Appin in the south at an elevation of 393 m above sea level and is about 100 km in length. The waterways in the catchment are a mix of natural creeks, concrete lined channels and enclosed pipe drainage systems. The Sydney Metropolitan region is highly urbanised and includes residential and industrial sections with some open space areas. Small areas of national park occur along the Georges River in its lower reaches.

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



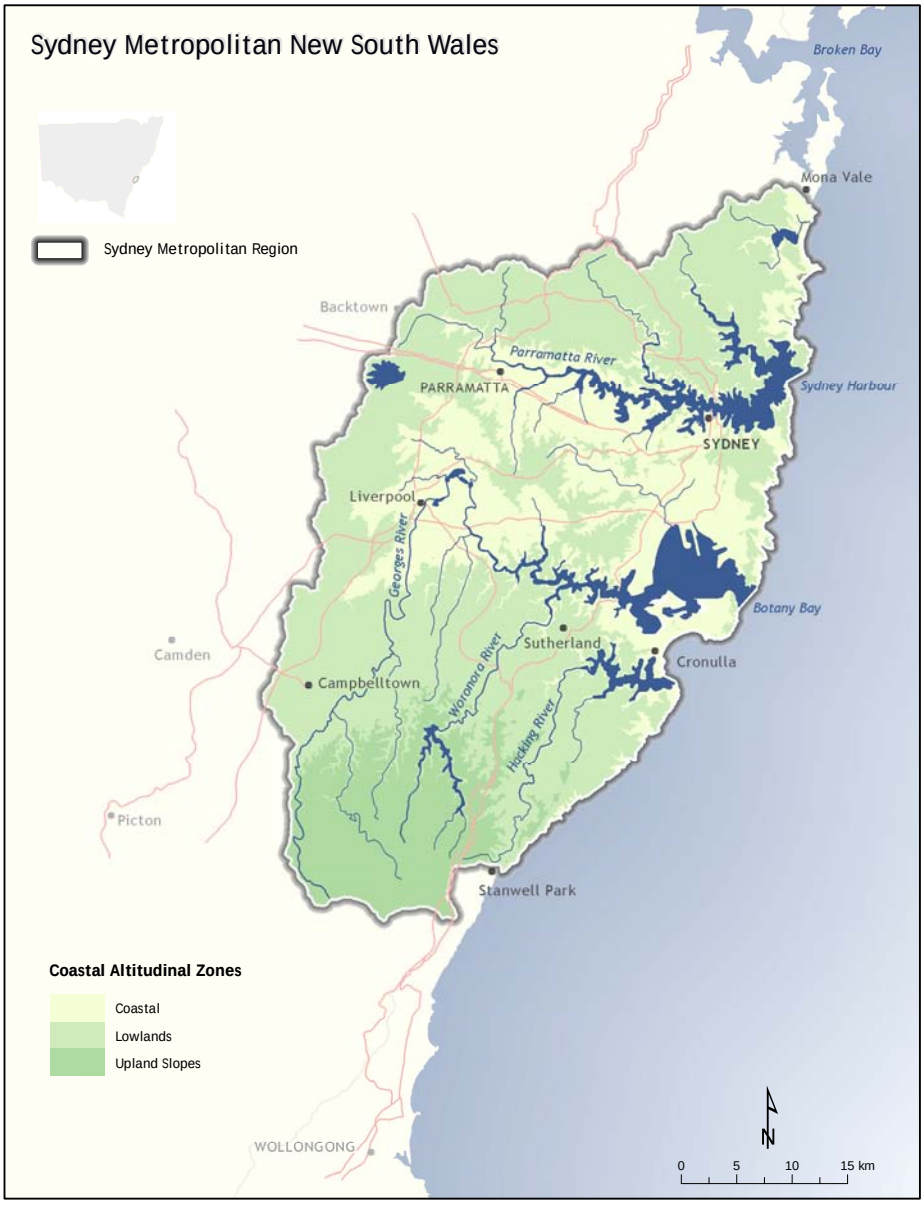


Figure 1 The Sydney Metropolitan region

Assessment

Riverine ecosystem condition has been assessed using water quality, macroinvertebrate, fish and hydrology indicators. Water quality condition is described as the degree to which the data exceeds the water quality guidelines for turbidity and total phosphorus (ANZECC & ARMCANZ 2000). Condition is described for macroinvertebrates, fish and hydrology by using a five point scale, a similar ranking to the scale used in the Sustainable Rivers Audit (SRA) (Davies et al 2008). Trend information was unavailable for all water quality indicators.

For the aquatic biota and hydrology indicators, different colour schemes are presented on the maps. A number of different methods were applied in the coastal regions, based either on a coastal adaptation of the SRA approach to condition assessment, or an interim approach where data or model availability did not allow an SRA style approach. Outcomes were not available for some areas. In all coastal regions, altitude zones could not be applied to macroinvertebrate modelling, unlike in the inland regions (ie SRA approach). For hydrologic condition mapping, where models were available, techniques based on the SRA approach were applied and the colour scheme on the map is similar to that used for inland regions (ie solid shading); for non-modelled catchments, hatching is used to indicate that a different method based on potential extraction pressures has been applied. The overall condition ratings have been applied based on whole-of-catchment, combinations of catchment management authority (CMA) areas, or major sub-region boundaries as applicable.

Condition

Water quality indicators

Condition was determined for the following indicators of water quality in the Sydney Metropolitan 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 July 2007 to June 2008. For turbidity in the Sydney Metropolitan region, the upper limit of the ANZECC guideline for lowland rivers was used (ie 50 nephelometric turbidity units (NTU)). For total phosphorus, the lowland river ANZECC guideline <0.05 mg/L was used.

The map (Figure 2) shows the degree to which the data at a site exceeds the guidelines. In general terms, the higher the percentage of exceedance, the higher the priority the site (and its catchment) would be for further investigation.

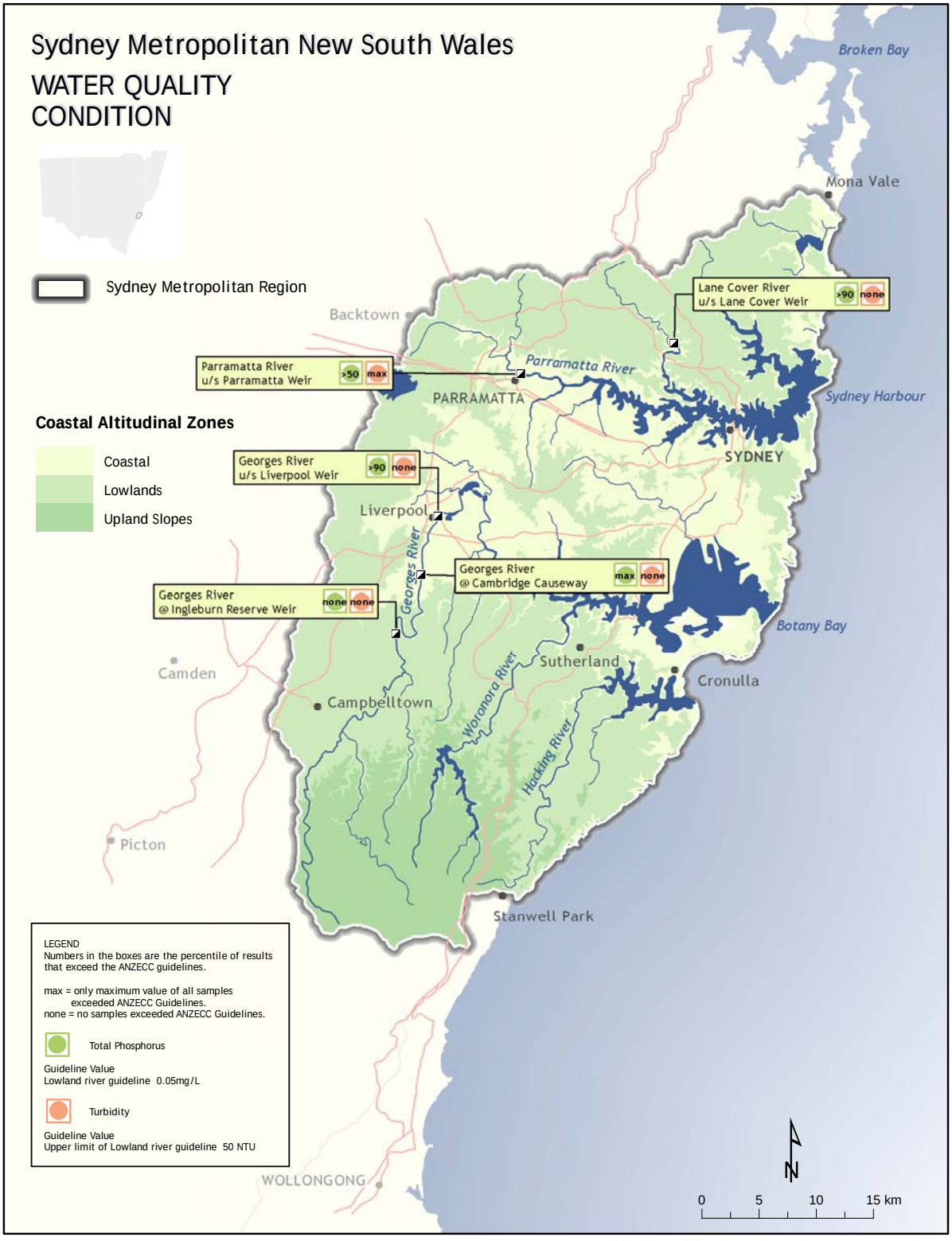
Water quality trend was not assessed for the Sydney Metropolitan CMA area as insufficient data was available.

Results were sourced from a report prepared by Sydney Water (2008). The period of analysis was for one year (July 2007 to June 2008). The percentage of samples that exceeded the total phosphorus guideline was moderate to very high across the region, apart from one site on the Georges River. Turbidity results did not exceed the guideline at all sites except one site on the Parramatta River, where the maximum number of samples exceeded the guideline (Figure 2).

Data confidence	Commentary
Not assessed	Data was analysed for the period July 2007 to June 2008. Data was sourced from Sydney Water (2008). Consult this reference for further information on water quality condition analysis.

Water quality trend

Data confidence	Commentary
Not assessed	There is insufficient data available to determine water quality trends.



Prepared by the Spatial Services Unit, March 2009, DWE Queanbeyan.

Figure 2 Water quality condition across the Sydney Metropolitan 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 condition of macroinvertebrate assemblages in the rivers of eastern New South Wales was modelled, giving predictions of AUSRIVAS O/E composition of macroinvertebrate fauna scores (see: ausrivas.canberra.edu.au/Bioassessment/Macroinvertebrates/Man/Sampling/NSW/NSW_Ausrivas_protocol_Version2_2004.pdf). The model combined areas of two CMA regions (Hawkesbury–Nepean and Sydney Metropolitan). The AUSRIVAS observed/expected (O/E) scores were scaled so the maximum possible value was 1, representing the condition when there was no observed disturbance. The scaling was achieved by subtracting the minimum possible value for that region (based on the maximum possible value of the disturbance index) from the prediction for each subcatchment and then dividing this by the full range of possible values. The scaled O/E scores were then mapped under five condition categories that represent different magnitudes of predicted loss of macroinvertebrate families compared with a relatively undisturbed reference condition (Figure 3).

1. **Very good:** loss of macroinvertebrate families was predicted to be less than five per cent and thus may be considered insignificant (O/E >0.95)
2. **Good:** loss of macroinvertebrate families was predicted to be less than 25 per cent (0.75<O/E<0.95)
3. **Moderate:** more than half of the macroinvertebrate families were predicted to be retained but over a quarter were lost (0.5<O/E<0.75)
4. **Poor:** most macroinvertebrate families were predicted to have been lost but over a quarter remain (O/E 0.25-0.5)
5. **Very poor:** three quarters or more of the macroinvertebrate families were predicted to have been lost.

An overall catchment condition score was not assessed due to insufficient recent data.

Further details on the scoring system for macroinvertebrates are listed in the technical report for riverine ecosystem condition (NOW in prep.).

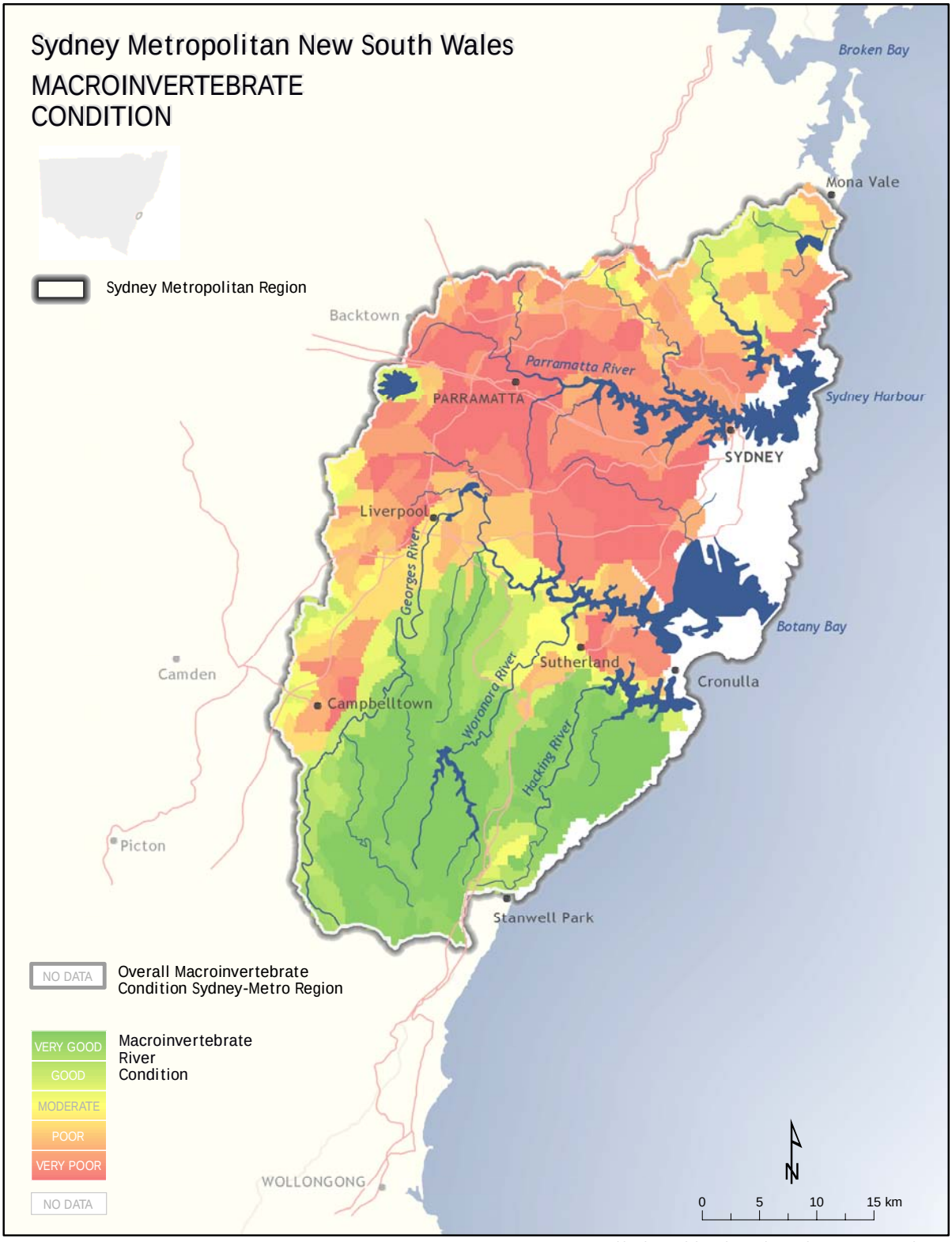
Fish assemblages

The Fish Condition Index (Figure 4) integrates indicators of 'expectedness' (the actual presence of native species relative to the species expected under reference condition) and 'nativeness' (proportion of fish population that is native rather than alien). The Pre-European Reference Condition for Fish (PERCH) scores derived for the calculation of the expectedness indicator for coastal catchments are based on existing data and a literature review, but have not yet undergone expert panel evaluation.

The site selection, sampling and analytical procedure used in coastal catchments were largely as described in the SRA report (Davies et al 2008) for inland valleys. The few minor exceptions were the addition of a fifth catchment zone in coastal valleys, called the coastal plain, which extended from 3 m to 35 m above sea level, a minimum distance of 2.5 km between sampled sites, the inclusion of randomly selected sites that fell within impoundments, and the measurement and inspection of an additional 20 random individuals per species per operation after the SRA sub-sampling requirement had been met.

Most importantly, sampling was not available for the minimum of seven sites per altitude zone, or a minimum of 18 sites per valley in coastal catchments, as required by the SRA method. However, the minimum site number requirements for coastal valleys have not yet been analysed and may differ from inland ones. Therefore, results from zones within valleys and valleys themselves should be interpreted with caution. However, at least seven sites were sampled per altitude zone per region so more confidence can be given to those data.

Data confidence	Commentary
Overall catchment condition: not assessed	There is insufficient recent data to calculate a score for these catchments.
Catchment model outcomes – medium	Assessments at many of the sites were based on AUSRIVAS O/E scores from a single sampling event that may be inadequate for representing the integrity of macroinvertebrate assemblages because of the large amount of uncertainty associated with each sample (Hose et al 2004, Gillies et al 2008). The five models developed for the coastal regions used all available macroinvertebrate assessments made between 1994 and 2008. Hence these maps represent the average condition of rivers since 1994. Disturbance indices used here (Stein et al 2002) were developed at a continental scale and do not incorporate some disturbances that are known to affect river biodiversity such as instream barriers and degradation of the riparian zone and instream environment. The hydrological component of the disturbance index was based on data that was too patchy to be incorporated into the models, so the current models do not account for the ecological degradation caused by flow regulation. The significance of the correlations underlying the regression models and the results of validation tests performed for each model suggest that the maps produced are likely to represent broad-scale patterns in the integrity of macroinvertebrate assemblages in the rivers of the five coastal regions.



Prepared by the Spatial Services Unit, March 2009, DWE Queanbeyan.

Figure 3 Macroinvertebrate condition across the Sydney Metropolitan region

Fish condition

The overall fish condition was moderate (Figure 4). Most individual catchment zones were in moderate condition, except for the Port Hacking subcatchment, which was in poor condition. Nativeness (the proportion of the fish assemblage that is native versus introduced fish) was good, but expectedness (the proportion of species collected during sampling that were expected to have occurred in each basin zone before European colonisation) was poor in all catchment zones.

Data confidence	Commentary
Low 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 ranged from low within the coastal plains zone, where there was substantial spatial variability across sites, to medium in the lowlands zone, with moderate inter-site variability, to high within the slopes zone where inter-site variability was low. Data confidence in the overall regional scale fish community rating was low because of the substantial inter-site variability in fish community condition across the region.

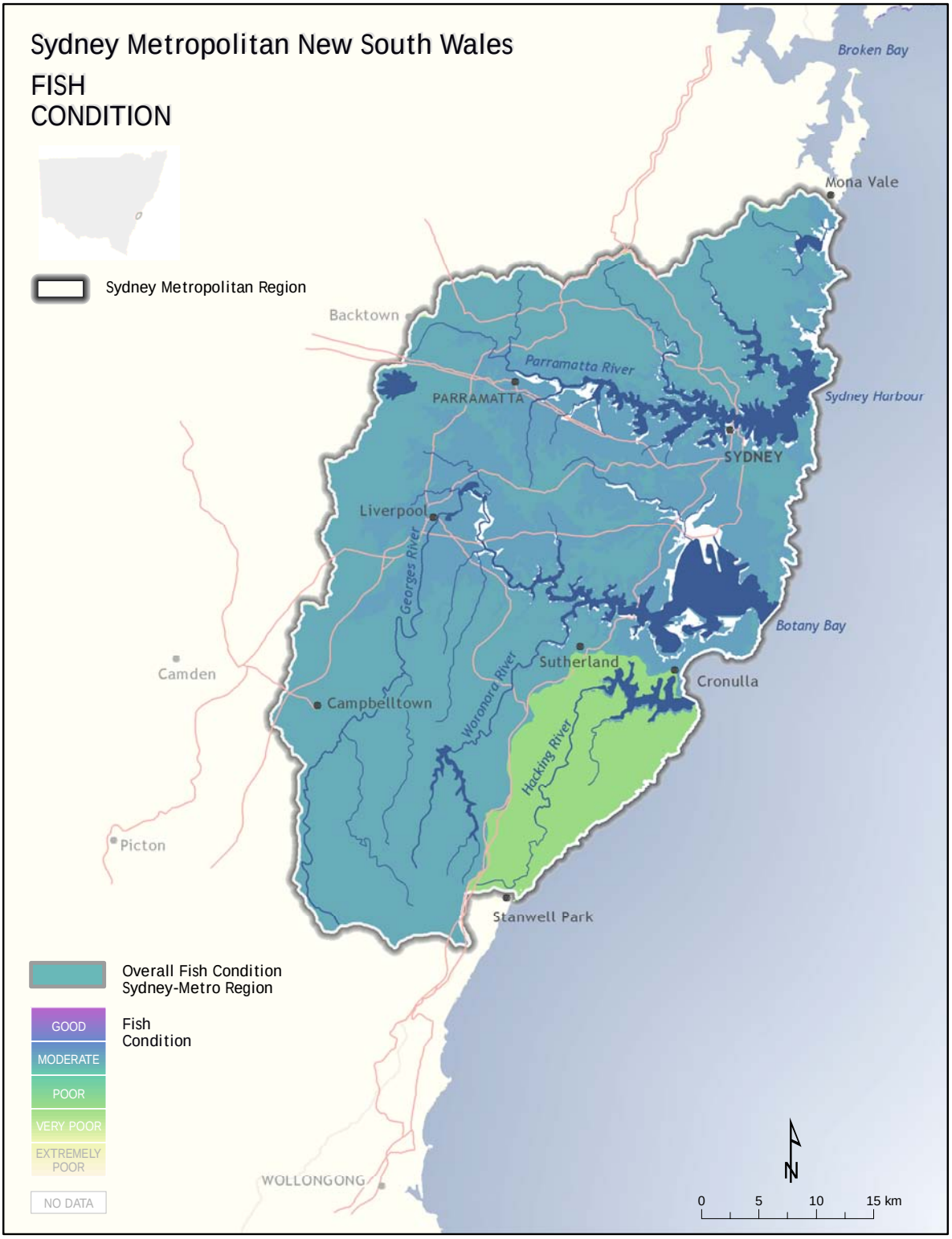


Figure 4 Fish condition across the Sydney Metropolitan region

Hydrology

No hydrology models were available. Hydrologic condition represented in the map (Figure 5) is based on the degree to which annual flows in a dry year can be affected by extraction; calculated by comparing water entitlement to annual flow in a low flow year (ie driest 10 per cent of years). In streams where instream impoundments are generally small, this indicator of hydrologic condition also reflects the extraction pressure on low flows. Increases in the frequency and duration of low flow periods have significant potential to influence riverine ecosystems.

The entitlement associated with urban water supply in the Georges River system (which has the same water supply system as the Parramatta River) is high in relation to the flow in the system in a dry year, hence the moderate hydrology condition classification. This is in contrast with the Hacking River system, which has considerably less entitlement and was classified as being in good overall hydrologic condition.

Hydrology condition

Data confidence	Commentary
Low (un-modelled catchment condition)	Condition data for many of the smaller streams included estimates of annual flows for ungauged catchments.
Low (overall region condition)	Overall condition is a combination of both modelled and un- modelled methods of assessing hydrologic condition, hence it includes estimates of annual flows for ungauged catchments.

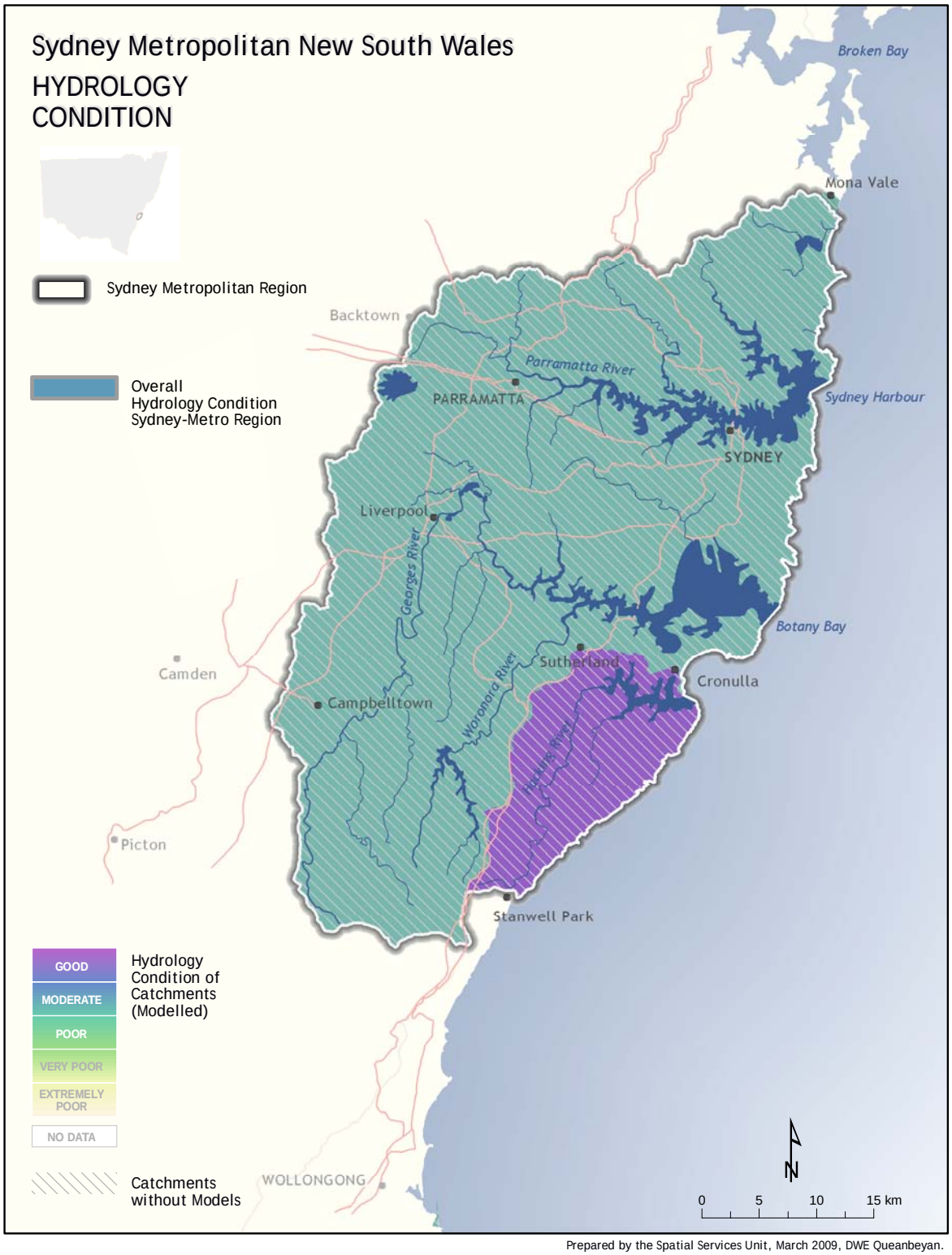


Figure 5 Hydrology condition across the Sydney Metropolitan region

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
Sydney Coast	Coastal plain	90
	Lowlands	100
	Slopes/Uplands	No Data
SMCMA Wollongong Coast	Coastal Plain/Lowlands/Slopes	100

Water management

Alteration of natural temperature patterns

There are no water storages identified as causing cold water pollution within the Sydney Metropolitan region.

Artificial barriers to fish passage

Many fish species migrate up and down rivers to breed or find alternative 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	Audley Weir	Hacking River	15
2	Hacking River Weir No. 2	Hacking River	14
3	Woollen Mill Weir	Darling Mills Creek	11
4	Wedderburn Weir	Georges River	20

Work on the Audley Weir project has stopped, so the weir is again a priority. Testers Weir, Lane Cove Weir and Wolli Creek Weir are all addressed as part of the Bringing Back the Fish project.

Alteration of natural flow patterns

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.

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 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'.

Planning

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

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 aim to make improvements in the management of NSW's water resources by providing flow patterns that are more beneficial to the river environment, particularly during low flow periods.

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 to adjust future water sharing plans to account for climate change impacts.

Specific hydrological actions for the Sydney Metropolitan region include:

- Sydney Metropolitan CMA Water Sensitive Urban Design in Sydney Program – building the commitment and capacity of local government to implement Water Sensitive Urban Design involving the Western Sydney Regional Organisation of Councils, NSW Stormwater Trust, Sydney Water Corporation, Sydney Coastal Councils Group and local government
- Sydney Metropolitan CMA Waterways Health Strategy – CMA funding for the restoration of rivers and small streams in the Sydney basin faces many challenges arising from high natural variability and the impacts of urbanisation.

Water quality

The Drinking Water Catchments Regional Environmental Plan No 1 (2006) aims to achieve water quality management goals while encouraging improved land-use practices for sustainable development, land managers and decision makers.

DOP is working with relevant government agencies and organisations to progress natural resource model clauses, including stormwater, for inclusion in the standard local environmental plan (LEP) instrument and to provide guidance on how local councils may incorporate these provisions into their new LEPs.

The following additional 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
- undertake development of regional water quality guidelines
- regularly monitor water quality at strategic locations to assess the long-term trends and changes in condition.

Fish

The Sydney Catchment Authority Hawkesbury–Nepean Weirs and Environmental Flows program is delivering works to improve environmental flows and allow fish passage below its Nepean River storages.

Regional level

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

Multiple condition/pressure actions

- a wetland hydrology study and erosion control structures will be completed adjacent to the wetland with 1 ha of wetland native vegetation enhanced/rehabilitated
- in the Cooks River Catchment, wetlands are being rehabilitated and seven stormwater control devices are being constructed
- a map of instream freshwater vegetation is being produced
- a Water Sensitive Urban Design (WSUD) in Sydney Program is being implemented across 42 LGAs
- a waterway health strategy is being implemented with 150 metres of riparian areas/reaches rehabilitated at three high priority sites
- the CMA is undertaking education programs on WSUD to increase the rate of implementation of WSUD principles and will deliver the Annual WSUD Seminar as an educational event for local and State government staff
- a study is being undertaken on the feasibility of rehabilitating the Audley Weir Pool on the Hacking River, and the future implementation of on-ground works and policies to control aquatic weeds and sediment.

Water quality

- a stormwater management plan is being developed.

Fish

- the Turella Weir Fishway is being implemented.

Local level

A number of other groups are undertaking significant work in the region that is contributing to

better outcomes for riverine ecosystems, including the following:

Multiple condition/pressure actions

- Yeramba Lagoon weir - urban catchment
- Cooks River Forum
- Cooks River Naturalisation Project.

Water quality

- Cooks River community-led stormwater planning and implementation
- Cooks River stormwater quality improvements
- community-led stormwater planning and implementation – Uswim sites, Marrickville LGA
- Streamwatch Sydney Metropolitan region
- restoration of Redfern Creek ICON project
- Freshwater Creek, Strathfield ICON project
- supporting councils to implement improved stormwater management in southern Sydney
- regional planning and implementation of improved water management (Campbelltown, Liverpool, Wollondilly)
- regional planning and implementation of improved water management (Sutherland and Bankstown)
- creek projects in the Parramatta electorate.

Further reading

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