

State of the catchments 2010

Estuaries and coastal lakes

Northern Rivers region

State Plan target

By 2015 there is an improvement in the condition of estuaries and coastal lake ecosystems.

Background

An estuary is any semi-enclosed body of water having a permanently or intermittently open connection with the ocean. Water levels inside the estuary vary in a periodic way in response to the ocean tide at the entrance. The upstream boundary is defined as the limit of tidal influence and will typically be found in the lower reaches of the creeks and rivers draining to the estuary.

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 DECCW website: www.environment.nsw.gov.au/publications/reporting.htm.

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.

Estuaries in New South Wales can be classified into five main types with decreasing oceanic influence:

- semi-enclosed embayments (six in NSW) are characterised by marine waters with little freshwater inflow
- drowned river valleys (13) have large, wide entrances and tidal ranges similar to oceans
- barrier estuaries (51) are rivers and lakes that are generally open to the ocean but are constricted at their entrances by sand from adjacent beaches. They are often associated with larger catchments, the flow from which assists in keeping the entrances open
- intermittent estuaries (110) are creeks and lagoons that become closed to the ocean for extended periods of time. They often have small catchments, hence low river flows to keep entrances open. This is the largest group of estuaries in NSW with many located along the south coast
- brackish lakes (four) are generally connected to the ocean by a long creek and hence have extended flushing times, allowing freshwater inflows to dominate.

Variation in estuary type, entrance condition, catchment characteristics and climate along the NSW coast produces estuarine ecosystems that are complex, dynamic and variable. As estuaries slowly infill, and as development further increases sediment and nutrient inputs, excessive levels of nitrogen or phosphorus in the estuary can cause algal blooms ('eutrophic' conditions) and other harmful effects that adversely impact ecosystems as well as human usage.

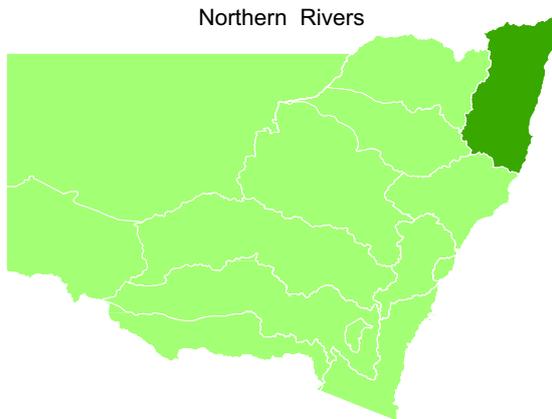
To adequately capture ecosystem complexity, a number of ecological indicators are being used to report estuary health covering eutrophication, habitat and fish.

Various pressures caused by human activity in the estuary and its catchment are also reported. The pressures were selected on the basis of the strength of their cause–effect link to condition and the feasibility of data collection or modelling along the entire coastline. Condition and pressure information combined provide valuable direction on priorities for policy, planning, investment and management.

The Northern Rivers region has 46 estuaries, or 25 per cent of the total number in NSW; 350 km² or 20 per cent of the total estuarine area in NSW; and 49,600 km² or 39 per cent of the total estuary catchment area. Of the 46 estuaries, there are 20 barrier rivers and lakes that are generally open, 23 creeks and lagoons with intermittently open entrances and three brackish water bodies.

Waterway surface areas vary widely with 25 estuaries having very small areas of less than 0.5 km² and associated catchments of generally less than 100 km². The nine largest estuaries have areas greater than 10 km² (and up to a maximum of 132 km² for the Clarence River) and catchments up to 22,000 km².

Map of the catchment



Assessment

Indicators

The indicators of estuary condition used are:

- eutrophication: chlorophyll a, macroalgae and turbidity
- habitat distribution: change in seagrass, mangrove and saltmarsh (macrophytes) extent
- fish assemblages: species diversity and composition, species abundance, nursery function and trophic integrity (food web).

Each indicator has been scored relative to a reference or least impaired condition. A number of methods have been employed to develop scoring classes on a five-colour scale of 'very good', 'good', 'fair', 'poor' and 'very poor' representing the extent of deviation from the reference condition. In the case of macrophytes, the size of change in extent observed has been scored.

Estuary index

A condition index has been calculated for each estuary by averaging the unweighted individual scores for each condition indicator and applying expert opinion to test whether the results look reasonable. A similar approach has been taken for a pressure index. Future statistical analysis is required to improve the aggregation rules currently being applied.

Owing to the limited availability of data for the condition index, additional rules have been applied to the aggregation process. At least one indicator from a minimum of two indicator groups must be populated; eg at least one eutrophication and one habitat or fish indicator. Also, if there were only one or two indicators that had data available, an overall score was not calculated.

Regional and state-wide index

A regional and a state-wide score for condition and pressure indicators have been included for comparison purposes, also using a simple unweighted approach. In recognition of the patchiness of some of the condition indicator datasets, an aggregation rule was applied whereby the regional score would only be calculated if there were more than five estuaries in the region with individual estuary scores.

Consideration must be given to whether different approaches may be more appropriate. For example, weighting scores by the estuary area to give an average by total estuary area may be a more accurate reflection of the total value of the resource to the community.

All condition and pressure indices have been scored between 5 (best) and 1 (worst) on a five-colour green-red scale, representing index scoring classes of >4.2–5.0, >3.4–4.2, >2.6–3.4, >1.8–2.6 and 1.0–1.8.

Data confidence

Systems were developed and applied for rating confidence in the data on eutrophication and fish. Seven criteria were defined for eutrophication and five for fish. However, in view of the number of data gaps in the condition report, it was decided to rate the confidence on the number of indicators for which data was available. When data was available for all seven indicators the confidence was rated high; for four to six indicators it was rated medium; and for three or fewer it was rated low. In the future, when more of the data gaps have been filled, it is proposed that an alternative system will be developed based on the confidence ratings for each individual indicator.

For the pressure indicators most of the data confidence is rated high except for the sediment and nutrient inputs which are rated medium because they have been modelled. As data is available for all indicators across all estuaries, a confidence level has been assigned on the basis of how many indicators have high, medium or low confidence. All indicators have the same datasets available, six of which are rated high and two of which are rated as medium confidence; therefore, an overall rating of high has been assigned to all estuaries. This is the type of rating system that will be applied to the condition indicators in future.

Condition

The distribution of condition scores for each indicator at estuary, regional and state levels is shown in Figure 1.

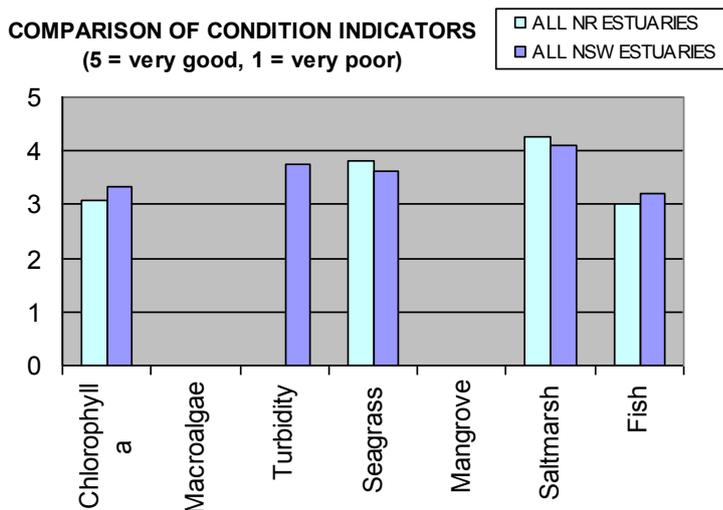


Figure 1 Condition indicator scores for Northern Rivers region (cont'd next page)

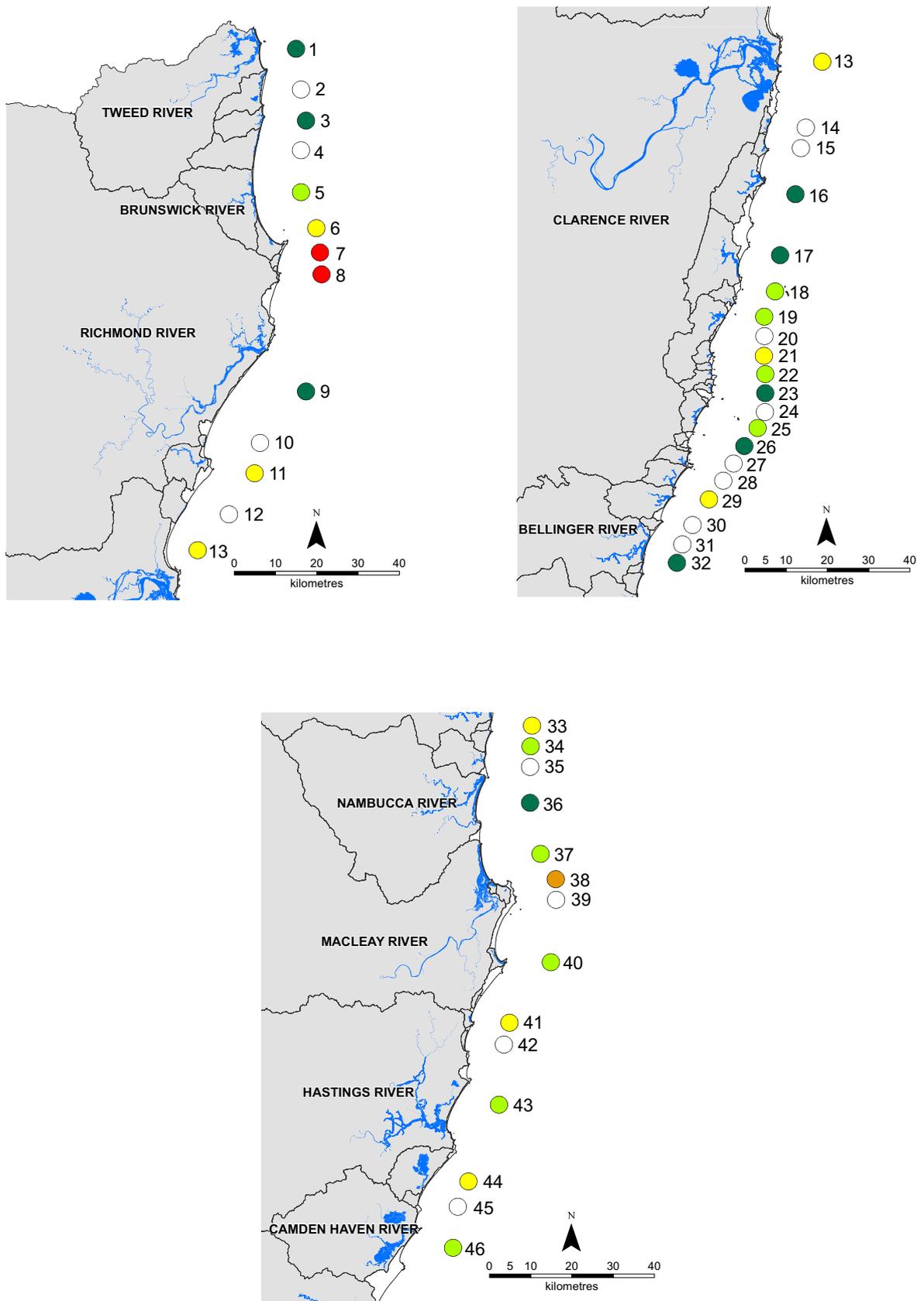


Figure 1 Condition indicator scores for Northern Rivers region (cont'd next page)

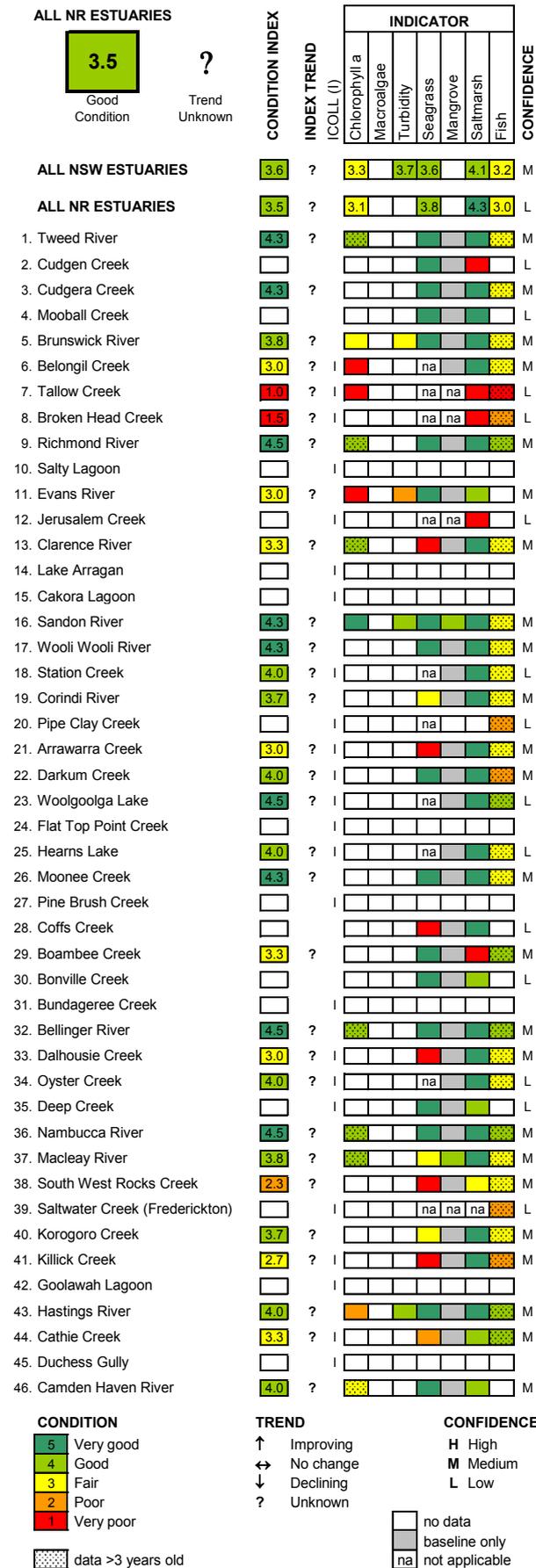


Figure 1 Condition indicator scores for Northern Rivers region (cont'd)

Note: ICOLL (I) = Intermittently Closed and Open Lake or Lagoon

Chlorophyll a indicates the amount of microscopic algae, called phytoplankton, growing in the water. Excessive input of nutrients from catchments can lead to algal blooms and detrimental effects on estuarine plants and animals. Estuaries were classified into three types according to their ability to dilute and flush catchment inputs, and trigger values were assigned for each type. Trigger values were defined as the 80th percentile of reference site data, in accordance with the recommendation of the National Water Quality Management Strategy (ANZECC & ARMCANZ 2000). Data was analysed for the period 2005–2008 and scored based on the percentage of samples complying with the triggers. If data was only available before 2005, the score in Figure 1 is shaded. The overall status for chlorophyll a in the 13 Northern Rivers estuaries with data is rated fair.

Macroalgae are large algae, commonly called seaweeds, which grow on aquatic plants and may extend to the water surface or float in the water. Macroalgal blooms can reduce oxygen levels and shade out desirable aquatic plants. They may also smother other habitats and shellfish. Residential areas can be affected by unsightly floating blooms and odours, and tourism values may be affected. The method of gathering information on macroalgae is currently being modified; therefore, Northern Rivers estuaries have not been rated.

Turbidity is a measure of light scattered by suspended particles such as sediment, algae and dissolved material in the water, which affect its colour or murkiness. Turbidity can increase from sediment inflows, shoreline erosion and increased microscopic algae. As for chlorophyll a, trigger values were defined as the 80th percentile of reference site data. In assessing estuary condition and assigning triggers, only data collected for the two years of the monitoring, evaluation and reporting program was used, due to the potential uncertainty associated with data collected using different methods and/or for special purposes (eg flood runoff). Data was only available for four estuaries; therefore no regional rating has been given.

Seagrasses are aquatic flowering plants that form meadows near shore. They are highly productive, provide nursery and foraging habitat (for fish, crustaceans and molluscs), bind sediments against erosion and help regulate nutrient cycling. They are very sensitive to changes in water clarity. Two broadly comparable surveys are available from 1985 and 2006 for estimating change in extent for seagrass, mangrove and saltmarsh. For seagrass and saltmarsh, scores were assigned as:

- >10% gain = very good
- ± 10 % gain = good
- –10 to –40% loss = fair
- –40 to –70% loss = poor
- –70 to –100% loss = very poor.

The overall status for seagrass in the 38 Northern Rivers estuaries with data is rated good but with significant variability from very good to very poor.

Mangroves grow between mid and high tide levels. They are an important food source, provide habitat, protect shorelines and cycle nutrients and carbon. The comparison of survey data showed a general increase in mangroves.

However, increasing mangrove extent could be due to a number of factors:

- recolonisation in areas previously removed, which would be viewed as a positive change
- colonisation upslope into areas currently occupied by saltmarsh, due to factors such as increased sedimentation and potentially sea level rise, which might be viewed as negative considering the limited areas of saltmarsh within NSW estuaries

- marination of estuaries (ie higher salinity levels) through entrance training, artificial entrance openings of lagoons, water extraction upstream, and lower rainfall associated with drought and climate change, providing mangroves with a competitive advantage, which could be considered negative.

With current knowledge, it is difficult to generalise about whether a change in mangrove extent is positive or negative for estuary health without conducting estuary-specific studies. The scoring system adopted therefore states that stable mangrove extent, defined as a change of between -10 to and +10%, is good. Any change outside that range has been shaded grey, indicating that change data is held but interpretation requires further investigation. The overall status for mangroves in the Northern Rivers estuaries is largely unknown, as 31 require further investigation while two, the Sandon and Macleay rivers, are rated good.

Saltmarsh is a community of plants and animals that grows above the mangroves at the highest tidal levels. Saltmarsh is important in estuarine food webs, providing a site for invertebrate breeding and a feeding area for economically important fish and shorebirds, the latter of which are subject to international agreements. Coastal saltmarsh is listed as an endangered ecological community under the *Threatened Species Conservation Act 1995*. The overall status for saltmarsh in the 37 Northern Rivers estuaries with data is rated very good.

Fish communities are a good biological indicator of ecosystem health because they occur in most estuaries, integrate the effect of multiple catchment and aquatic habitat factors, are easy to identify and are highly valued by the community. Using data on juvenile fish sampled with small beach seine nets, the overall status for fish in the 30 Northern Rivers estuaries with data is currently rated fair. Future monitoring is likely to include additional ways of sampling fish and this will enable reporting of more comprehensive fish data for some estuaries in the Northern bioregion for the next SOC report.

Missing data

The macroalgae indicator is still being trialled in a number of estuaries to determine the best method of gathering the data and will be available for future SOC reports. A significant number of estuaries did not have eutrophication or fish data available, but these may be captured during future monitoring.

Regional summary

Table 1 shows a summary of how estuaries rated for condition within the Northern Rivers region, the number and proportion of estuaries with limited data that did not warrant a condition score and those with no data at all.

Table 1 Regional summary of estuarine condition

Category	Very good	Good	Fair	Poor	Very poor	Limited data	No data	Total
No. of Northern Rivers region estuaries	9	10	8	1	2	8	8	46
% of Northern Rivers region	20%	22%	17%	2%	5%	17%	17%	100%

Pressures

A total of eight indicators of estuary pressure are reported. To enable meaningful comparison of pressures between different types of estuaries, the data often has to be 'normalised' by such factors as the area of the estuary or its catchment, or some other physical characteristic. The indicators used, the normalised metric (ie measure) and the boundaries between scoring classes from very low to very high are described below, together with the regional assessment for each indicator. The distribution of pressure scores for each indicator at estuary, regional and state levels is shown in Figure 2.

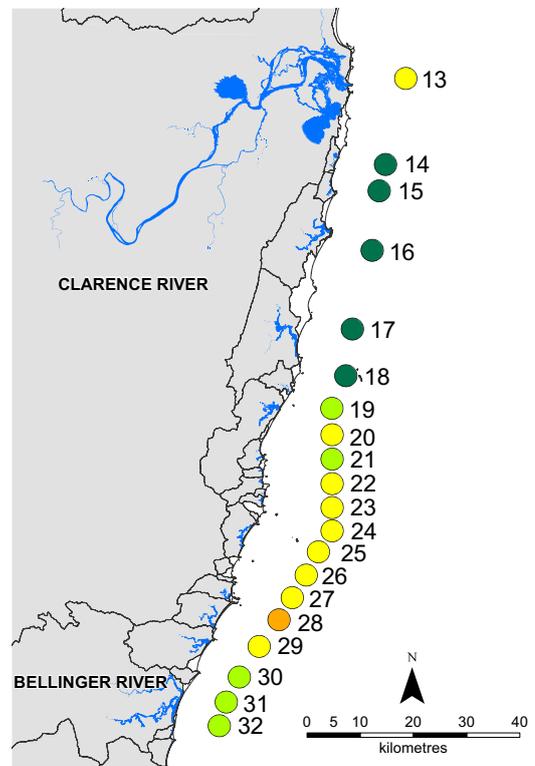
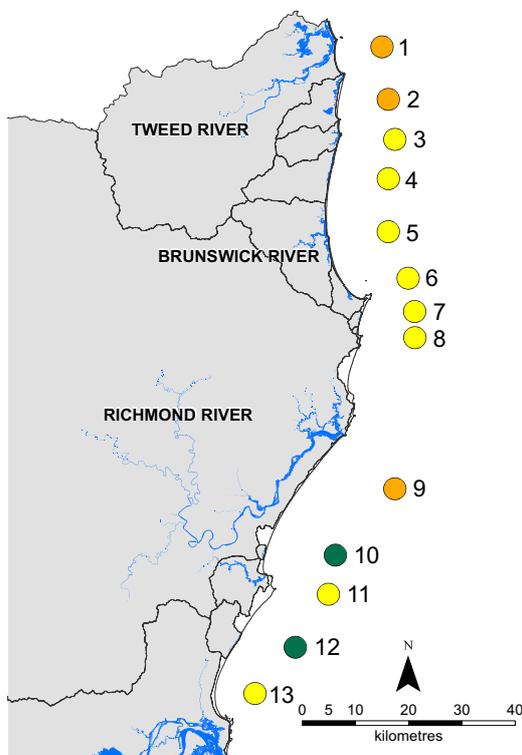
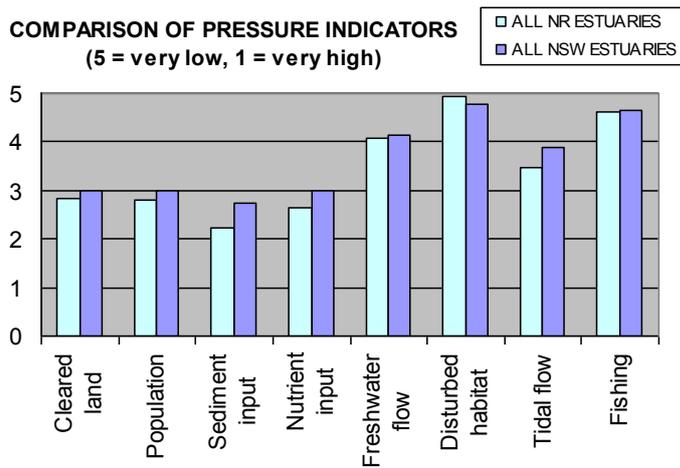
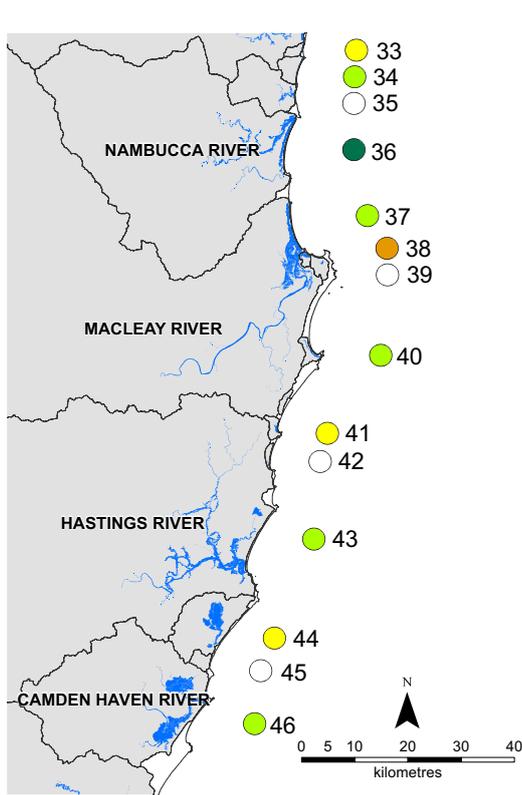


Figure 2 Pressure indicator scores for Northern Rivers region (cont'd next page)



ALL NR ESTUARIES

3.5	?
Low Pressure	Trend Unknown

ALL NSW ESTUARIES

ALL NR ESTUARIES

1. Tweed River
2. Cudgen Creek
3. Cudgera Creek
4. Mooball Creek
5. Brunswick River
6. Belongil Creek
7. Tallow Creek
8. Broken Head Creek
9. Richmond River
10. Salty Lagoon
11. Evans River
12. Jerusalem Creek
13. Clarence River
14. Lake Arragan
15. Cakora Lagoon
16. Sandon River
17. Wooli Wooli River
18. Station Creek
19. Corindi River
20. Pipe Clay Creek
21. Arrawarra Creek
22. Darkum Creek
23. Woolgoolga Lake
24. Flat Top Point Creek
25. Hearn's Lake
26. Moonee Creek
27. Pine Brush Creek
28. Coffs Creek
29. Boambee Creek
30. Bonville Creek
31. Bundageree Creek
32. Bellinger River
33. Dalhousie Creek
34. Oyster Creek
35. Deep Creek
36. Nambucca River
37. Macleay River
38. South West Rocks Creek
39. Saltwater Creek (Frederickton)
40. Korogoro Creek
41. Killick Creek
42. Goolawah Lagoon
43. Hastings River
44. Cathie Creek
45. Duchess Gully
46. Camden Haven River

PRESSURE INDEX	INDEX TREND	INDICATOR							CONFIDENCE
		Cleared land	Population	Sediment input	Nutrient input	Freshwater flow	Disturbed habitat	Tidal flow	

3.6	?	3.0	3.0	2.7	3.0	4.1	4.8	3.9	4.6	H
3.5	?	2.8	2.8	2.2	2.7	4.1	4.9	3.5	4.6	H
2.3	?									H
2.5	?									H
3.3	?									H
2.9	?									H
2.6	?									H
2.9	?									H
2.8	?									H
3.3	?									H
2.5	?									H
5.0	?									H
3.1	?									H
5.0	?									H
3.0	?									H
5.0	?									H
4.9	?									H
4.5	?									H
4.4	?									H
5.0	?									H
3.9	?									H
3.1	?									H
3.5	?									H
2.9	?									H
2.8	?									H
2.8	?									H
3.1	?									H
3.4	?									H
2.9	?									H
2.5	?									H
3.1	?									H
3.6	?									H
3.9	?									H
4.1	?									H
3.8	?									H
3.8	?									H
3.4	?									H
3.0	?									H
3.4	?									H
3.3	?									H
3.3	?									H
3.9	?									H
3.6	?									H
4.9	?									H
3.3	?									H
3.0	?									H
3.0	?									H
3.0	?									H

PRESSURE

5	Very low
4	Low
3	Moderate
2	High
1	Very high

TREND

↓	Declining
↔	No change
↑	Increasing
?	Unknown

CONFIDENCE

H	High
M	Medium
L	Low

Figure 2 Pressure indicator scores for Northern Rivers region (cont'd)

Note: ICOLL (I) = Intermittently Closed and Open Lake or Lagoon

Indicators

Cleared land for agricultural, residential and industrial development is a major pressure in many NSW coastal catchments and is known to result in increased inputs of eroded sediments, nutrients and organic material into the estuary. Using data available from land-use mapping undertaken over the last five years, the percentage of cleared land in each estuary catchment was scored into five classes with approximate boundaries of 0, 8, 22, 39, 69 and >69 per cent (see supporting technical report). Northern Rivers region estuaries are rated as being under moderate pressure from cleared land.

Population density of people residing in a catchment is a general measure of pressure placed on an estuary. Effects can include increased pollution loads in stormwater and sewage overflows, disturbance of riparian and foreshore vegetation, litter and general degradation of the environment. Population data was obtained from the 2006 census conducted by the Australian Bureau of Statistics and the density in the estuary catchment was scored into five classes with boundaries of 0, 2, 9, 41, 264 and >264 people/km². Northern Rivers region estuaries are rated as being under moderate pressure from population density.

Sediment inputs are generated by soil erosion in catchments disturbed by human activity as well as riverbank and shoreline erosion. Coarse sediment settles out along river beds, floodplains and at tributary mouths while finer suspended sediment fills bays and central basins and reduces water clarity. Hydrology models of rainfall runoff developed for each estuary catchment were used to estimate the quantity of sediment exported on an annual basis. The models were run for current land-use conditions and for a fully forested, undisturbed catchment. Percentage increase in total suspended solids (TSS) export for current land-use was scored into five classes with boundaries of 0, 10, 40, 80, 600 and >600 per cent. Northern Rivers region estuaries are rated as being under high pressure from sediment inputs.

Nutrient inputs are also associated with catchment disturbance as well as fertiliser application, effluent discharges and urban stormwater. Excess nutrients can lead to blooms of microscopic algae (phytoplankton) or macroalgae and changes to ecosystems. As for sediment inputs, the same models were used to estimate the increase in nutrient inputs. Algal growth in estuaries is generally limited by the supply of nitrogen, so total nitrogen has been used and is in accordance with the internationally accepted measure of nutrient load increase. The percentage increase in total nitrogen inputs for current land-use conditions compared with a fully forested, undisturbed catchment has been scored into five classes with boundaries of 0, 10, 50, 150, 400 and >400 per cent. Northern Rivers region estuaries are rated as being under moderate pressure from nutrient inputs.

Freshwater flow into estuaries affects salinity levels, aquatic plant distributions, migration and spawning of aquatic animals, frequency of estuary mouth openings and fish communities. These ecosystem characteristics are all modified by catchment clearing, which increases the frequency and intensity of rainfall runoff. This, in turn, causes a change to the quantity and timing of ecologically significant freshwater inflows to the estuary, catchment and river bed/bank erosion and polluted runoff. The percentage increase in catchment runoff between current land-use and a fully forested undisturbed catchment has been used as a net measure of these changes and scored into five classes with boundaries of 0, 4, 12, 22, 44 and >44 per cent increase.

Licensed water extraction entitlements have been used as a second metric and normalised by the annual freshwater inflow. The total volume of entitlements compared to the annual flow has been scored into five classes with boundaries of 0, 6, 13, 19, 25 and >25 per cent of annual flow and the two metrics then combined into a single score. Northern Rivers region estuaries are rated as being under low pressure from freshwater flows.

Disturbed habitat can arise from removal of foreshore vegetation, placement of foreshore structures such as reclamation walls, jetties and moorings, aquaculture leases, presence of the invasive seaweed *Caulerpa taxifolia* and trawling for fish. Current data on the presence of foreshore structures and aquaculture leases has been used. The length of estuary perimeter occupied by foreshore structures has been scored into five classes with boundaries of 0, 4, 8, 12, 16 and >16 per cent. The area of estuary occupied by aquaculture has been scored into five classes with boundaries of 0, 5, 10, 15, 20 and >20 per cent, and both metrics combined into a single indicator score. The validity of this indicator will improve significantly when mapping of the extent of foreshore vegetation is completed and this can also be included as a metric. Northern Rivers region estuaries are rated as being under very low pressure from disturbed habitat using this simple indicator.

Tidal flow can be affected by training walls built to keep estuary entrances open and the artificial opening of lagoon entrances for flood mitigation and other purposes. Both result in an increase in salinity levels, tidal ranges and flushing, and associated ecological effects. A score of five has been assigned to estuaries without training walls, three for one wall and one for two walls. Entrance opening levels were obtained from local government records and have been assigned increasing pressure as the artificial opening level reduces. Scores have been assigned as five for opening levels above 2.9 m AHD; four for 2.4–2.9 m; three for 1.9–2.4 m; two for 1.4–1.9 m; and one for <1.4 m Australian Height Datum (AHD). Northern Rivers region estuaries are rated as being under low pressure from changes to tidal flows.

Fishing by recreational and commercial fishers removes finfish and shellfish from the estuarine ecosystem. Disturbance of habitats by boats, gear and people can also be associated with these activities. Annual commercial fish catch data was normalised by estuary area and scored into five classes with boundaries of 0, 2, 3.9, 5.9, 7.8 and >7.8 tonnes/km²/year. Northern Rivers region estuaries are rated as being under very low pressure from commercial fishing.

Regional summary

The main pressures occur along the more developed and populated northern and central parts of the region. The trend in pressures for Northern Rivers estuaries is not yet known.

Table 2 is a summary of how estuaries rated for pressure within the Northern Rivers region and a comparison with how Northern Rivers region estuaries rated against NSW estuaries generally. Compared to the state average, the Northern Rivers region has a smaller proportion of estuaries rated in the very low and low categories and a larger proportion rated in the moderate and high categories. This is due to the higher proportion of relatively developed estuaries and their catchments found on the NSW north coast compared to elsewhere along the NSW coastline, particularly the south coast which contains more than half the estuaries in NSW.

Table 2 Regional summary of estuarine pressures

Category	Very low	Low	Moderate	High	Very high	Total
No. of Northern Rivers region estuaries	8	9	25	4	0	46
% of Northern Rivers region	17%	20%	54%	9%	0%	100%
% across all NSW	26%	26%	42%	6%	0%	100%

Management activity

Condition and pressure assessment

The condition indicators of chlorophyll a and fish assemblages have been given a fair rating for the Northern Rivers region. Both of these indicators are known to be affected by stresses from catchment development. Urban stormwater, agricultural diffuse source runoff, sewage and industrial effluent discharges contain nutrients, sediments, organic material and toxins that can increase algal blooms, contaminate sediments and alter the composition of fish assemblages. Waterway stresses such as habitat disturbance and fishing can also alter fish species composition.

The pressure indicators of cleared land, population density, sediment and nutrient inputs represent different aspects of catchment development. Sediment input rated high overall with cleared land, population density and nutrient input rated moderate, providing some confirmation of the condition indicator assessment, albeit with a limited dataset.

State and local government, catchment management authorities (CMAs), industry and the community respond to the pressures and threats posed to estuary health at a range of levels. Responses vary from state-wide policy, programs, land-use planning and economic instruments through regional planning and investment, down to local planning, capacity building, best management practice (BMP) and on-ground rehabilitation works.

State level

The State Plan embodies the natural resource management (NRM) targets set by the NSW Government. The targets are being addressed through state, regional and local partnerships. Some of the main activities at state level are listed below.

Policy/strategy

- Coastal and planning policies direct, and set the context for providing for, population growth and economic development, while at the same time protecting the natural, cultural, spiritual and heritage values of the coastal environment. Relevant policies include the NSW Coastal Policy 1997, NSW State Rivers and Estuaries Policy 1993, NSW Estuary Management Policy 1992 and NSW Diffuse Source Water Pollution Strategy 2009.

Planning

- The NSW Estuary Management Policy encourages state government, local government and communities to prepare and implement estuary management plans (EMPs) that aim to achieve integrated, balanced, responsible and ecologically sustainable use of estuaries. There are 31 plans prepared or in preparation, as shown in Table 3.
- Pressures on coastal lakes led the NSW Government to endorse a statement of intent (SOI) on coastal lakes. The SOI includes the preparation of sustainability assessments and management strategies for a group of priority lakes. A coastal lakes assessment and management tool has been developed for the assessments. Sustainability assessments have subsequently been prepared for a number of other Northern Rivers region coastal lakes, as shown in Table 3. The assessments can be used to review and update existing plans including EMPs and local government land-use plans.

Table 3 EMPs and sustainability assessments prepared for Northern Rivers region sites

EMPs	Sustainability assessments
Upper and Lower Tweed River	Terranora Broadwater (Tweed River) Cobaki Broadwater (Tweed River)
Cudgen, Cudgera and Mooball Creeks	Cudgen Lake
Brunswick River	
Belongil Creek	Belongil Creek
Lake Ainsworth	Tallow Creek
Richmond River*	
Shaws Bay	
Evans River	
Clarence River	Lake Wooloweyah (Clarence River)
Wooli Wooli River	Lake Cakora
Corindi River	
Corindi Lagoon (Pipeclay)*	
Arrawarra Creek*	
Hearns Lake	Willis Creek
Woolgoolga Lake*	Woolgoolga Lake
Coffs Creek	Coffs Creek
Bonville & Pine Creeks	Fiddamans Creek
Moonee Creek	
Boambee & Newport Creeks*	Dalhousie Creek
Bellinger/Kalang	Urunga Lagoon
Nambucca River	
Deep Creek*	Deep Creek
Swimming Creek	
Killick Creek	
Saltwater Creek	

Korogoro Creek	
Macleay River*	Back Creek (South West Rocks)
Hastings River	
Lakes Cathie/Innes	Lake Cathie/Innes
Camden-Haven	Queens Lake
Vinegar Creek	

*EMPs in preparation

Legislation

State legislation designed to reduce the pressures and threats associated with catchment development includes:

- the *Native Vegetation Act 2003* to limit land clearing
- the *Threatened Species Conservation Act 1995*, under which coastal saltmarsh is listed as an Endangered Ecological Community
- the *Water Management Act 2000* to protect environmental flows for rivers and estuaries
- the *Protection of the Environment Operations Act 1997* to licence sewage effluent discharges
- the *Fisheries Management Act 1994* to manage commercial fisheries, aquaculture, aquatic habitat disturbance and invasive species
- the *Environmental Planning and Assessment Act 1979* under which, for example, standard NRM clauses are being developed for local environmental plans (LEPs). Section 117 directions require LEP provisions to protect the environment; state environmental planning policies cover coastal wetlands, littoral rainforests, canal developments, aquaculture, urban bushland, coastal protection and rural lands.

Comprehensive Coastal Assessment Toolkit

To support local councils in developing LEPs and long-term strategies in line with the NSW coastal policy, regional strategies and other policies, orders and directions, the State Government developed the Comprehensive Coastal Assessment Toolkit. The toolkit provides datasets and decision support tools to assist in undertaking strategic land-use planning.

Regional level

The Department of Planning has prepared the Far North Coast and Mid North Coast Regional Strategies to guide sustainable growth while protecting valuable natural and cultural assets. The regional strategies:

- require coastal lake sustainability assessments to be considered when zoning land for future development
- require that LEPs maximise achievement of the principles and implementation of the recommendations of EMPs
- provide a number of mechanisms for councils to manage the risk associated with climate change.

Catchment action plans (CAPs) and supporting investment programs are the key regional documents that coordinate and drive the effort to improve natural resources. The CAPs describe the whole-of-Government approach to address each of the state-wide targets at the regional level, and specify regional targets and activities to contribute to the achievement of the state-wide targets.

The Northern Rivers CAP can be found at www.northern.cma.nsw.gov.au/region_catchment_action_plan.php.

At the regional level the Northern Rivers CMA and its partners are undertaking a number of activities in relation to the estuaries and coastal lakes theme, including:

- in addition to encouraging the preparation of EMPs by local government, the CMA is funding implementation of priority NRM actions within these plans, including control of stream bank erosion, BMP of the riparian zone, estuarine habitat management, and awareness activities targeting recreational boating impacts on seagrass and riverbanks
- preparing sustainability assessments for coastal lakes and lagoons within the region
- promoting the implementation of best practice commercial fishing gear by fishers in the estuary general fishery, by providing by-catch reduction devices
- working closely with the oyster industry and other partners to help resolve issues affecting production, and to develop projects that will improve water quality in priority locations.

Local level

Local government plays a key role in protecting the health of estuarine ecosystems through a number of mechanisms, including land-use and strategic planning, development controls and policies covering erosion and sediment control and water-sensitive urban design, provision and upgrading of reticulated sewerage systems, management of septic systems, and preparation and implementation of stormwater management plans and EMPs.

At the local level, the Northern Rivers CMA is:

- improving awareness and understanding amongst resource users and the wider community of the estuarine environment and their impacts on it, through various projects
- implementing a range of on-ground works projects across all coastal river catchments, through the soil/land resource, water, biodiversity and land-use planning CAP programs, which collectively contribute to improved land-use management and better water quality entering estuaries and coastal lakes. Acid sulfate soil amelioration, soil erosion control, dairy effluent management and riverine corridor enhancement projects make a particular contribution to the estuaries target.

Further reading

ANZECC & ARMCANZ 2000, *Australian and New Zealand guidelines for fresh and marine water quality*, National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra, [www.mincos.gov.au/publications/australian_and_new_zealand_guidelines_for_fresh_and_marine_water_quality].

Bricker SB, Clement CG, Pirhalla DE, Orlando SP & Farrow DRG 1999, *National Estuarine Eutrophication Assessment: Effects of Nutrient Enrichment in the Nation's Estuaries*, NOAA, National Ocean Service, Special Projects Office and the National Centers for Coastal Ocean Science, Silver Spring, MD: 71pp.

Harrison TD & Whitfield AK 2004, 'A multi-metric fish index to assess the environmental condition of estuaries', *Journal of Fish Biology* 65, 683-710.

Queensland Government Environmental Protection Agency 2006, *Queensland Water Quality Guidelines 2006*.

Scheltinga DM, Counihan R, Moss A, Cox M & Bennett J 2004, *Users' Guide to Estuarine, Coastal and Marine Indicators for Regional NRM Monitoring*, CRC for Coastal Zone, Estuary and Waterway Management.

US EPA 2001, *Nutrient Criteria Technical Guidance Manual: Estuarine and Coastal Marine Waters*, Office of Water, US Environmental Protection Agency, Washington DC, EPA-822-B-01-003.

US EPA 2002, *Methods for Evaluating Wetland Condition: Developing Metrics and Indexes of Biological Integrity*, Office of Water, US Environmental Protection Agency, Washington DC, EPA-822-R-02-016.

Williams RJ, West G, Morrison D & Creese RG 2006, *Estuarine Resources of New South Wales*, prepared for the Comprehensive Coastal Assessment (Department of Planning) by the NSW Department of Primary Industries, Port Stephens.

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