Natural Heritage Trust

Helping Communities Helping Australia

A Commonwealth Government Initiative

CATCHMENT, RIVER AND ESTUARY CONDITION IN AUSTRALIA

A summary of the National Land and Water Resources Audit's Australian Catchment, River and Estuary Assessment 2002

www.environment.gov.au/atlas

NATIONAL LAND AND WATER RESOURCES AUDIT

Assessing the condition and capacity of Australia's natural resources

The National Land and Water Resources Audit (Audit) is conducting the first Australia-wide assessments of :

- water availability and quality
- dryland salinity
- vegetation
- rangelands
- agricultural productivity and sustainability
- Australians in natural resource management
- landscapes, catchments, rivers and estuaries
- biodiversity

It is the first time that the Commonwealth, States and Territories have collaborated on such a broad program.

Australian Catchment, River and Estuary Assessment 2002:

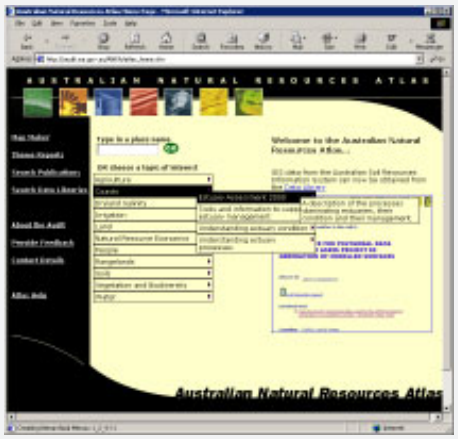
- reports on the condition of catchments, rivers and estuaries within Australia's more intensively used river basins
- presents assessment methods based on the key biophysical processes affecting catchment, river and estuary condition
- serves as an input towards improved assessment, investment and management

PROVIDING ACCESS TO INFORMATION

Australian Natural Resources Atlas

The Australian Natural Resources Atlas (Atlas) is an internet-based 'one-start-shop' for information on Australia's natural resources. The Atlas provides summary information at national, State and regional scales as well as the complete *Australian Catchment, River and Estuary Assessment 2002* report.

www.environment.gov.au/atlas

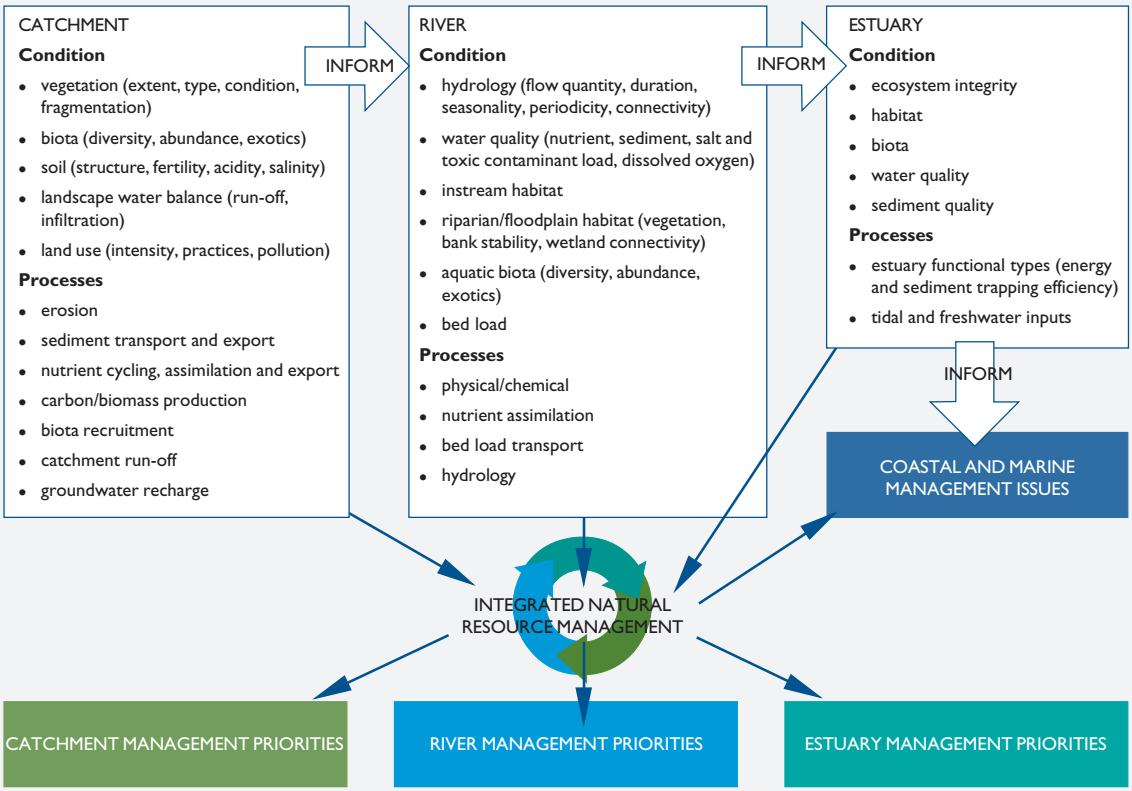


ASSESSING THE AGGREGATE IMPACT OF RESOURCE USE ON KEY NATURAL ECOSYSTEMS

Assessing the status of Australia's natural resources and the health of its ecosystems is of paramount importance for their wise use, development and management.

Benchmarks for the assessments of catchments, rivers and estuaries were based on natural conditions. These provide a basis for assessing aggregate impact and change in condition. For many extensively modified catchments, rivers and estuaries, management targets need to be defined in the context of trade-offs between natural condition, current condition and the other values provided by using these resources.

Figure 1. The Audit's catchment based integrated natural resource assessment approach.



AUSTRALIAN CATCHMENT CONDITION

What is catchment condition?

Catchment condition is ultimately a judgement that depends on biophysical attributes in the context of social and economic values. These value judgements can be made at local to regional scales. The Audit's assessment of catchment condition, defined in terms of land, water and biota components, presents a way to make comparative assessments of catchment biophysical condition. It provides an information input for catchment management decisions.

The assessment used an indicator approach and a geographic data compilation system to define patterns of relative biophysical condition. Priorities and opportunities for protective or remedial catchment management from a biophysical perspective can then be made.

Criteria were developed and applied to 110 biophysical attributes to screen for suitable condition indicators. Fourteen indicators were selected (Table 1) and used to generate a five-class condition scale from better to poorer to rank and map relative catchment condition. The result is colour-coded maps for:

- individual indicators;
- composite sub-indices for water, land and biota condition; and
- an overall composite catchment condition index.

Table 1. The 14 indicators used to assess biophysical condition.

Indicators	Related catchment management issue
Land	
2050 high dryland salinity risk/hazard	Dryland salinity and landscape water balance
Soil degradation hazard	Land-use sustainability and soil management
Hillslope erosion ratio	Soil erosion and land degradation
Water	
Suspended sediment load	Stream sedimentation, turbidity and diffuse nutrient load
Pesticide hazard	Pesticide contamination of waterways
Industrial point source hazard	Industrial pollution
Nutrient point source hazard	Nutrient point source loading of waterways
Impoundment density	Ecosystem changes associated with altered flows
Biota	
Native vegetation extent	Habitat quantity and distribution
Native vegetation fragmentation	Deterioration in native habitat function
Protected areas	Level of habitat protection
Road density	Human population and land use intensity pressures
Feral animal density	Extent feral animals have impacted on native biota
Weed density	Extent weeds have disturbed native vegetation

The assessment found that biophysical condition can be described using relatively few key attributes—change in vegetative cover, native vegetation fragmentation, inputs into rivers and streams, and changes to catchment hydrology, particularly impoundments. These attributes all relate to land use intensity.

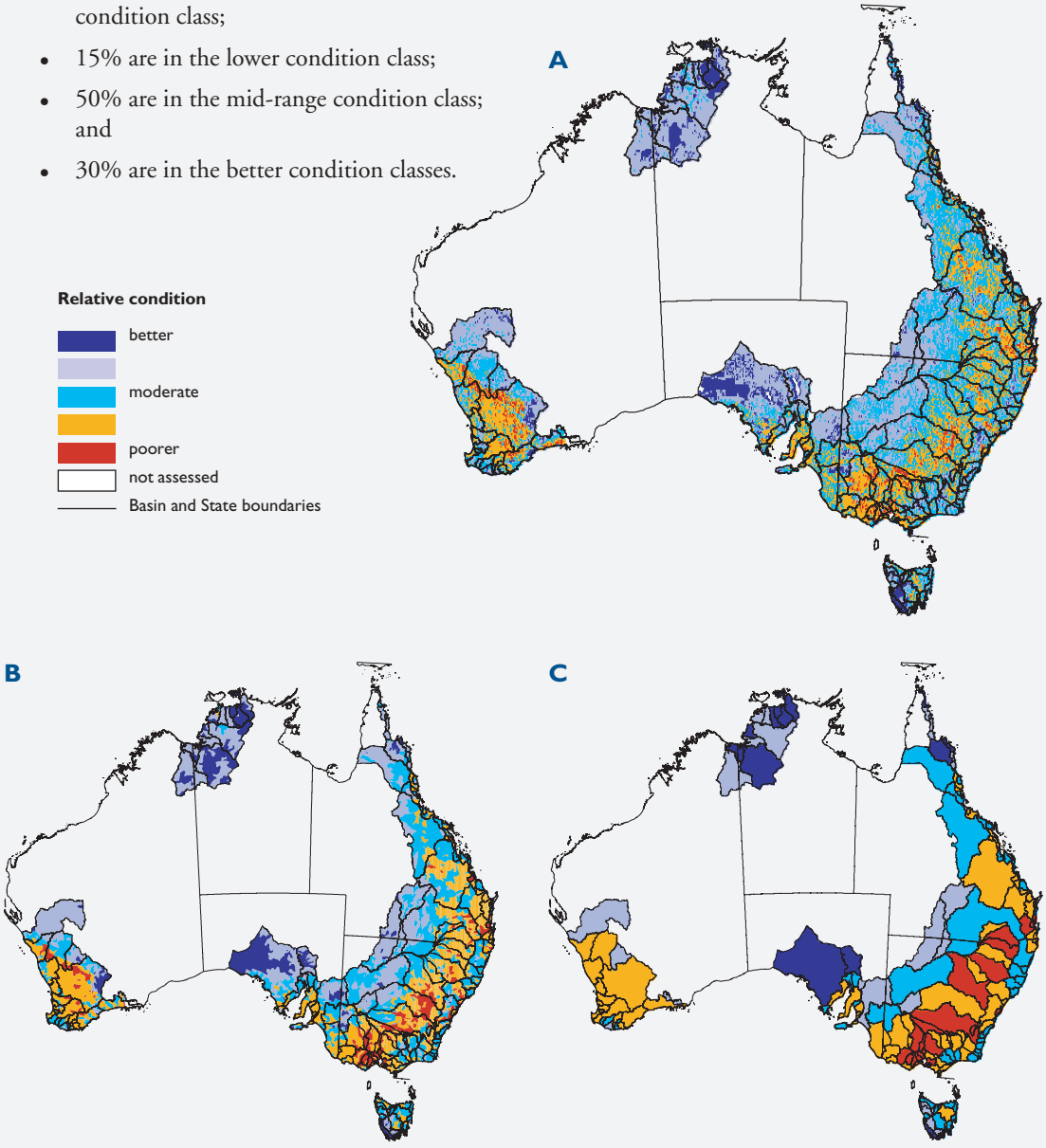
AUSTRALIAN CATCHMENT CONDITION

Key findings

The assessment provides insight into the biophysical condition of Australia's more intensively used catchments. Using the composite condition index, relatively:

- 5% of catchments are in the poorest condition class;
- 15% are in the lower condition class;
- 50% are in the mid-range condition class; and
- 30% are in the better condition classes.

Figure 2. Overall composite catchment condition defined (a) for 500 km^2 sub-catchments, (b) for 5 km grid cells and (c) for Australian Water Resources Council River Basins.



Tool for priority setting

As demonstrated by the various aggregations of the composite condition data, the patterns of condition vary according to the scale of the assessment framework. Larger comparative frameworks such as entire river basins 'smooth over' the heterogeneity of finer scale patterns of catchment condition displayed in the 5 x 5 km grid.

Using river basins as the basis for comparison and for setting Australia-wide or State/Territory target and priorities is appropriate. Comparisons between entire river basins also highlight links between catchment condition and downstream resources (water quality or estuary condition), where the total catchment acts as an integrator for downstream condition.

Finer scale assessment frameworks are required to identify priorities for investment in catchment management for a specific catchment or region and define localised areas of better or poorer condition. The 500 km^2 subcatchments and the 5 x 5 km frameworks used in this project are appropriate for these applications.

Narrowing the window of relative assessment

Comparisons of condition were made across Australia. The method also has application to smaller numbers of catchments to determine relative ranking within a State/Territory or a drainage division (e.g. catchments draining to the Great Barrier Reef or forming the Murray–Darling Basin). Narrowing the window of analysis also provides the opportunity to use finer-scale data sets that might only be available for one region or State. Finer scale data can be loaded into the decision support tool and used to provide analyses that better serve specific catchment management needs.

Condition indicators—identifying specific issues

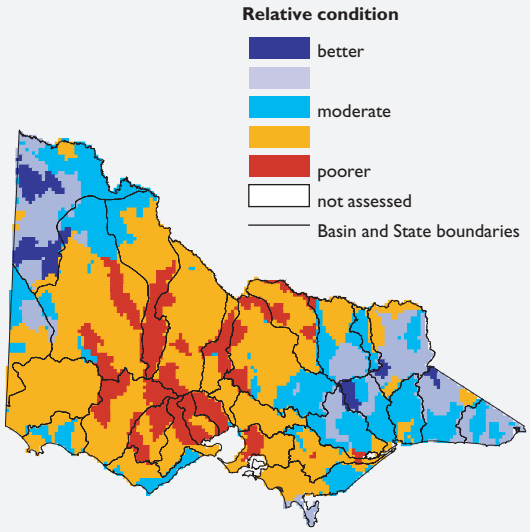
Analysis of individual indicator patterns provides a way to examine the relative importance of specific biophysical attributes or processes contributing to the condition of a catchment. Assessments using individual indicators assist in defining the priority management needs within a catchment.

Assessing how well individual indicators reflect composite patterns of condition also provides a way to identify minimum indicator sets—essential for cost-effective investment in data collection.

Further information

The Catchment Condition Online Mapping System allows users to interrogate catchment condition maps at all scales. Go to www.brs.gov.au/mapserv/catchment/index.html

Figure 3. Relative condition defined for Victorian 500 km^2 sub-catchments.



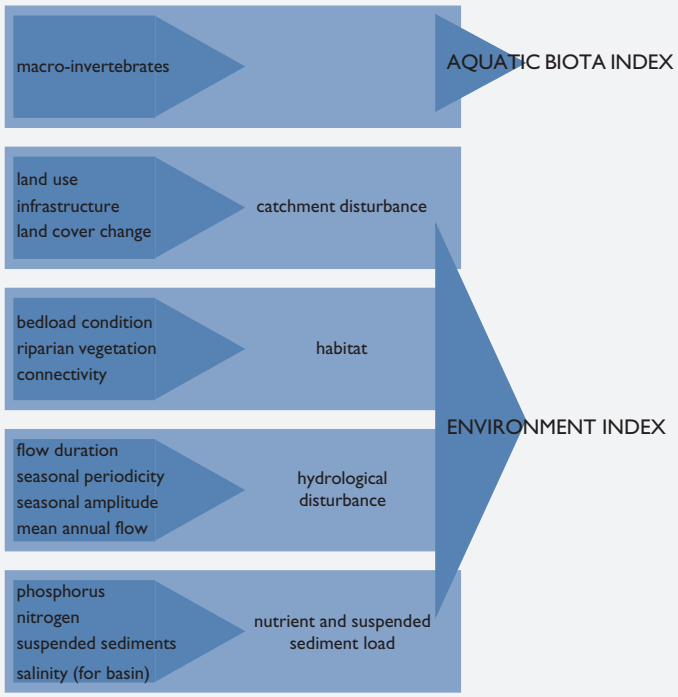
AUSTRALIAN RIVER CONDITION

Rivers provide water for agriculture, industry and domestic use. They also sustain ecosystems that provide economic, recreational, aesthetic, social and cultural benefits. The Audit assessment of Australian rivers found that they have been significantly altered by land use and that without informed and strategic management, the condition of Australia's rivers will continue to deteriorate.

The approach

The river assessment collated and interpreted data for Australia's river reaches within the more intensively used catchments. The assessment used attributes reflecting key ecological processes at the river reach and basin scales and built on other river assessment initiatives such as AusRivAS. Two condition indices were used: an *aquatic biota index* using macro-invertebrates; and an *environment index* with four sub-indices—catchment disturbance, hydrological disturbance, habitat, and nutrient and suspended sediment load.

Figure 4. River assessment indicators



Key findings

- Change in river condition was found to be most strongly linked to intensity of land use, increased nutrient and sediment loads, and loss of riparian vegetation
- Over 85% of river length assessed is classified as *modified* in environmental features
- 33% of river length assessed has *impaired* aquatic biota, with almost 25% having lost between 20% and 50% of aquatic macro-invertebrate groups
- Nutrients (mainly phosphorus) and suspended sediment loads are higher than natural loads in more than 90% of river length assessed; 33% of river length is classified as *substantially modified* with respect to nutrients and sediments for mainland Australia
- Over 80% of river length assessed is affected by *catchment disturbance* with land uses affecting delivery of sediment, nutrients and water
- more than 50% of river length assessed has *modified habitat*, mainly linked to loss of riparian vegetation
- Hydrologic change could be assessed in only 25% of river length because of limited data to allow assessment of change of hydrology from natural flows—flow regimes are *largely unmodified* in approximately 20% of the regulated river length assessed (11% of river length is regulated)

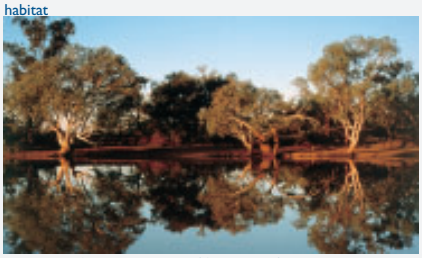
Reporting

The assessment philosophy is based on departure from reference—or pre-European settlement conditions. There were 14 606 (11 028 longer than 5 km) reaches identified in the assessment area and included in the assessment. Individual reach scores were aggregated into descriptive condition bands to simplify Australia-wide reporting.

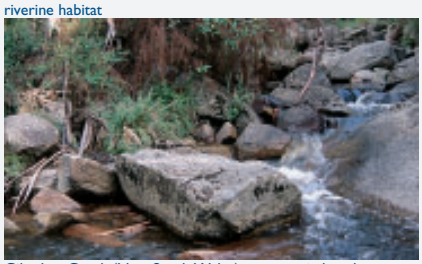
Figure 5. Reporting bands for reach condition assessments.

A stream near Goulburn (New South Wales) in extensively modified condition as a result of changes to the catchment, the riverine habitat and water quality

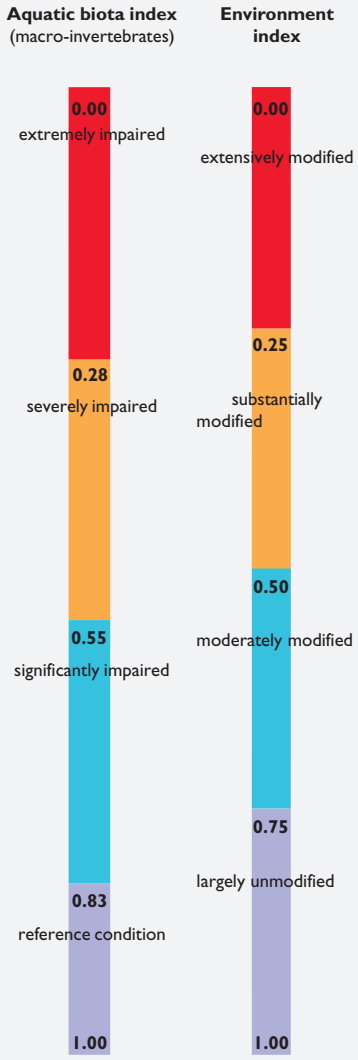
A section of the Murrumbidgee River (Australian Capital Territory) in substantially modified condition as a result of catchment disturbance and significant changes to the riverine habitat



A section of the Paroo River (Queensland) in moderately modified condition as a result of changes to the catchment and riverine habitat



Gibralter Creek (New South Wales), a stream in largely unmodified condition



AUSTRALIAN RIVER CONDITION

Condition of river environments

Increases in nutrients and suspended sediment loads, and decreases in the extent of riparian vegetation have resulted in 85% of the river length being assessed as substantially or moderately modified from natural condition.

- In the Northern Territory, two-thirds of the river length assessed is in largely unmodified condition (based on 67% of river length with data).
- In all other States and Territories except Tasmania, more than 80% of the river length assessed is substantially or moderately modified.

Figure 7. River environment index results for each State and Territory. Total length of reach (km) in each category. Percent length with data shown.

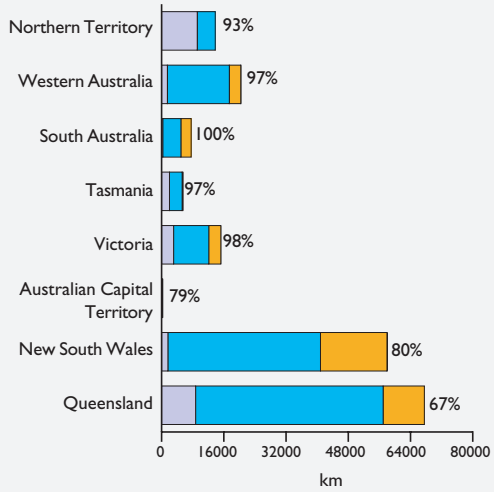
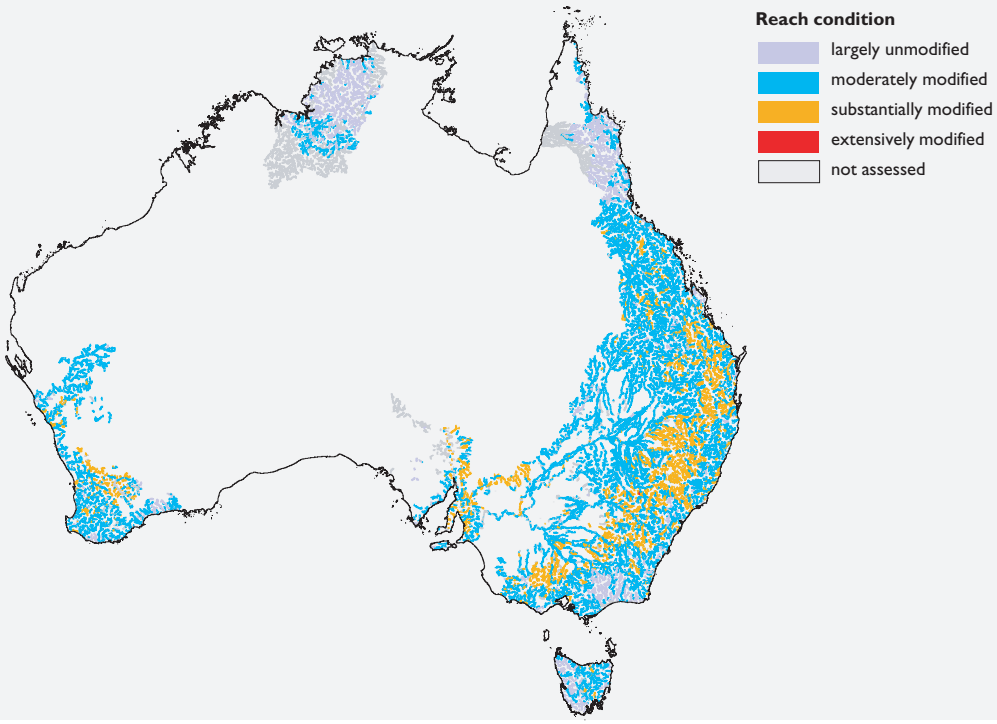


Figure 6. River condition based on the environment index.



Condition of aquatic biota

One-third (21909 km) of the river length assessed is to some degree impaired (has lost between 20% and 100% of the various kinds of aquatic invertebrates that should live there).

- New South Wales is assessed as having the poorest aquatic biota condition; approximately 50% of the river length assessed had impaired aquatic biota. Some of the most affected areas were the Georges River and Wollongong Coast basins.
- Over 35% of the river length assessed in the Australian Capital Territory and Western Australia had impaired biota.
- Between 12% and 24% of the river length assessed in the remaining States and Territories had impaired biota.

Figure 9. Aquatic biota index (macro-invertebrates) results for each State and Territory. Total length of reach (km) in each category. Percent length with data shown.

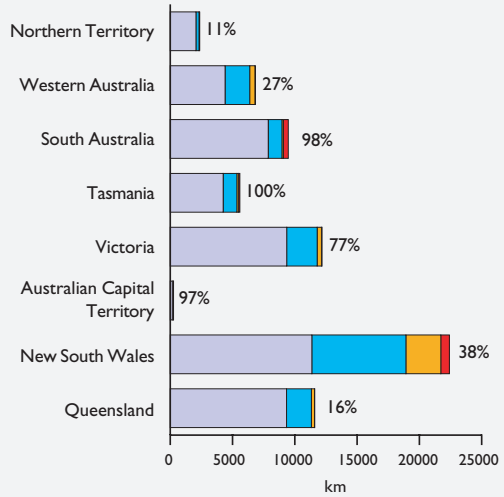
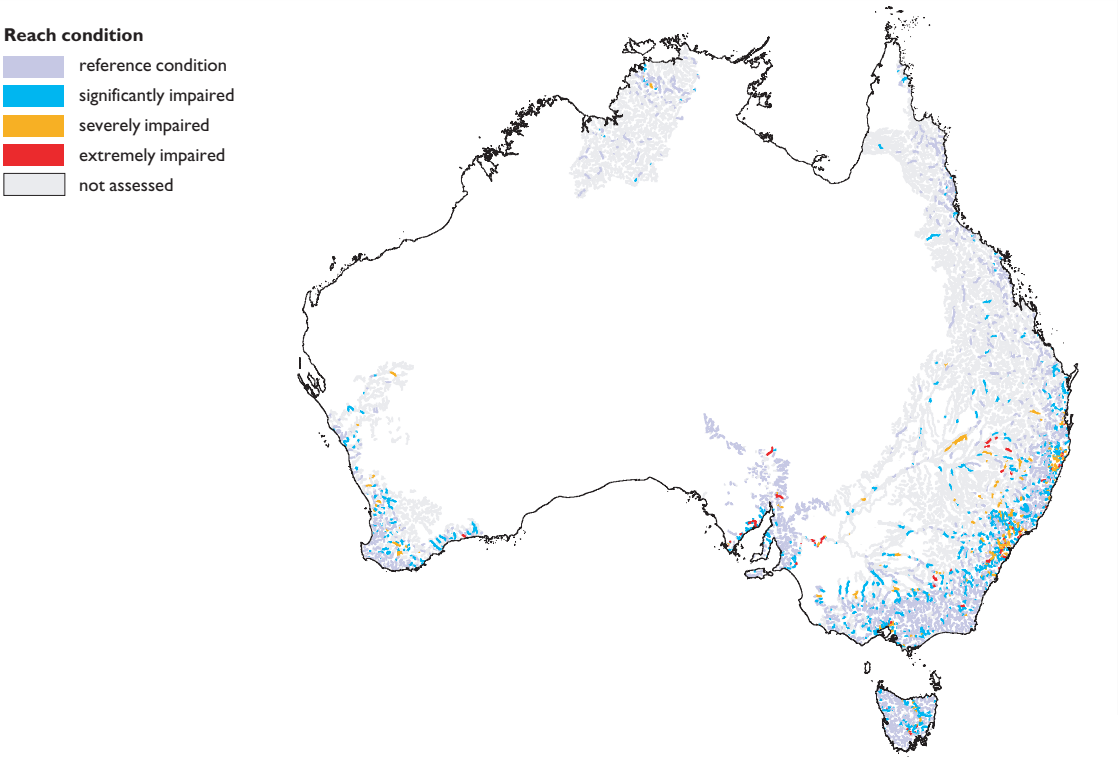


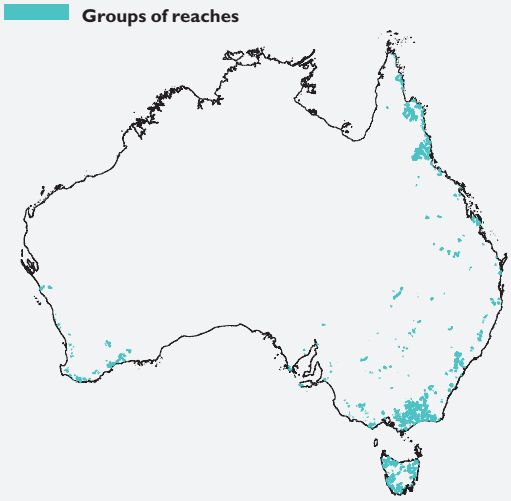
Figure 8. River condition based on the aquatic biota index.



The challenges of maintaining natural condition

River reaches that were classified *largely unmodified* in all aspects except hydrology (habitat, catchment disturbance and nutrient and suspended sediment loads) are scattered across Australia. These especially occur in far north Queensland, eastern Victoria and Tasmania. They require investment in protective management to minimise the impact of threatening processes and to ensure their condition is maintained.

Figure 10: River reaches in natural condition.



Management response

Multiple factors have caused the decline of most river reaches. Recognising the interconnected nature of many of these factors, an approach that deals with single factors is unlikely to produce maximum benefits.

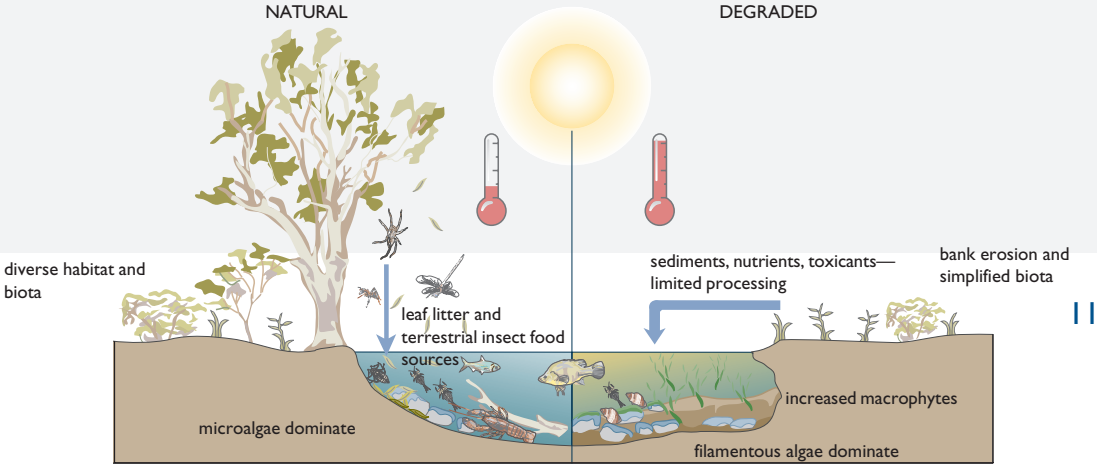
To deal with the scale and complexity of the problems facing Australia's rivers, management responses must be based on an understanding of river processes and implemented within a whole of catchment context. Reducing the impact of catchment land uses can be best achieved by industry through improvements in land use practice focusing on vegetation management and soil conservation, and conservative practices for urban development, stormwater and sewerage. This will reduce levels of sediments, nutrients and other contaminants entering rivers.

If rivers are to be managed sustainably, the crucial step for river managers is to plan strategically and implement management action in the best possible areas. Assessments such as the river assessment provide a framework for inputs into regional natural resource priority setting and regional planning.

For the rivers and wetlands themselves key integrated activities under programs such as Rivercare must be designed to include:

- protective management of good condition riparian lands and wetlands;
- revegetation of disturbed riparian lands;
- reduction in the barriers to fish passage;
- rehabilitation and re-establishment of wetlands; and
- provision of environmental flows.

Figure 11. Loss of riparian vegetation - a major driver of river degradation and a key management challenge.



AUSTRALIAN ESTUARY CONDITION

Australia has 36 700 km of coastline and over 1000 estuaries. Estuaries provide highly productive and diverse habitats for fauna and flora. They support fisheries, aquaculture, ports and recreational activities, and are dynamic systems that link catchments, rivers and inshore marine waters. Eighty-three percent of Australia's 19.4 million people live in coastal Australia. The assessment of estuaries has identified that land use impacts are compromising the ecological, economic and social values of many Australian estuaries.

The approach

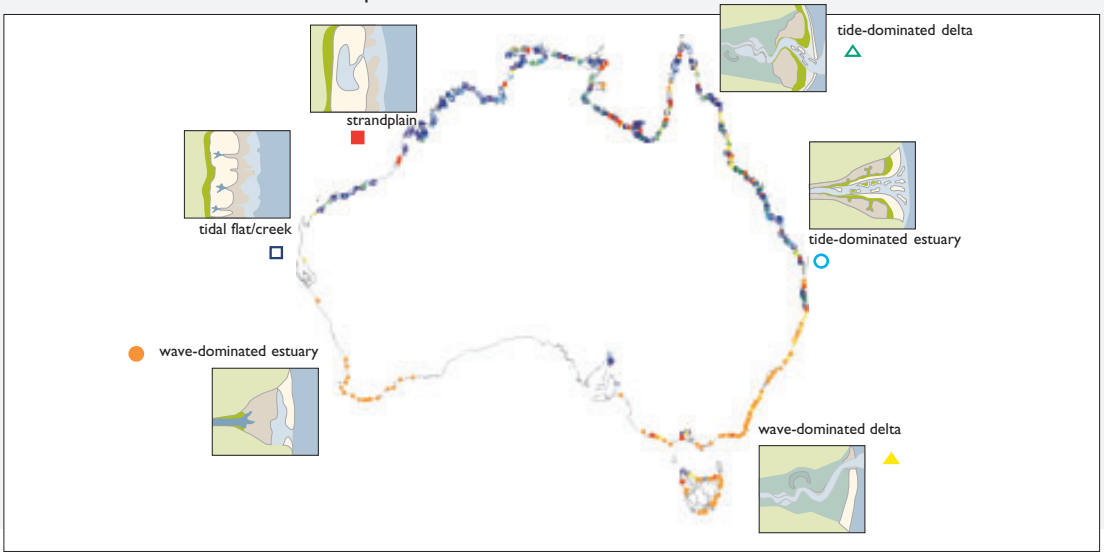
The assessment compiled readily available data and used qualitative and quantitative methods. The assessment provides detail on the condition of Australian estuaries including the amount of modification from the pristine state, drivers of change, susceptibility to further change, and key management needs.

Estuary processes

Understanding the dominant natural processes in estuaries is the basis to developing cost-effective management strategies. Australia's estuaries were classified into six classes according to relative influence of the wave, tide and river energies that shape them:

- 17% of estuaries were classified as wave-dominated estuaries;
- 11% were classified as tide-dominated estuaries;
- 10% were classified as wave-dominated deltas;
- 9% were classified as tide-dominated deltas;
- 5% were classified as strand plains, coastal lakes and lagoons; and
- 35% were classified as tidal creeks and flats.

Figure 12. Tide-dominated systems are mainly located in northern tropical Australia. Maintenance of tidal flows and minimising restrictions to tidal flows caused by bridges, causeways and barrages are a priority management concern for these systems. Wave-dominated systems are mainly located in southern temperate regions. Minimising the inputs of sediments and nutrients to these systems is essential, as is informed management of the entrance for both tidal and non-tidal phases.



AUSTRALIAN ESTUARY CONDITION

Key findings

Of the 979 estuaries and coastal waterways assessed:

- 50% are in *near-pristine* condition;
- 22% are in *largely unmodified* condition;
- 19% are in *modified* condition; and
- 9% are in *extensively modified* condition.

Figure 13. Most of Australia's near-pristine estuaries are located away from population centres. Some are found around the developed areas of Australia, often within or adjacent to managed public lands such as national parks.

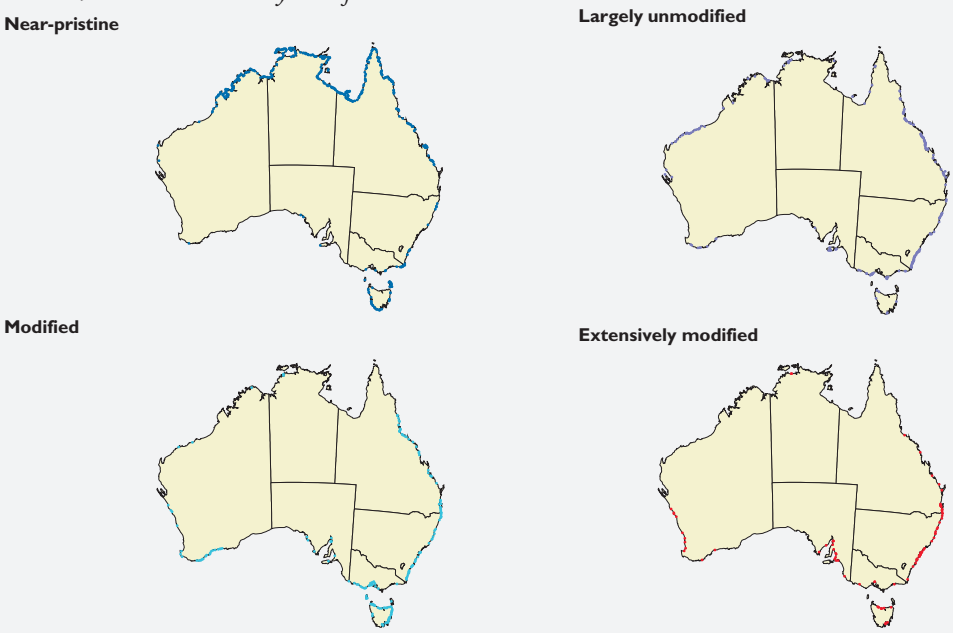
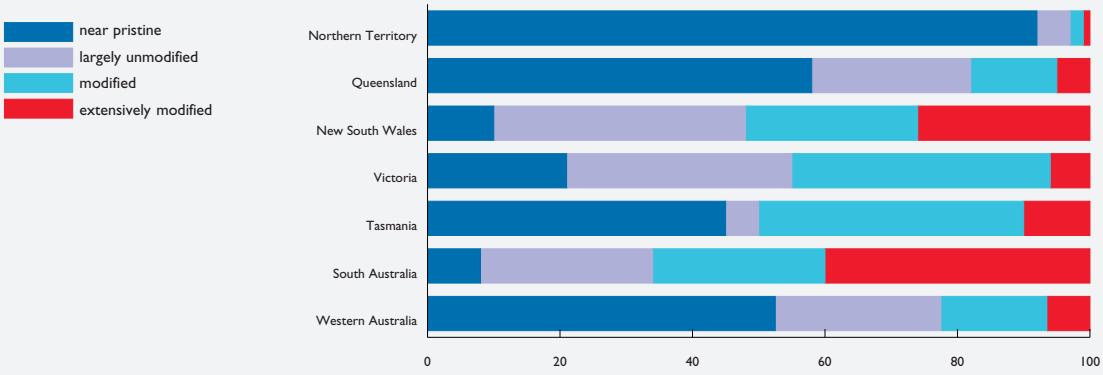


Figure 14. Condition of Australia's estuaries by State and Territory. State and Territory overviews and estuary types are available in the full report.



AUSTRALIAN ESTUARY CONDITION

Sharing information

The estuary assessment engaged agencies and groups from around Australia and has catalysed a number of estuarine specific initiatives including the establishment of a national estuary management network. A key issue for improved estuarine management is to build knowledge and understanding at all scales from community groups to senior management in government. For effective estuarine management we need to understand:

- estuarine processes;
- linkages between catchment land use and estuary condition;
- implications of management decisions within catchments or estuaries;
- priority management investments; and
- complexities and variation within the Australian landscape.

A series of products were commissioned by the Audit to enhance our collective understanding of the concepts and imperatives for improved estuarine management. These include:

- conceptual models that link catchment and estuarine use, estuarine ecology and estuary condition;
- a simple estuarine response model <www.marine.csiro.au/serm/> to test the likely change in estuary condition that would accompany an increase or decrease in inputs such as nutrients; and
- the OzEstuaries Database <www.ga.gov.au/oracle/ozestuaries>.

These tools will assist estuarine managers to identify issues, assess management options, develop monitoring programs and establish priorities for works and investment.

Management challenges

The key challenges facing estuarine managers include:

- establishing and maintaining protective management strategies for near-pristine estuaries;
- working to achieve estuarine management targets within natural resource planning processes;
- implementing a clearer delineation of institutional and lead agency responsibilities for estuarine management at a State and national level;
- developing an Australia-wide coastal policy and management initiative that builds on the strong industry and community commitment for improved estuarine management; and
- continuing to provide information, training and support to assist local government planning and estuarine management staff.

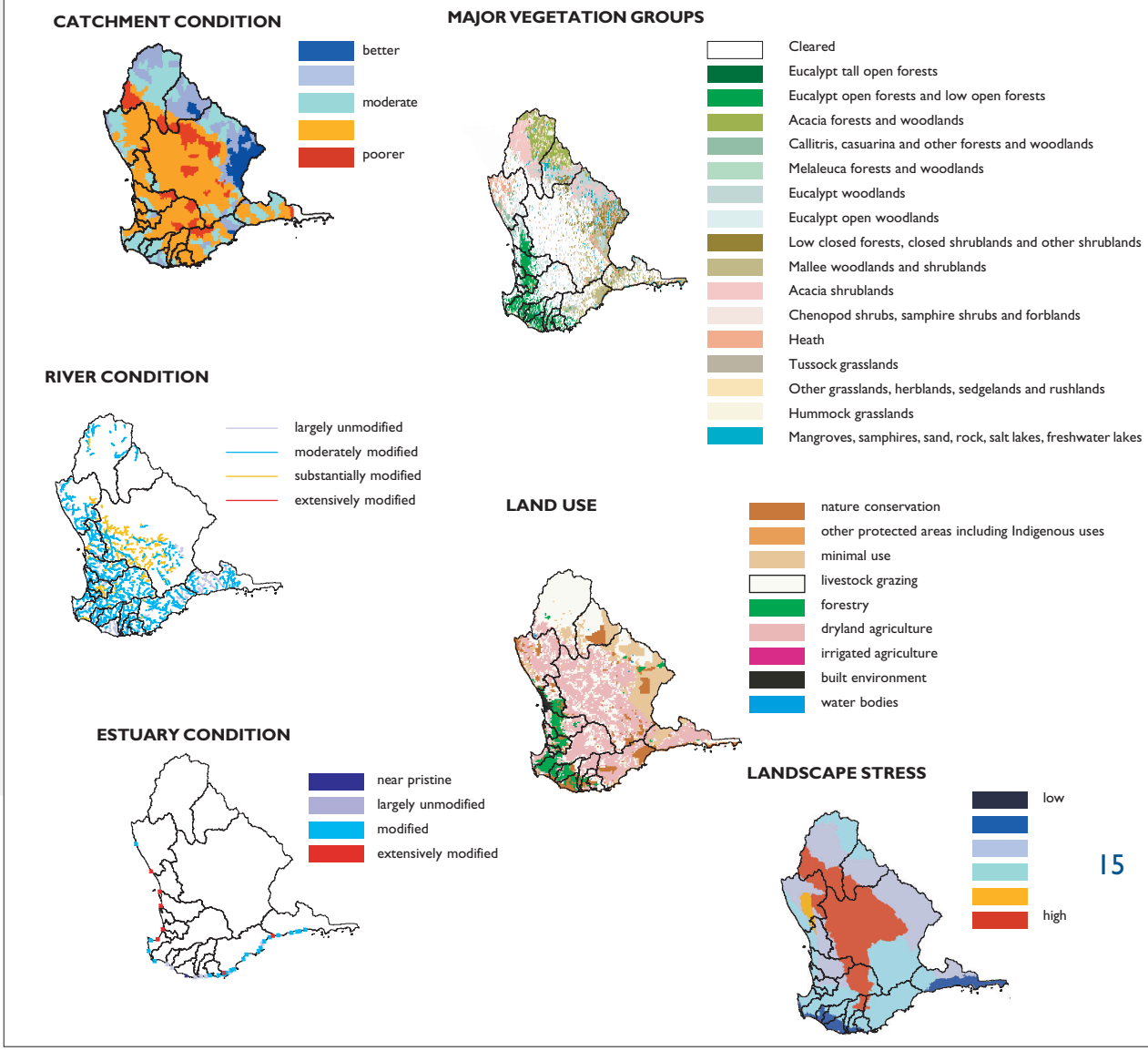
NATURAL RESOURCE CONDITION IN AUSTRALIA'S DRAINAGE DIVISIONS

Natural resource management strategies need to identify interactions between different resource management issues and deal with development opportunities and degradation issues systemically. Use of an integrated catchment management framework for tackling natural resource issues has been promoted for many years, most recently by the Commonwealth as part of its National Action Plan for Salinity and Water Quality.

Natural resource assessments compiled by the Audit provide an unprecedented opportunity to examine the regional patterns of ecosystem condition and the key investment opportunities for improved management. Audit findings within Australia's drainage divisions:

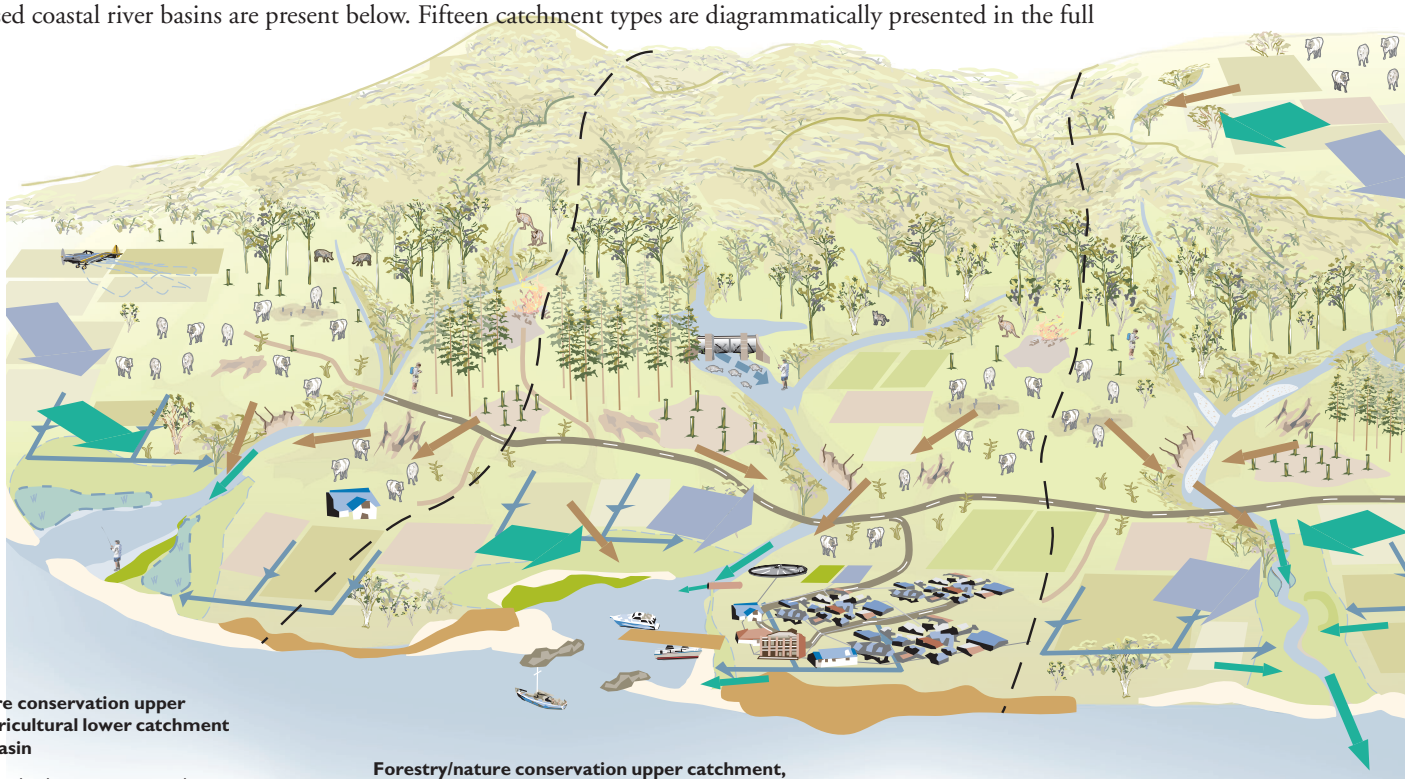
- identify climatic, geographic and resource use drivers of catchment, river and estuary condition;
- define the relative importance of these drivers;
- examine relationships between patterns of resource use and the condition of catchments, rivers and estuaries; and
- suggest regionally specific, integrated natural resource management challenges.

Figure 15. Audit assessments of land use, vegetation, landscape stress, and catchment, river and estuary condition for the South West Drainage Division.



ECOSYSTEM CONDITION DRIVERS

The suite of catchment based drivers of ecosystem condition operating in any particular river basin is dependent upon its climate, geography and the pattern and intensity of land use. Examples of land use patterns in Australia's more intensively used coastal river basins are present below. Fifteen catchment types are diagrammatically presented in the full report.



Forestry/nature conservation upper catchment, agricultural lower catchment coastal river basin

- Low intensity land use in upper catchment areas help maintain catchment-scale processes and good ecosystem condition.
- Ecosystem condition drivers, mainly associated with more intensive land use of lower catchment area, include clearing, total grazing pressure, increased sediment and diffuse nutrient loads, changed run-off and floodplain hydrology, chemical use, weeds, feral animals, and fire regime change.
- Examples in southern and eastern Australia (e.g. Bega River, New South Wales; Huon River, Tasmania).

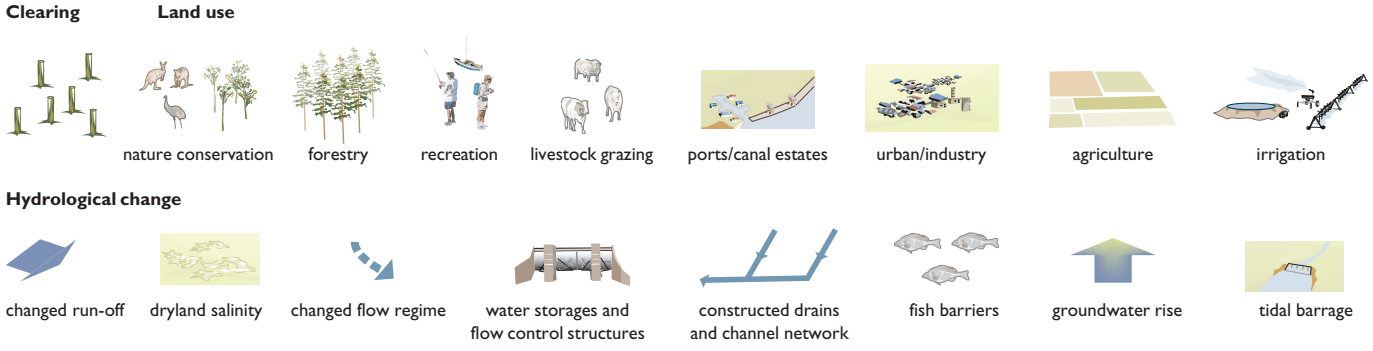
Forestry/nature conservation upper catchment, agricultural mid and built environment lower catchment coastal river basin

- Low intensity land use in upper catchment areas help maintain catchment-scale processes and good ecosystem condition.
- Ecosystem condition drivers—mainly associated with more intensive land uses of middle and lower catchment area—include clearing, total grazing pressure, changed run-off and floodplain hydrology, altered flow regimes, increased sediment and diffuse nutrient loads, point source nutrient and pollutant loads, fish passage barriers, chemical use, intensive recreational use, weeds, feral animals, and fire regime change.
- Where these river basins drain to wave-dominated estuaries with high sediment trapping efficiency and poor tidal exchange, there is significant potential for impacts on estuary condition.
- Many examples in southern Australia (e.g. Yarra River, Victoria; Hawkesbury River, New South Wales).

Agriculture/grazing tablelands forestry/ nature conservation mid catchment and agriculture/built environment lower catchment river basin

- Low intensity land use areas in mid catchment—potentially affected by ecosystem condition drivers operating in upper catchment.
- Ecosystem condition drivers—mainly associated with more intensive land uses of upper and lower catchment area—include clearing, total grazing pressure, changed run-off and floodplain hydrology, increased sediment and diffuse nutrient loads, chemical use, weeds, feral animals, fire regime change.
- Many examples in southern and eastern Australia (e.g. Macleay River, New South Wales; Johnstone River, Queensland).

Figure 16. Land use patterns within coastal river basins with higher intensity use.



Mixed dryland agriculture/grazing coastal river basin

- Relatively intensive land use pattern throughout basin.
- Ecosystem condition drivers include clearing, total grazing pressure, changed run-off and floodplain/groundwater hydrology, dryland salinity, increased sediment and diffuse nutrient loads, chemical use, weeds, feral animals, and fire regime change.
- Where these river basins drain to wave-dominated estuaries with high sediment trapping efficiency and poor tidal exchange, there is significant potential for impacts on estuary condition.
- Many examples in southern Australia (e.g. Avon River, Western Australia; Gawler River, South Australia; Hopkins River, Victoria).

Mixed agriculture/grazing upper catchment and built environment lower catchment coastal river basin

- Relatively intensive land use pattern throughout basin with built environment in lower catchment.
- Ecosystem condition drivers include clearing, total grazing pressure, increased sediment and diffuse nutrient loads, changed run-off and floodplain/groundwater hydrology, dryland salinity, altered river and tidal flow regime, fish passage barriers, chemical use, weeds, feral animals, fire regime change, point source nutrient and pollutant loading, and intensive estuary use.
- Where these river basins drain to wave-dominated estuaries with high sediment trapping efficiency and low tidal exchange, there is significant potential for impacts on estuary condition.
- Many examples in southern Australia (e.g. Swan Coast Basin, Western Australia; Torrens River, South Australia; Maribyrnong River, Victoria).

Erosion and sedimentation processes

hillslope soil erosion

gully erosion

riverbank erosion

sediment source

river sedimentation

bare ground

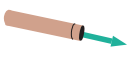
Chemical use

Fire regime

Nutrient sources and loads

diffuse nutrient

increased basin



point nutrient

sewage treatment plant

Feral animals and weeds

weeds

Feral animals

WAYS FORWARD

The Audit assessment of Australia's catchments, rivers and estuaries reveals that much remains to be done to target our investment activities and improve the condition of catchments, rivers and estuaries.

Key challenges

- **Land use**. We need to continually improve land use patterns and practices, with attention to soil erosion, nutrient balance, dryland salinity, vegetation and pasture management, water resource sustainability and water use efficiency.
- **Institutional and policy needs**. We need to seek a balance between public and private benefits and costs, especially for key public resources—rivers and estuaries—and develop more integrated approaches to natural resource management.
- **Information provision**. We need to ensure data collection, monitoring and assessment are cost-effective and provide information that supports management decisions and track progress in management programs.

With continued commitment to sustainability, Australia's productive and ecologically diverse landscapes will continue to provide the goods and services the community demands.

ACCESS TO INFORMATION

Australian Natural Resources Atlas

The interactive web-based Atlas presents Audit products at scales from local to regional to Australia-wide.

www.environment.gov.au/atlas

IN PARTNERSHIP

Catchment, River and Estuary Condition in Australia was prepared by the National Land and Water Resources Audit in partnership with State, Territory and Commonwealth natural resource management agencies and research and development organisations.

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