Managing River Health for Social, Economic and Environmental Outcomes – An Australian Case Study

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Abstract
Rivers make up only a small part of the Australian landscape and yet their importance for the economy, ecology and community is immense.

Australian cities and towns are built around rivers and estuaries. Rivers provide vital water for homes, farms, industry and businesses and are a major drawcard for recreation and tourism. For many, rivers have a special place in their memories and are deeply associated with their 'sense of place' and 'belonging'.

Rivers are also important ecosystems. They support a large number of native flora and fauna and provide a range of services that are only now starting to be recognised and valued accordingly.

Virtually all community services provided by rivers rely on the environmental condition of the river. Where the health of a river declines, so does its capacity to provide the services we value.

The Victorian Government has recognised the dependence of our economy and quality of life on the health of our rivers and has made a major commitment to achieving healthy rivers, which meet the environmental, economic, recreational and cultural needs of current and future generations through the Victorian River Health Strategy.

Wimmera Catchment Management Authority (CMA), in its role as caretaker of river health in the Wimmera, is committed to protecting high value rivers and maintaining the rest through the Wimmera Waterway Health Strategy. The Strategy brings together the knowledge and aspirations of the community and provides a vision for the future of the region's rivers and wetlands, guiding management activities through the challenges of the next five years.

Wimmera CMA's vision is 'waterways for life'.

The Wimmera River, a heritage river, is the largest river in Victoria that does not flow to the ocean. The river and its tributaries flow from mountain ranges in the south-east to the terminal Lakes Hindmarsh and Albacutya.

Lake Hindmarsh is Victoria's largest freshwater wetland and Lake Albacutya is a Ramsar wetland of international significance. However, changes in land and water use over many decades mean Lakes Hindmarsh and Albacutya are now frequently dry.

The Wimmera River is highly stressed and suffers from erosion, salinity, weed and rabbit infestations and greatly reduced natural flows.

This paper presents an overview of river health management in the Wimmera (Victoria, Australia), the policies, frameworks and challenges facing the community and agencies in balancing community perspectives with achieving river health outcomes into the future.

1. Introduction

Like most countries, river management in Australia has undergone a radical re-invention over the past few decades. Where in the past rivers were used as drains and rubbish dumps those same rivers are now prize real estate, with water front views highly sought after.

As a society, Australian's are now recognising that rivers have immense importance for their contribution to the economy, ecology and communities of Australia. This importance has been further emphasised by the ongoing significant drought experienced by most of Australia over the past seven to ten years.

Rivers provide vital water for homes, towns, farms and businesses and are a major drawcard for recreation and tourism. For many in our communities, rivers also have a special place in their memories and are deeply associated with their 'sense of place' and 'belonging'.

Our rivers are also highly significant ecosystems in their own right. They support a large number of native plant and animal species (many of which are endangered or threatened) and provide a range of ecosystem services (e.g. purification of water by natural catchments) that are only now becoming recognised and valued (DSE, 2006a).

Virtually all ecosystem services provided by rivers rely on those rivers to be in good environmental condition. Where the health of a river declines, so does its capacity to provide the services we value as a society (DSE, 2006a). While some of the losses are able to be measured in economic terms. Others such as community anger, loss of amenity or an endangered species are not.

In Victoria, a south-eastern state of Australia, the Government has recognised the dependence of our economy and quality of life on the health of rivers and has made a major commitment to achieving healthy rivers, which meet the environmental, economic, recreational and cultural needs of current and future generations through the Victorian River Health Strategy.

In a further step, the Victorian Government, in 2004, outlined its agenda for achieving sustainable water management through its Our Water Our Future Action Plan. The plan represents one of the most innovative, integrated water strategies in Australia and indeed the world (DSE, 2006a). Key initiatives include:

- Identifying regional Catchment Management Authorities as the caretakers of river health; and
- Establishing Environmental Water Reserves (environmental flows) for rivers.

In central western Victoria, Wimmera Catchment Management Authority (CMA) is the caretaker of river health for the Wimmera River.

The Wimmera River is the largest river in Victoria that does not flow to an ocean. The River and its tributaries flow from Mt Cole and Pyrenees Ranges in the south-east and the Grampians in the south to terminal lakes including Lakes Hindmarsh and Albacutya.

Lake Albacutya is listed as a wetland of international significance under the Ramsar convention on wetlands. However, changes in land and water use over many decades mean the terminal lakes are now more frequently dry.

Unfortunately, these waterways are under threat from reduced flows, sedimentation and erosion, invasion by pest plants and animals and declining water quality. Gully and land erosion occurs extensively throughout the catchment, particularly in the upper catchment, and is contributing significant sediment to waterways. The associated decline in water quality is further exacerbated by grazing pressure on the bed and banks of waterways. Changes in flow regimes and increasing sedimentation are leading to significant changes in aquatic vegetation growth and, combined with a history of snag removal, are having a significant impact on aquatic habitats.

Wimmera CMA has recently endorsed a strategic plan for our rivers, lakes and wetlands. The Wimmera Waterway Health Strategy provides the strategic framework to assist the community and agencies to protect and enhance the waterways of the region.

This paper outlines the strategic framework for river health management in Victoria, Australia, its application at a regional scale, the key achievements to date and future challenges to be overcome.

2. Victoria and the Wimmera

Hugging the tip of the Australian east coast, Victoria is Australia's second-smallest state, covering 227,600 square kilometres - roughly the size of the British Isles (Figure 1) (Tourism Victoria, 2007).

Victoria has 1,800 km of coastline and is 2.6 percent of the total area of Australia (Norris, *et. al.*, 2001). The Great Dividing Range is a key feature of the state, running east west across the State, and rising to nearly 2,000 metres in the east.

Hundreds of rivers flow through inland Victoria. From Alpine streams in the north-east to lowland floodplain rivers in the west. Victoria is home to significant rivers and lakes, the most significant being the mighty Murray River, Victoria's northern border.

The Murray River, one of the world's longest navigable rivers, stretches 2,700 kilometres from the mountains of the Great Dividing Range in north-eastern Victoria to near Adelaide in South Australia (Tourism Victoria, 2007). It varies from a small mountain stream in its upper reaches to a wide meandering river lined with magnificent river red gum trees and sandy beaches in its lower reaches, finally empting into the Indian Ocean.

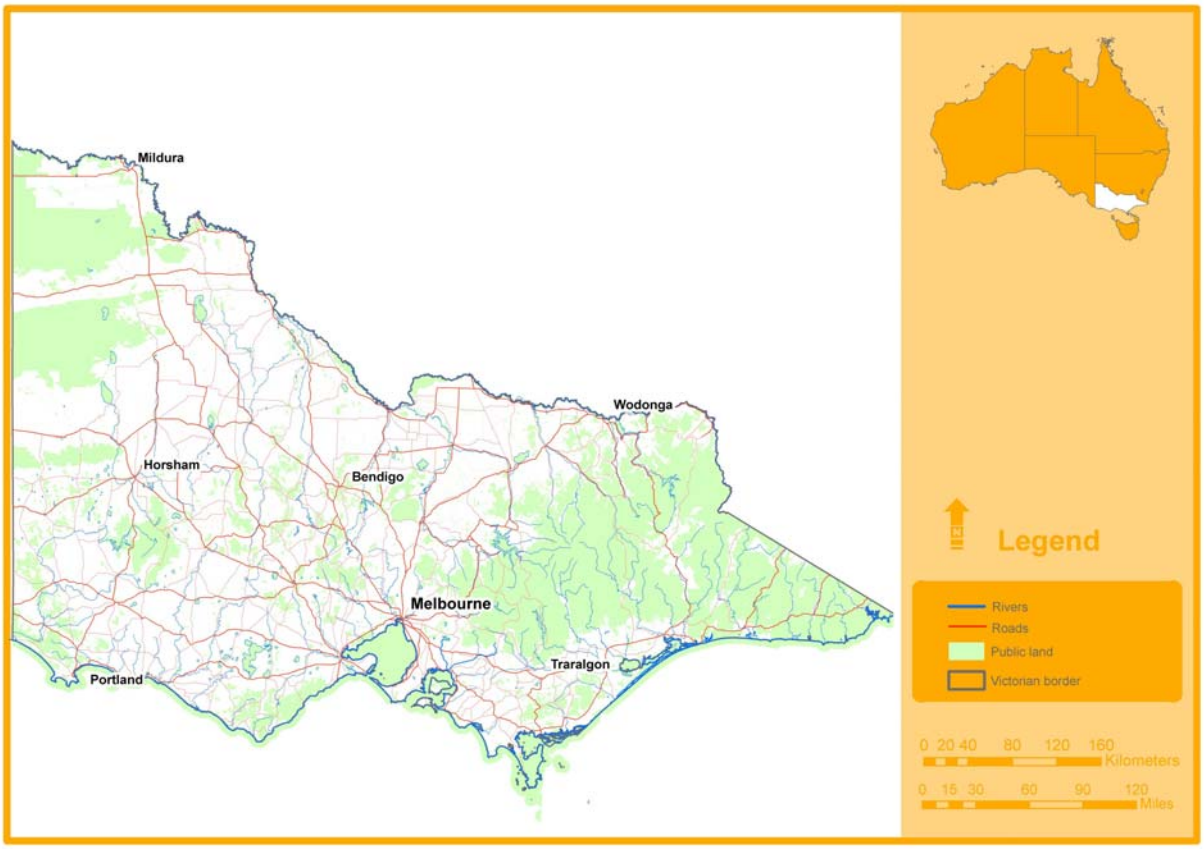

Figure 1. Map of Australia and Victoria.

The Wimmera Region encompasses 23,500 square kilometres of western Victoria, extending from the Grampians in the south to Lake Albacutya in the north and from the South Australian state border in the west to the Pyrenees ranges in the east (Figure 2) (WCMA, 2003). It is a diverse Region; with mountains, plains and desert, moist foothill forest, box ironbark forest, woodlands, grasslands, and mallee heath. Annual rainfall varies from up to 1000 mm in the Grampians, to as low as 300 mm in the northern plains.

The Region covers 10.3 per cent of Victoria's total area and incorporates 7 Local Governments. The Region supports a diverse range of significant natural environments and human activities including dryland and irrigated agriculture, tourism and recreation.

The Wimmera River is the Region's largest river and the largest endoreic river in Victoria. The river rises on the north-western slopes of Mount Buangor and terminates in Lakes Hindmarsh (Victoria's largest freshwater wetland) and Albacutya (a Ramsar listed wetland).

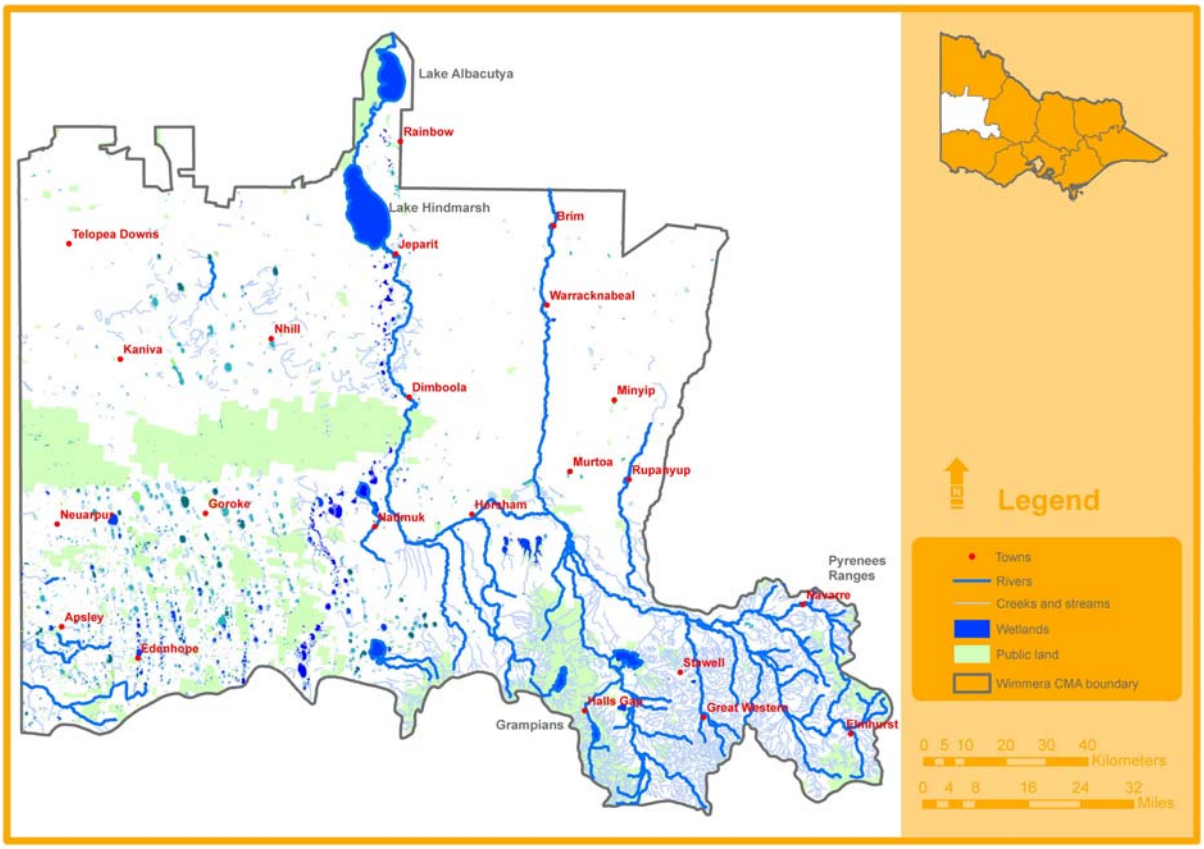

Figure 2. Map of Wimmera Region in Central Western Victoria.

3. Rivers – Our Natural Assets

3.1 Why do Rivers Matter?

Healthy rivers support the native fish, animals, and plants that depend on them. They supply water that sustains our industries, towns, homes and recreational activities.

The best science indicates that healthy rivers (DSE, 2007):

- Move carbon (the product of decomposition of material buried or lying on the floodplain) between the river floodplain and wetlands;
- Have healthy river bank vegetation, which stabilises banks and slows erosion;
- Contain native fish that move easily up river to the floodplain to feed and breed;
- Provide freshwater and food for estuarine and marine fish and shellfish;
- Provide flows of sufficient depths and duration for waterbirds to build nests, breed, and raise chicks to fledging age;
- Replenish groundwater stores and dilute salty water left in wetlands and billabongs after dry periods;
- Have a diversity of habitats supporting a mix of plants and animals;
- Provide floodplain vegetation as food for native animals; and
- Replenish the floodplains by depositing soil and nutrients.

Healthy rivers also provide (DSE, 2007):

- A healthier environment in which to live, relax, swim and work;
- Good water quality for stock and domestic needs, and for irrigators and other users;
- An attractive and enjoyable destination for relaxation and sport;
- Investment opportunities for environmentally-based tourism;
- Recreational and commercial fishing opportunities;
- Natural processes for breaking down sewage and agricultural runoff; and
- Reduced need for pesticides in crops by supporting insect-eating waterbirds

3.2 What is the Current Environmental Condition of Victorian Rivers?

In 2001, the Commonwealth Scientific and Industrial Research Organisation's Land and Water division and Cooperative Research Centre for Freshwater Ecology scientists completed an audit of the ecological condition of Australian rivers. Norris, et. al.(2001) found that for the assessed river length:

- Approximately 80% was modified; 59% moderately and 20% substantially. This degradation was attributed to catchment disturbance, changes to the hydrological regime and to water quality;
- Approximately 90% had disturbed catchments, the majority of this attributable to land use activities;
- More than 40% showed hydrological disturbance, with 16% severely modified;
- Approximately 50% of the riverine physical habitat had been altered, resulting in changes to connectivity, riparian vegetation and bedload condition;
- More than 60% had severely modified riparian vegetation, indicating that there is very little riparian vegetation left along these sections of river; and
- Approximately 70% of rivers in Victoria had altered water quality with elevated loads of suspended solids (65% river length assessed) and total phosphorus (65%).

The environmental condition of Victorian Rivers is assessed on a five-yearly basis through a tool called the Index of Stream Condition (ISC). Five key components of river health are assessed by the tool. These components, or sub-indices, measure changes in hydrology, water quality, streamside zone (vegetation), physical form (bed and bank condition and instream habitat) and aquatic life (DSE, 2005).

In 2004, 21% of major rivers and tributaries assessed using ISC were in good or excellent condition, 47% were in moderate condition and 32% were in poor or very poor condition (Figures 3 and 4). When compared to the 1999 results, it was noted that there has not been any general improvement in condition, but importantly, overall deterioration in stream condition appeared to have stabilised (DSE, 2005). At a state-wide level, river health had remained basically the same, with basins in the east of the State generally in better condition than those in the mid and west regions (DSE, 2005).

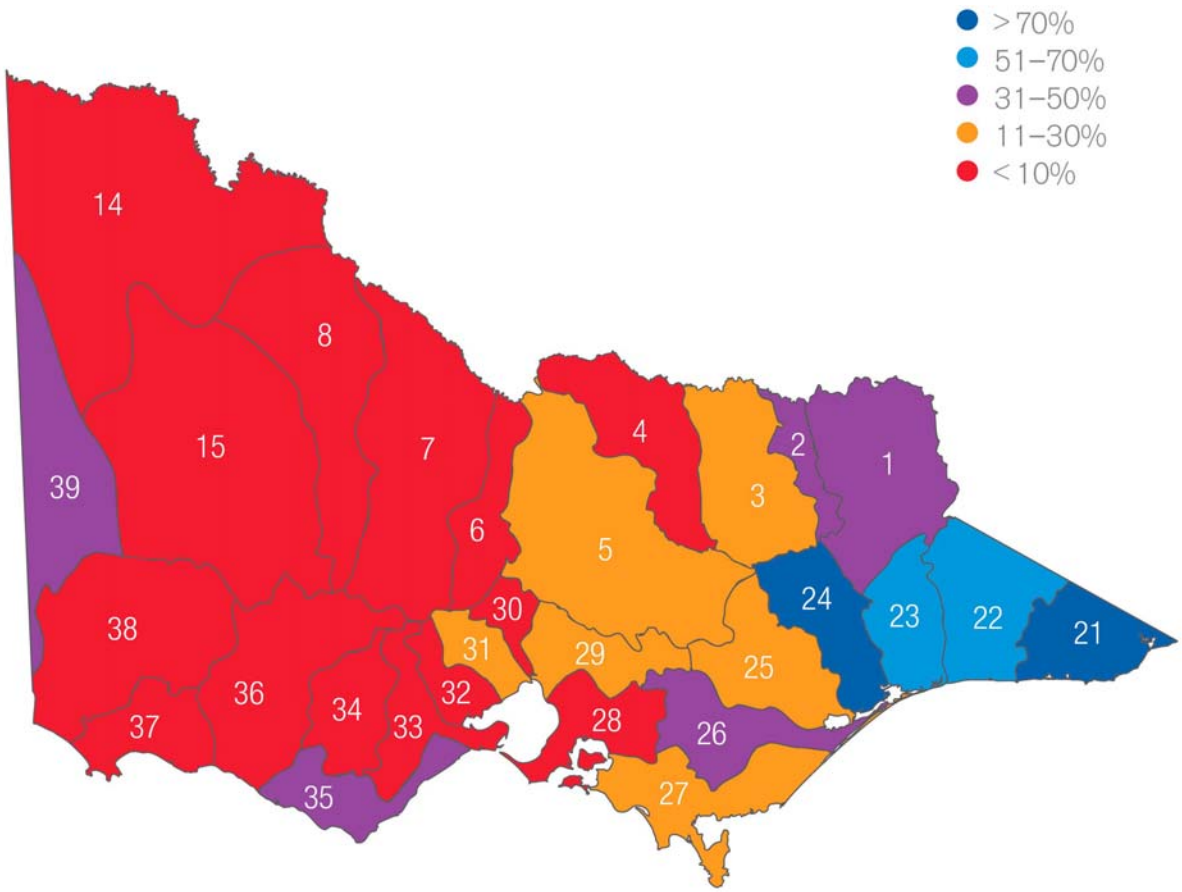

Figure 3. Victorian River Condition in 2004 (Colour indicates percentage length of major rivers and tributaries in each river basin in good or excellent condition).

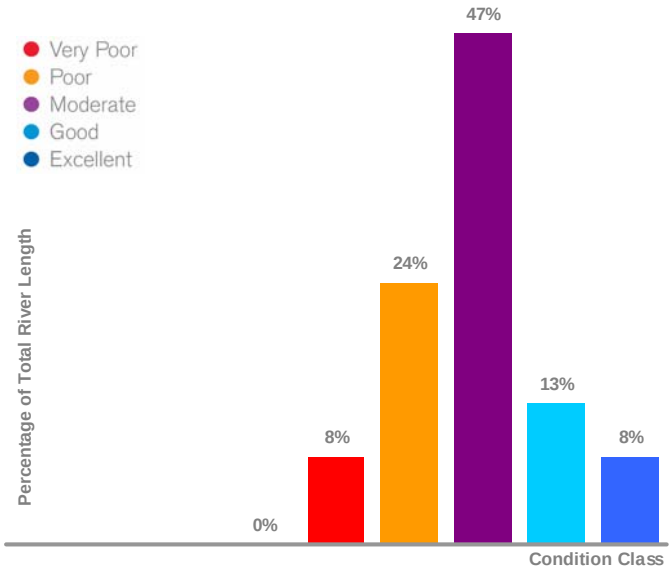

Figure 4. Breakdown of Victorian Rivers by Environmental Condition.

At a regional level, the condition of the Wimmera rivers is variable (Figures 5 and 6), with over half of the assessed length of rivers in the region being in a 'moderate' condition (875

km) with the remainder mainly being classified in ‘good’ (148 km) and ‘poor’ (266 km) condition, as well as smaller lengths in ‘excellent’ (27 km) and ‘very poor’ (25 km) condition.

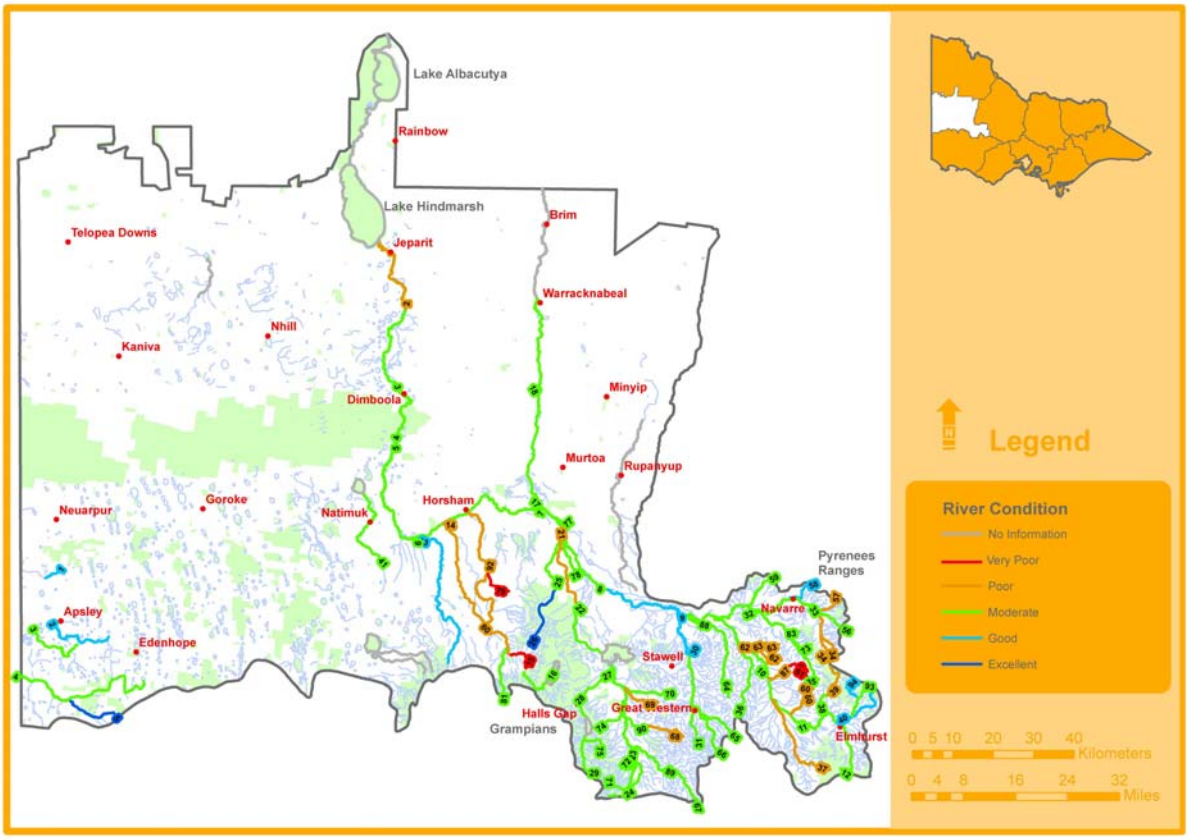

Figure 5. Environmental Condition of Wimmera Rivers in 2004.

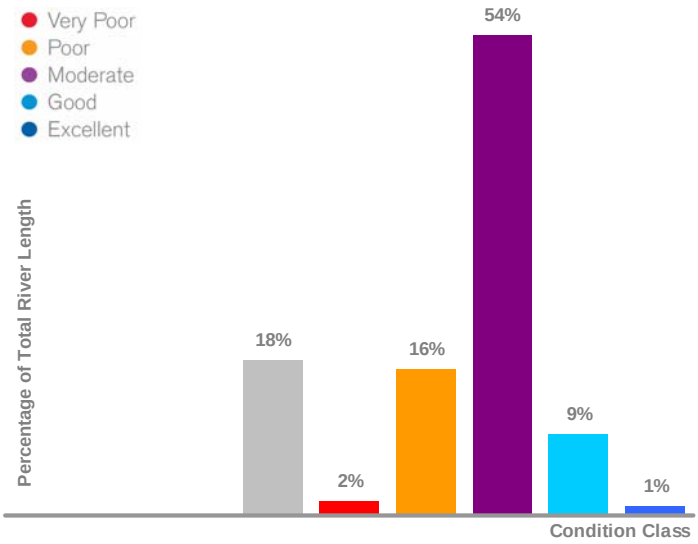

Figure 6. Breakdown of Wimmera Rivers by Environmental Condition.

Victoria's Strategic Framework for River Health

4.1 State-wide Framework

Improving the health of Victorian rivers will only be achieved by addressing environmental flows, declining water quality and degraded riverine habitats in an integrated way (DSE, 2004).

Victoria's medium term goal is to significantly improve the health of Victoria's rivers, floodplains and estuaries by 2011. Specific targets include:

- Significant improvements achieved in environmental flow regimes of 20 high value river reaches currently flow stressed;
- 4800 kilometres of rivers with an improvement in riparian condition;
- An additional 7000 ha of riparian areas under management agreements;
- 600 kilometres of rivers where in-stream habitat has been reinstated; and
- 1000 high value public assets protected.

The state-wide framework for achieving Victoria's vision and these targets is the Victorian River Health Strategy released in 2002.

The Victorian River Health Strategy (www.dse.vic.gov.au)outlines the approach that Government, in partnership with the community, will use to make decisions on managing and restoring Victoria's rivers. It provides:

- A common vision for managing rivers in Victoria;
- State-wide targets for river restoration;
- A planning framework which:
  - is based on community decision-making within an integrated catchment management context,
  - balances environmental, economic and social needs,
  - integrates the management of all activities impacting on rivers, and
  - is based on the best available scientific understanding of river functioning and is responsive to new knowledge.
- Criteria for priority-setting for investment in river protection and restoration;
- An overview of Government policy relating to management of activities affecting river health, including environmental water releases and water allocation; and
- The institutional arrangements for managing river health in Victoria.

The policy approach for achieving Victoria's vision is:

- Protecting the rivers that are of highest community value from any decline in condition;
- Maintaining the condition of ecologically healthy rivers;
- Achieving an 'overall improvement' in the environmental condition of the remainder of the state's rivers by investing in areas where there is:
  - the highest environmental and community gain; and
  - real community commitment towards long term improvement of river health.
- Preventing damage from future management activities.

The philosophical basis for the framework is:

- A healthy economy and society is dependent on a healthy environment;
- Trade-offs need to be made between human use and environmental condition of rivers;
- Trade-offs should be made in open and transparent decision-making processes involving regional communities and stakeholder groups;
- Decision-making processes are best undertaken at the regional level but within strong state-wide policy frameworks; and
- Decisions are based on best available science within an adaptive management framework.

4.2 Regional Implementation

The regional implementation of the state-wide framework is through regional river health strategies. For the Wimmera region this is the Wimmera Waterway Health Strategy.

The Wimmera Waterway Health Strategy (www.wcma.vic.gov.au) is the region's first attempt to combine the many elements of river management in one umbrella document. The Strategy integrates river health programs into a multi-disciplinary framework and considers floodplains, wetlands, riparian land, instream habitat and channel-form, environmental water reserve management, water quality, significant flora and fauna, and communication, education and engagement. The Strategy's foundation is an adaptive management framework for monitoring, evaluating and reporting on the achievements of activities undertaken in implementing the Strategy (WCMA, 2006).

The Wimmera Waterway Health Strategy brings together a large amount of work, completed by numerous agencies and individuals into one, documenting the strategies, actions, knowledge and resources to form a comprehensive and coherent plan for protecting and enhancing river health (WCMA, 2006).

The Strategy identifies the values intrinsic to region's rivers and the threats to these values. It then prioritises the threats against those values to clearly identify which actions need to be implemented, and in what order. It provides a vision for the future of waterways of the region and will guide waterway management actions through the challenges of the next five years.

The Wimmera Waterway Health Strategy provides the regional framework for integration of actions which will enable waterways of high value to be protected and others to be enhanced for current and future generations (WCMA, 2006).

Wimmera CMA's vision for waterways of the Wimmera is ***Waterways for Life***.

The Wimmera Waterway Health Strategy aims to achieve this vision through four key objectives:

1. The waterways of the Wimmera region are proactively managed by all to protect and enhance their environmental, social and economic values;
2. The condition of ecologically healthy waterways are maintained;
3. An overall improvement in the environmental condition of the region's waterways is achieved; and
4. Damage to waterways from future management activities is prevented.

To achieve these objectives the Wimmera Waterway Health Strategy:

- Identifies environmental, economic and social values associated with our waterways;
- Identifies threats which may impact on those environmental, economic and social values;
- Sets short-term management action and long-term condition targets for waterway health;
- Provides a framework for developing and implementing issues-based action plans;
- Provides a basis for developing and implementing multi-benefit actions and programs;
- Identifies gaps in current waterway health management;
- Identifies opportunities for restoration and the requirements for restoration;
- Identifies and prioritises the management actions; and
- Defines the adaptive management framework of monitoring, evaluating and reporting to enable continuous improvement.

5. Working Together - Partnerships are the Key to Success!

The health of a river is a cumulative outcome of the combined impacts of land and water management within the catchment and the rivers and tributaries (WCMA, 2006). Therefore, managing river health in the region is undertaken within a broader integrated catchment management context.

5.1 Clear and Agreed Responsibilities

As part of the broader program of catchment management, managing and restoring river health is undertaken as a partnership between agencies and the community, with clear, agreed responsibilities for each partner.

The goals for river health can only be achieved with the full and ongoing commitment and input from regional communities and resource managers, Local Government and the Victorian and Australian Governments (WCMA, 2006). This requires clear and agreed roles (Table 1).

Table 1. General Roles of Major Groups in River Health.

Group	General Roles
Australian Government	• contribute funding to States, regional authorities, groups and individuals to achieve national objectives for river restoration; • facilitate national or interstate coordination where necessary; • invest in the development of better management principles, tools and systems; • improve the knowledge base through strategic research and development; • ensure that the wider Australian community is well informed about natural resource management issues; • facilitate the monitoring of the effectiveness of natural resource management at appropriate scales; • oversee the implementation of relevant Commonwealth legislation including the *Environment Protection and Biodiversity Conservation Act 1999;* • ensure that Australia meets its obligations under international agreements; and • identify issues of national significance.
State Government	• set state-wide policy and strategic directions for river restoration; • establish legislative frameworks; • establish effective catchment/regional institutional arrangements; • provide funding to achieve State and regional priorities; • provide relevant advice, and undertake research and monitoring, planning, extension,

Group	General Roles
State Government cont.	on-ground works and some referral and enforcement functions to support regional communities; and • participate in effective inter-government processes and national approaches where necessary, and implement State responsibilities under nationally agreed strategies.
Catchment Management Authorities	• develop, in partnership with the community and other stakeholders, regional strategies and other action plans which define the vision for the catchment and set targets for land and water management; • provide advice to the State Government on resourcing priorities at a regional level; • develop and implement measures for river protection and restoration to implement regional strategies; • ensure community involvement in river management; • undertake floodplain management; • develop partnerships between resource managers in the catchment, and coordinate activities impacting on river health; • provide a focus for regional investment in river management • monitor the condition and management of the land and water resources in the region; • provide community education; and • act as a communication conduit between regional communities and Government on issues relating to land and water management.
Regional Resource Managers (e.g. water authorities and government land managers)	• participate in the development and implementation of regional strategies; • act in partnership with Catchment Management Authorities to implement regional strategies; • undertake all activities which can potentially impact on rivers to best management practice standard, in accordance with 'duty of care' responsibilities and good corporate citizenship; • recognise their dependence on a healthy resource base and their potential impact on it, and manage in accordance with the principles of ecologically sustainable development; and • develop partnerships with other resource managers in the catchment to enhance project coordination and implementation.
Local Government	• work in partnership with Catchment Management Authorities to set priorities for and implement regional strategies; • incorporate river restoration and catchment management objectives, priorities and actions into statutory planning processes; • undertake floodplain management and flood warning in accordance with the *Victoria Flood Management Strategy;* • develop and implement urban stormwater plans in an integrated catchment management context; • manage rural drainage schemes where appropriate; • facilitate local industry involvement in river restoration; • provide support for local action groups; and • undertake all activities which can potentially impact on rivers to best management practice standard, in accordance with 'duty of care' responsibilities and good corporate citizenship.
Industry	• manage in accordance with the principles of ecologically sustainable development; and • minimise their impact on the environment by the implementation of best management practices, in accordance with 'duty of care' responsibilities and good corporate citizenship.
Individuals	• participate in regional planning, priority setting and the implementation of work programs related to river management and restoration; • participate in community groups (e.g. Landcare, Waterwatch, etc.) aimed at monitoring river health or undertaking restoration projects in priority areas; and • manage their own enterprises in ways that acknowledge their 'duty of care' and their role in the stewardship of natural resources.

Source: Victorian River Health Strategy (DSE, 2002).

Even with clear and defined roles and responsibilities, the achievement of sound river health outcomes depends on the:

- Development and maintenance of effective partnerships;
- Ongoing commitment of all parties; and
- Full engagement of regional and local communities.

5.2 Engaging Our Communities

The interdependence between river health and human use means that the management of rivers requires a delicate balance between using our rivers and maintaining their environmental condition.

Community understanding of the potential impacts of management actions on river condition is vital.

Transparent decisions need to be made about what purposes we want our rivers to serve, what consequent environmental condition we are prepared to accept and what the implications of that level of environmental condition are for other uses now and into the future.

The Victorian River Health framework is therefore built on the foundations of community support and involvement, recognising that it is only with long-term support, commitment and a willingness by the community and Government to undergo change that any improvements in Victoria's rivers can be made (DSE, 2007).

The Victorian River Health Strategy states two key outcomes for enhancing community capacity in river health in Victoria. They are that the community:

1. has an understanding and knowledge about the issues that affect river health; and
2. participates in priority setting and decision making at a catchment level.

The involvement of our communities has been critical to the success of regional river health programs to date.

Between 2002 and 2004, more than 11,300 formal river health community awareness raising activities and training events were undertaken across Victoria, with the majority facilitated by regional Catchment Management Authorities (DSE, 2007).

Activities included media, training workshops, field days and demonstrations sites on landholder properties. There are more than 3000 landholder agreements in place which form the basis for much of the priority river restoration work in partnership with local landholders.

Since the launch of the Victorian River Health Strategy, the Victorian Waterwatch Program continues to grow with over 1800 groups (26,000 individuals) regularly monitoring water quality at more than 4000 sites (DSE, 2007). Waterwatch is an Australia-wide community-based monitoring network that aims to develop the participation of community groups and individuals in the protection and management of waterways (see www.vic.waterwatch.org.au).

In addition to the regular monitoring groups, over 78,000 people have participated in other Waterwatch activities, ranging from macro-invertebrate sampling to stormwater drain stencilling in 2005 alone.

6. Achievements to date

Recognising that achieving healthy rivers across Victoria is a long-term goal, four (2005), 10 (2011) and 20 (2021) year targets were established to measure progress towards achieving the overall goal (DSE, 2006b).

As a result of strategic planning, increased investment and the hard work of agencies and the community, the four year (2005) targets were achieved (Table 2) and Victoria is well placed to deliver on the 2011 (10 year) targets (Table 3).

Table 2. Progress towards Victorian River Health Management Action Targets.

Target	Progress	
An increase in length of river accessible to native fish by an additional 2000 km	Since 2002, fish passage has been provided past 33 barriers, which has opened up 2100 km of river as additional habitat for migrating fish.	
Significant improvement in floodplain linkages in ten areas of national and state significance	During 2002-2005 works were undertaken at 11 significant sites to improve linkages between the river corridor and its adjacent floodplains.	
All rivers with either sustainable catchment limits or negotiated environmental flows in place	The *Water (Resource Management) Act 2005* established the Environmental Water Reserve and provides the legal protection for environmental water in the water allocation and water resource planning provisions. Additionally, in 2004 the amount of water for consumptive use was capped in all basins across the State through basin caps, bulk entitlements or sustainable diversion limits.	
Report on the second benchmarking of the environmental condition of Victorian rivers	The 'Index of Stream Condition: The second benchmark of Victorian River Condition' was released in August 2005. A full copy of the report can be found at www.vicwaterdata.net and follow the ISC link.	

 Exceeded  Achieved  On target – with current work program  Work to do – to ensure target will be achieved  Not on target

Source: Restoring our Rivers for Future Generations. Victorian River Health Program Report Card 2005 (DSE, 2006b)

Table 3. Progress towards Victorian River Health Resource Condition Targets.

Target	Progress	
Significant improvements achieved in environmental flow regimes of 20 high value river reaches currently flow stressed	The EWR of 43 river reaches has been improved and there are commitments and proposals in place to also improve the EWR in a further 57 river reaches across the State.	
4800 km of rivers with improvement of one rating in the measurement of riparian condition	Between 2002 and 2005, 6000 ha of river frontage has been protected and improved, including 2000 km of riparian fencing and 750,000 plants established. In addition 178 km bank stabilisation works have been undertaken.	
An increase of 7000 ha of riparian areas under management agreements	Between 2002 and 2005, 3077 landholder agreements were established, covering approximately 6000 ha of riparian land.	
95% of all highland and upland and 60% of all lowland monitoring sites will meet State Environment Protection Policy (SEPP)	The attainment of SEPP objectives improved between 2001 and 2004. In 2004, the targets for salinity and pH have been met or are close to being met. The target for turbidity has been met for lowland but not upland sites.	

Target	Progress	
environmental quality objectives	Further work is required to address dissolved oxygen, total nitrogen, total phosphorus and biological parameters.	
600 km of rivers where in-stream habitat has been reinstated	Between 2002 and 2005, 323 km of in-stream habitat was restored (for example through the reintroduction of woody debris and planting aquatic vegetation). Further to this, 249 km of river bed was protected or restored, including the establishment of 74 bed stabilisation structures and 59 rock chutes.	
1000 high value public assets provided with appropriate level of protection	Since 2002, river health improvement works have been undertaken in 267 high priority river reaches where a total of 2155 environmental, social and economic assets occur, as identified in the regional RHSs.	
An improvement in the status of designated freshwater-dependent focal species	Since 2002 river health improvement work has been undertaken in 223 high priority river reaches that provide habitat for vulnerable, rare, threatened, or endangered water-dependent species. However, further work is required to assess if these works have improved the status of water-dependent species.	

 Exceeded  Achieved  On target – with current work program  Work to do – to ensure target will be achieved  Not on target

Source: Restoring our Rivers for Future Generations. Victorian River Health Program Report Card 2005 (DSE, 2006b)

Achievement of these progress targets has been through a range of integrated management actions including:

- Restoring flow regimes through environmental water reserves;
- Stablising stream beds and banks and re-establishing in-stream habitats;
- Creating riparian linkages and removing domestic stock grazing from rivers and creeks;
- Restoring natural links between rivers and their floodplains;
- Monitoring long-term river health and river response to short-term events;
- Engaging our communities;
- Learning from each other; and
- Filling knowledge gaps with applied research.

7. Adaptive Management – Learning as we go

The Victorian Government is committed to the long term goal of achieving healthy rivers, floodplains and estuaries. However, given that only 21% of major rivers and streams are in good and excellent condition and one third are in poor or very poor condition, it is recognised that the task is both challenging and attainable only in the longer term (DSE, 2006a).

The approach is to move towards the goal in achievable steps – setting priorities and targets for immediate action, undertaking the work, reviewing progress and moving on to the next set of targets (DSE, 2006a).

The framework for managing river health must be adaptive (WCMA, 2006). Adaptive management is about learning and applying what has been learnt to improve the management of operational or investment programs and is often referred to as 'learning by doing' (Schreiber *et al.*, 2004).

Successful adaptive management for river health outcomes requires integration of science, policy and management (DSE, 2005).

Applied research underlies improvements and innovation in river health management (DSE, 2007). Considerable work has been done in priority research areas, including:

- The development of a standard method for assessing environmental flow requirements (FLOWS methodology);
- Several studies investigating threats to river health such as invasive willows, threats to native fish communities and emerging threats such as climate change; and
- The use of market based instruments to achieve an improvement in river health through tender/auction approaches where landowners engage in a market-based approach to the conservation, restoration and rehabilitation of priority riparian areas (http://www.necma.vic.gov.au/programs/water/rivertender).

In addition, the Victorian River Health Strategy and the regional river health strategies will be reviewed in five year cycles to build on new knowledge, improved objective setting, improved stakeholder and community engagement and consultation and monitoring and evaluation.

8. Future Challenges

Whilst Victoria has made significant inroads towards the long-term river health goals, a number of challenges remain:

- Community engagement to solve the hard problems:
    - Increase community understanding of how rivers function and the value of environmental flows;
    - Involving regional communities in policy decisions; and
    - Planning and implementation of engagement of specific community sectors (e.g. indigenous, Local Government, industry, farmers, etc.).
- Retaining community interest over time;
- Communicating success whilst maintaining a long-term program;
- Showing success and demonstrating benefits through monitoring;
    - water recovery/enhanced environmental water reserves; and
    - real on-ground improvements.
- More thoroughly demonstrating economic dependencies of healthy rivers;
- Increasing capability through increasing our knowledge and investment;
- Understanding emerging risks:
    - Climate change; and
    - Pest plants and animals.
- Understanding the links between groundwater and our rivers, lakes and wetlands.
- Getting real – some of our rivers may never be ecologically healthy whilst supporting industry and community.

The interdependence between human use and river health means that the management of our rivers is not an easy task. A delicate balance between using our rivers and maintaining their environmental condition is required.

Community understanding of the potential impacts of management actions on river condition is vital (DSE, 2007).

Transparent decisions need to be made about what purposes we want our rivers to serve, what consequent environmental condition we are prepared to accept and what the implications of that level of environmental condition are for other uses now and into the future (DSE, 2007).

The Victorian river health management framework is therefore built on the foundations of community support and involvement, recognising that it is only with long-term support, commitment and a willingness by all to undergo change that any improvements in Victoria's rivers can be achieved.

References

DSE, 2004. *Victorian Government White Paper. Securing our Water Future Together*. Department of Sustainability and Environment, Melbourne, Australia.

DSE, 2005. *Index of Stream Condition: The Second Benchmark of Victorian River Condition.* Department of Sustainability and Environment, Melbourne, Australia.

DSE, 2006a. *Restoring our Rivers for Future Generations. 10 Year Action Plan (Draft).* Department of Sustainability and Environment, Melbourne, Australia.

DSE, 2006b. *Restoring our Rivers for Future Generations. Victorian River Health Program Report Card 2005,* Department of Sustainability and Environment, Melbourne, Australia.

DSE, 2007. www.dse.vic.gov.au.

Norris, R., Prosser, I., Young, B., Liston, P., Bauer, N., Davies, N., Dyer, F., Linke, S. and Thoms, M., 2001. *The Assessment of River Condition (ARC). An Audit of the Ecological Condition of Australian Rivers*. CSIRO Land and Water and CRC for Freshwater Ecology, Canberra.

Schreiber, S.G., Bearlin, A.R., Nicol, S.J. and Todd, C.R., 2004. *Adaptive management: a synthesis of current understanding and effective application.* Ecological Management and Restoration 5: 177-182.

Tourism Victoria, 2007. www.visitvictoria.com.au

WCMA, 2003. *Wimmera Regional Catchment Strategy 2003-2008*. Wimmera Catchment Management Authority, Horsham, Australia.

WCMA, 2006. *Wimmera Waterway Health Strategy 2006-2011*. Wimmera Catchment Management Authority, Horsham, Australia.

Glossary

Asset	Something that has an identifiable owner and the owner must be able to derive a benefit from holding or using the asset. A feature in the region that has economic, social or environmental values.
Basin	The catchment of a large river or group of rivers. There are 29 basins within Victoria.
Catchment	That area of land contributing run-off to a defined stream or stream system; it includes the soil, water, vegetation and developments.
Environmental water releases	The flow of water released from a water storage or weir to meet environmental water requirements and to maintain appropriate environmental conditions in a waterway.
Environmental Water Reserve	The share of water resources set aside to maintain the environmental values of a water system and other water services which are dependent on the environmental condition of the system.
Erosion	Modification of the channel boundary by entrainment and removal of sediment.
Flow regime	The pattern of flow in a river which can be described in terms of the quantity and variability of water flows.
Index of Stream Condition (ISC)	The Index of Stream Condition is an integrated measure of waterway health that calculates the state of a stream's hydrology, water quality, aquatic life, vegetation, instream habitat, and bank and bed condition thereby enabling the classification of a waterway's overall health. It is designed to be completed every five years at hundreds of waterways across the state. Each stream that is classified using ISC is divided into reaches of approximately 10-30 km and are each surveyed to provide a snapshot of the health along the vast majority of Victoria's creeks and rivers.
Integrated Catchment Management	Management of plants, animals and water in a particular area of land.
Management Action Target	Short-term targets specific to management actions (1-5 years).
Natural Resource Management	The management of natural resources – land, soil, native vegetation, biodiversity and water.
Ramsar	The Convention on Wetlands, signed in Ramsar, Iran in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 146 Contracting Parties to the Convention, with 1456 wetland sites, totalling 125.4 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.
Reach	A length of stream or river, typically 10-30km long, which is relatively homogenous with regards to its hydrology, physical form, water quality and aquatic life sub-indices and used for management/reporting purposes. In this Strategy, reaches are based on the Index of Stream Condition reaches unless otherwise indicated.
Resource Condition Target	Pragmatic and achievable medium term goals (10-20 years)
Restoration	Improvement or enhancement of the environmental condition of the river toward 'ecologically healthy'.
Riparian land	Riparian land is any land next to or which directly influences a body of water. It includes land immediately alongside small creeks and rivers, gullies and dips that sometimes run with surface water, areas surrounding lakes and wetlands on river floodplains which interact with the river in times of flood. It often has water-dependent vegetation. Riparian land is the interface between the catchment and instream area of a river or stream.

Risk	Risk is the potential harm/danger that may arise from some present process or from some future event.
Salinity	The total amount of water-soluble salts present in the soil or stream.
Target	A measurable result expected to be achieved within a given timeframe.
Terminal Lake	Receives inflows from streams or rivers draining its catchment, but has no streams draining from it. It is the end point of a river system.
Threat	An action or process likely to cause harm to an asset i.e. degrade a value.
Tributary	A river or creek that flows into a larger river or creek.
Value	Something considered to be important or beneficial.
Waterway	A waterway is defined as a natural river, creek, stream, watercourse or wetland.
Wetland	Inland, standing, shallow bodies of water which may be permanent or temporary, fresh or saline.