



North Central River Health Strategy

2005



NORTH CENTRAL
Catchment Management Authority



North Central River Health Strategy

ISBN: 0 9756011 0 5

North Central Catchment Management Authority
PO Box 18
Huntly Vic 3551
T: 03 5440 1800
F: 03 5448 7148
E: info@nccma.vic.gov.au
www.nccma.vic.gov.au

© North Central Catchment Management Authority, 2005

A copy of the document is also available at www.nccma.vic.gov.au.

Front cover photos:

Loddon Falls (photo: Stephen Malone Photography), Rock chute at Shelbourne (photo: Matt Jackson), Waterwatch activity photo: Stephen Malone Photography)

Back cover photos:

Tullaroop Creek (photo: Matt Jackson), Field day on the Loddon River (photo: Kirsty Cogdon), Campaspe River (photo: Eamon Dullard)

This publication may be of assistance to you, but the North Central Catchment Management Authority and its employees do not guarantee that the publication is without flaw of any kind, or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on information in this publication.

Specific references to funding levels in this Strategy are for indicative purposes only. The level of government investment in this Strategy is contingent on budgets and government priorities.





Minister's foreword

Victoria is built around its rivers and other waterways. These unique environmental assets - important ecosystems in their own right - support our communities by providing water for farms, towns, and industry and are of significant recreational and cultural value.

The challenge to manage their health has never been more important than it is now. The pressure of climate change, drought and increasing demand for water has highlighted the importance of the role of rivers in the complete water cycle.

The health of the rivers in the North Central region has degraded significantly over time – based on Victoria's benchmarking tool, the Index of Stream Condition, few waterways are in good condition.

The North Central Regional River Health Strategy is the result of extensive community involvement. This community input into the strategy development is essential as it provides a framework for communities, industries and Government to work in partnership with river health managers to restore and manage our rivers over the long-term.

The strategy establishes regional priorities for river protection and restoration over the next five years. It will be used by a wide range of stakeholders and community groups and steer river health investment.

The strategy identifies priority waterways throughout the Avoca, Avon/Richardson, Loddon and Campaspe catchments. Priority waterways have been identified for their values as well as their association with sites of international significance including the River Murray, Gunbower Forest and the Kerang Lakes Ramsar sites.

The strategy uses an innovative asset-based approach. This allows river health managers to acknowledge the range of social, environmental and economic values of local waterways and also helps them to identify the threats and risk to these values so that the priority actions to protect and restore our rivers are clearly established. The strategy provides a framework for communities, industries and Government to work in partnership with river health managers to restore and manage our rivers over the long-term.

It is one of 10 strategies developed across the State to implement key river health objectives from the Bracks Government's action plan for water, *Our Water Our Future*, and the Victorian River Health Strategy.

I congratulate the North Central catchment community for this innovative strategy. Your valuable contribution in protecting and restoring our precious rivers will benefit all Victorians.

Honourable John Thwaites, MP

Minister for Environment and Water





Chair's foreword

Waterways and wetlands are complex and special places. Together with their associated floodplains they support a diversity of aquatic and terrestrial plants, birds and other animals.

Rivers hold strong cultural significance for Indigenous and non-Indigenous people – they provide places of recreational, social, aesthetic, educational and spiritual value. Economically they provide a water resource, vital to the region's horticultural, agricultural and industrial productivity.

Healthy rivers, which reflect the health of our catchments, are important for healthy communities. The health of the rivers in the North Central region has degraded significantly over time. The 1999 Index of Stream Condition rated just 2% of the waterways as being in good condition, 45% in moderate condition and 53% in poor to very poor condition. None were rated as excellent.

The North Central region contributes river flows to the nationally significant River Murray and therefore has an obligation to take action to improve the health of the Murray.

River health is affected by many factors including declining water quality, salinity, modified flow regimes, loss of riparian vegetation, poor land management practices and fragmentation of floodplains and wetlands.

Development of this Strategy is a key commitment of the North Central Regional Catchment Strategy.

The Strategy has been developed in line with the principles and direction of the Victorian River Health Strategy.

The North Central River Health Strategy provides an integrated approach to river health management and sets a clear direction and priorities for taking action to meet the long-term vision of improving the health of rivers of the North Central region.

Realising this vision will only be achieved by individuals, community and agencies working in partnership. This is a strategy for the entire community of the North Central region, for urban and rural dwellers, landholders and Landcare groups, for individuals and government agencies.

River health management and water policy in Victoria and Australia are currently in sharp focus with the release of the Victorian Government's 'Our Water Our Future' document, the COAG Agreement on the National Water Initiative and the Living Murray process. This Strategy will position the North Central region to make the most of this changing climate in river health management and to direct the investment needed to restore the health of our rivers for current and future generations.

The level of community awareness and interest in the health of our rivers and waterways has also increased recently: we all share an 'ownership' of our rivers and waterways. The North Central Catchment Management Authority has been greatly encouraged by the quality of the input received from the regional community and I am confident that we can claim that this River Health Strategy 'belongs' to the North Central region.

I thank everyone who has contributed to the development of the Strategy, and invite the wider regional community to participate in the implementation.

Dr Ian MacBean

Chair

North Central Catchment Management Authority



Executive summary

Context and background

Although rivers, creeks and wetlands are only a small portion of our landscape, their overall importance to the economy, the ecology and the social fabric of the North Central region is significant. The North Central region is an important part of the Murray-Darling Basin and therefore has a direct influence on the health of the River Murray.

In 2002, the Government released the Victorian River Health Strategy (RHS), which provides a statewide policy framework for managing the health of Victoria's rivers, floodplains and estuaries. Within this statewide context, regional strategies aim to identify the environmental, social or economic water services (or assets) in each region, their value to the State and the region, and the issues that threaten these services. They also establish priority areas for restoration, and provide an integrated program for river restoration at the regional level.

The North Central River Health Strategy (RHS) forms a key component of the North Central Regional Catchment Strategy (RCS). The North Central RCS is the primary integrated planning framework for natural resource management in the North Central region.

In June 2004, the Victorian Government released 'Our Water Our Future' that sets out an action plan to secure Victoria's water future over the next 50 years through sustainable water management. This document strengthened the role of catchment management authorities as 'caretakers of river health' and the managers of the Environmental Water Reserve. Government has also recently released the 'Our Environment Our Future: Victoria's Environment Sustainability framework'. The framework strengthens Victoria's commitment to maintaining and restoring our natural assets for a prosperous and livable Victoria.

The North Central RHS has been developed over several years and has involved:

- identification of environmental, recreational, cultural, social and economic assets
- identification of threats and risks to these assets
- review of existing action plans relevant to the North Central RHS
- identification of knowledge gaps
- the setting of priorities based on a number of principles and a risk-assessment approach
- development of five-year management action and ten-year resource condition targets
- development of integrated river health objectives
- outlining of a monitoring, reporting and review program
- implementation of a consultation plan and the outlining of a community awareness program for the implementation of the North Central RHS.

Vision and objectives

The following vision for river health in the North Central region was developed by the North Central RHS consultative committee who helped to guide the completion of the Strategy by reviewing its development, and providing important stakeholder input into the process.

NORTH CENTRAL RIVER HEALTH STRATEGY – VISION

Waterways and wetlands will be managed sustainably to protect and enhance their diversity and ecological function while supporting the uses of the regional community.

To support and provide further direction to realise this vision, the Strategy outlines a series of regional objectives that are regional, broad and represent long-term goals. These objectives are based on:

- community engagement
- flow regimes
- water quality
- riparian lands
- instream biota
- threatened species and communities



- floodplain, wetlands and groundwater
- adaptive management, monitoring and education
- strategic planning.

To meet these objectives, waterways, wetlands and floodplains in the North Central region will:

- support efficient, sustainable agriculture
- supply clean and safe drinking water
- support recreational pursuits, e.g. fishing, camping, birdwatching, canoeing
- preserve Indigenous values.

Strategic and regional framework

The North Central RHS is a key regional document providing direction and management of river health across the region. There are many national, state and regional policies and strategies that influence natural resource management in the region. The North Central RHS has been developed in consideration of these strategies, in particular the Victorian RHS, 'Our Water Our Future' and the North Central RCS.

Regional waterways

For the purpose of river health planning at the regional scale, the North Central RHS is based on 11 Program Areas containing 101 waterway reaches, which is based on the 1999 Index of Stream Condition (ISC) assessment (Figure 1).

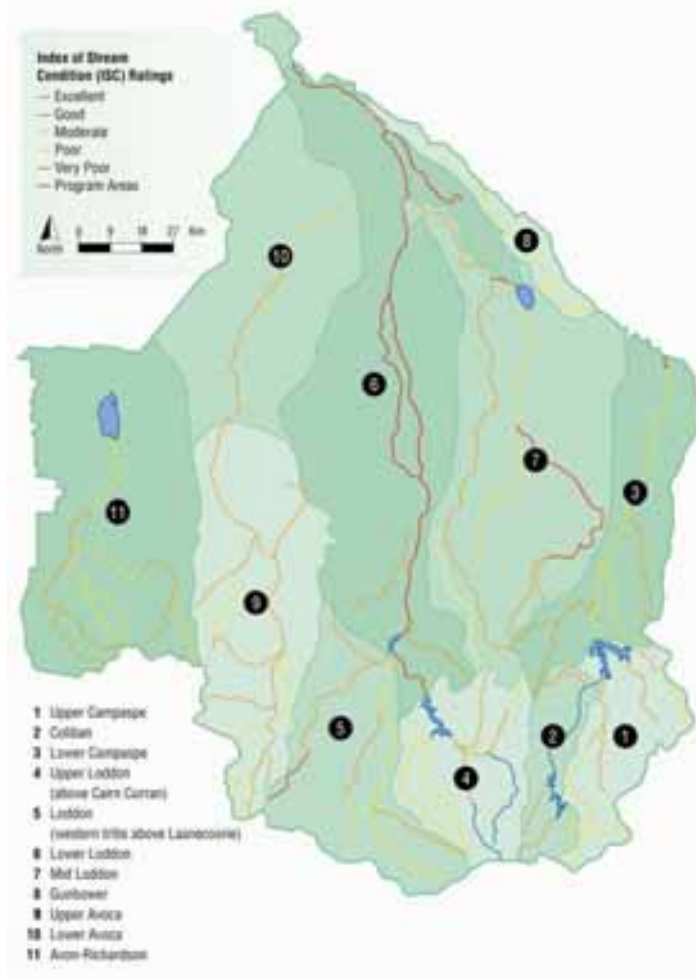


Figure 1 North Central CMA Program Areas



The current condition of the rivers, wetlands and lakes in the North Central region is the result of the cumulative impact of a multitude of factors. In summary, the 1999 ISC assessment of the health of waterways in the region rated just 2% of the waterways as being in good condition, 45% in moderate condition and 53% in poor to very poor condition (Table 1).

Each of the four catchments that make up the North Central region are unique in terms of their history, land use, population, topography, water resources and native plants and animals. They have a variety of environmental, social and economic values and face a number of issues. The perceived values and threats to waterways within each catchment were captured in 2002 at a series of community River Health Forums, in addition to two Indigenous forums and an agency forum.

These perceived values and threats were also used to cross-reference the RiVERS (River Values and Environmental Risk System) database from state-wide datasets and knowledge of North Central CMA staff. The RiVERS database was developed by the Victorian Waterway Managers Forum and DSE to provide a framework for the prioritisation of waterway management programs. The RiVERS database forms the basis of all regional river health strategies across Victoria.

The RiVERS database was used to assign scores to quantify the environmental, social and economic values and threats to the 101 waterway reaches in the North Central region. The database was populated with the best available knowledge at the time. The complete value and threat dataset and risk-scores are available in a supporting document titled North Central waterways – values, threats and risks (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Some of the information available to populate the RiVERS database was limited, e.g. fish populations. These information gaps have been identified as a high priority to complete. An evaluation of the RiVERS decision support tool will be undertaken, led by the DSE. This will include a review of the risk-assessment approach and will consider a review of the current asset and threat database.

The information contained in the RiVERS database guided the setting of priorities for waterway management in the North Central region.

Prioritising regional waterways

Setting priorities for waterway management ensures that resources are allocated to the most important areas and issues. Given the array of values and threats that characterise the river management issues in the North Central region, the Strategy uses a clear method to determine:

- the location of priority waterway reaches
- the priority actions to address key values and threats along these reaches.

As such, river health priorities for the North Central region are based on the following principles. While the order of these principles generally aligns with those in the Victorian RHS, it does not necessarily mean that any one principle over-rides another as they are each legitimate reasons to undertake river health management actions. Likewise, a reach may be a priority under more than one principle although the management actions may differ according to the principle objectives.

Principle 1: Protect and enhance ecologically healthy rivers and representative rivers

Principle 2: Minimise risks to connected high-value assets

Principle 3: Protect and enhance reaches of high-risk

Principle 4: Protect reaches with high-environmental-, social- and economic-value

Principle 5: Maintain and enhance community capacity, awareness, motivation and involvement across the region

Principle 6: Protect individual sites of significance along regional waterways

Principle 7: Prevent damage and degradation of our rivers from future development activities

The Strategy describes the process used to define priority reaches under the above principles, key objectives for management of these reaches, and indicates the types of actions required.

The priority-setting process determined 56 priority reaches of the total 101 ISC reaches across the North Central region according to Principles 1, 2, 3 and 4. Principles 5, 6 and 7 relate to waterways across the entire North Central region to provide the management flexibility required when considering the dynamic nature of regional communities, waterways and future development. Figure 2 details the location of the 56 priority reaches.

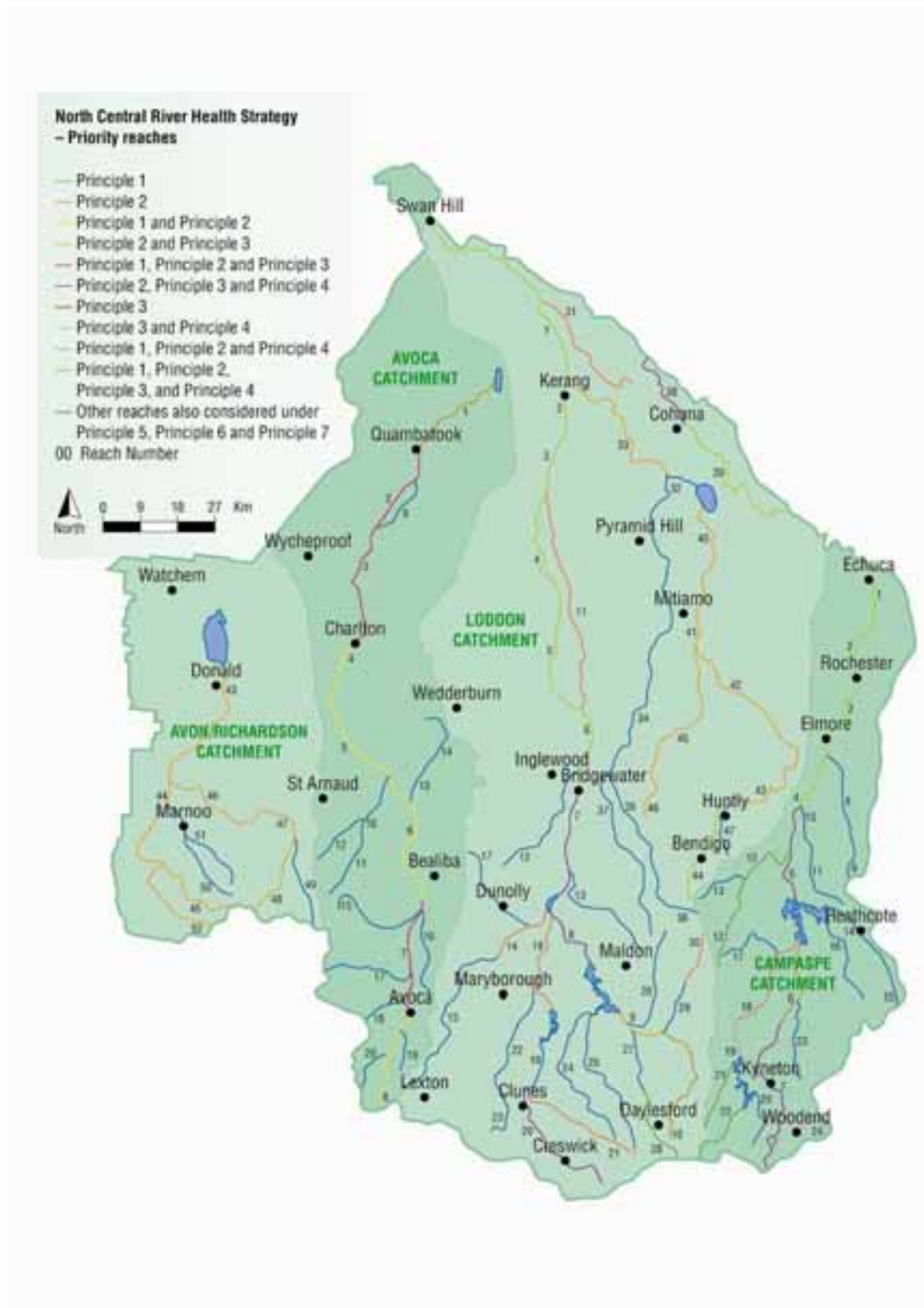


Figure 2 Priority waterway reaches and their corresponding priority-setting principles



Regional actions and targets

To allocate resources to maximise outcomes in river health, clear targets need to be set. Targets for the North Central region have been developed to align with national, state and regional aspirational goals and targets.

The following three targets are defined in the Strategy:

- Aspirational Targets – describes the vision for the desired long-term (50+ years) condition of natural resources in each catchment.
- Resource Condition Targets - the level of change that might reasonably be sought within a ten-year period along a priority reach with the general application of currently recommended management practices for priority actions.
- Management Action Targets - reflects the activities or level of effort required in the short term (5 years) to reach the Resource Condition Target along priority reaches.

The Strategy outlines a number of general and specific assumptions relating to the Management Action and Resource Condition Targets.

The Strategy groups the priority reaches, their actions and related targets into 11 Program Areas. The values and threats of each priority reach are summarised, and the critical and high priority actions are highlighted based on the level of risk of a threat degrading a value.

The action and target tables integrate actions from key plans and strategies and were developed in consultation with key stakeholder agencies. They are based on a number of target-setting and unit-cost assumptions outlined in the appendices. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholders. These plans are guided by the priorities contained in the Strategy and the extensive background information contained in the River Health Plans.

It is important to note that the Victorian Government's 'Our Water Our Future' guides the future management of water resources in Victoria, including the roles, responsibilities and key actions of stakeholders. Several regional actions are identified, such as the development and implementation of a Sustainable Water Strategy for Northern Victoria in partnership with DSE, urban and rural water authorities and local government.

Community involvement

Communities of the North Central region place a high-value on their waterways. Cultural heritage is important for both the Indigenous and non-Indigenous population to maintain spiritual, physical and emotional links to the environment.

A key objective of the North Central RHS is to involve the community in the planning and implementing of river health projects. Landholders are vital to successful implementation, as most works are on privately owned land or affect areas that require private co-operation. Effective natural resource management involves creating and sustaining partnerships within and between the various levels of government, communities and community groups, Indigenous communities and private landholders.

Integral to the development of the North Central RHS was effective consultation and involvement of the community and other key stakeholders. This was achieved through:

- A series of community, Indigenous and agency River Health Forums held in 2002 to gather community feedback on the values and threats associated with their local rivers and creeks, and provide an indication of the types of management activities the regional community would like to see implemented.
- The formation of a consultative committee comprised of representatives from the North Central community and stakeholder agencies to review the development and progress of the North Central RHS and provide important stakeholder input.
- The distribution of the draft North Central RHS to the community and partner agencies for public comments between 26 August and 29 October 2004.
- The planned development of a community engagement plan to direct the implementation of the Strategy in terms of community engagement and agency involvement.

Changing the way natural resources are managed requires leadership, knowledge, participation, resource wealth, grassroots action and accountability. In recognition of this, building community capacity is viewed as imperative to ensure a level of ownership and commitment to improve river health through the actions outlined in the Strategy.



To achieve this, Community Involvement Targets developed in consultation with local community facilitators, aim for continual improvement in community involvement in accordance with the North Central RCS. These actions and targets take into account the role of partner agencies in community engagement across the region.

Implementation of the Strategy

Integrated catchment management can only occur when all parties are involved in the planning and implementation process. The natural resource management capability of the North Central region is considerable, made up of individuals, community groups, urban and rural water authorities, local government, state agencies and many more. The challenge is to establish and maintain effective relationships between the stakeholders in a way that grows partnerships, information exchange and support.

The implementation of the North Central RHS is the primary responsibility of the North Central CMA in partnership with the community, government agencies (e.g. DSE, DPI, EPA Victoria), urban and rural water authorities (G-MW, GWMWater, Coliban Water, Central Highlands Water, Lower Murray Water, Western Water) and local government (including 15 local government areas). The actions, roles and responsibilities outlined in 'Our Water Our Future' are reflected in the North Central RHS.

While the North Central RHS recommends that resources be directed to the areas of highest priority, it is clear that the task is a major one requiring significant resources and long-term commitment by the Victorian and Australian Governments and the local community. It is important that long-term funding reflects the general cost-sharing principles for natural resource management as set out in the Victorian RHS and truly represent, in a fair and equitable way, the groups and beneficiaries most affected by river health.

It is anticipated that the implementation of the five-year Strategy will cost approximately \$28,400,000, approximately \$5,700,000 per year. This figure has been calculated using the costs to address the critical and high priority actions in each of the Program Areas, detailed in Section 6. The cost of implementing only critical priority actions requires approximately \$26,400,000. The total contribution from landholders is approximately \$4,000,000, over five years.

Tables 1 and 2 summarise the costs of on-ground works (including management costs) at the Program Area scale and region-wide costed actions. All costs are indicative and are dependant on a number of factors, as identified in the target-and cost-setting assumptions (Appendix 9) and unit-cost assumptions (Appendix 10).

The Catchment Management Authorities, who are the statutory waterway managers and caretakers of river health, are responsible for implementing the bulk of the river health activities. River health related activities undertaken by other agencies such as water authorities, DPI, local government and DSE and associated costs have been identified and documented wherever possible. It is important to recognise that implementation of other action plans and sub-strategies under the Regional Catchment Strategies contribute to river health outcomes, and are not directly costed or implemented under this strategy.

It is important to note that the estimated funding requirements and proposed cost shares are indicative. Catchment Management Authorities coordinate and implement river health related activities on behalf on Government, in accordance with Government policies. Government's investment in this region's strategy is contingent on Government budgets and priorities. The timelines for implementing a strategy's targets may need to be amended in line with the funding provided.

Table 1 Indicative costs for implementation of river health on-ground works and preliminary assessments over the next five years in priority reaches

Resource condition	Key threat	North Central region \$	Upper Campaspe \$	Coliban \$	Lower Campaspe \$	Upper Loddon \$	Loddon (western tribs) \$	Lower Loddon \$	Mid-Loddon \$	Gunbower \$	Upper Avoca \$	Lower Avoca \$	Avon-Richardson \$	TOTAL \$
Environmental Water Reserve	Flow deviation	The development and implementation of the EWR will occur in line with policy established in Our Water Our Future, 2004. The costs associated with the delivery of Environmental Water Reserves will be determined by a range of stakeholders.												
Riparian zone	Degraded riparian vegetation		\$209,000	\$436,000	\$620,000	\$495,000	\$626,000	\$2,008,000	\$1,588,000	\$668,000	\$745,000	\$550,000	\$1,037,000	\$8,915,000
	Exotic flora		\$300,000	\$30,000	\$173,000	\$280,000	\$216,000	\$315,000	\$188,000	\$370,000		\$370,000	\$155,000	\$2,322,000
Instream habitat	Bed/bank erosion*			\$20,000			\$20,000	\$40,000	\$84,000	\$20,000	\$40,000	\$20,000		\$224,000
	Instream barriers*			\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000			\$60,000
	Loss of instream habitat*					\$11,000		\$33,000		\$11,000	\$33,000		\$33,000	\$121,000
Water quality	Poor water quality^	\$7,500,000												\$7,500,000
TOTAL		\$7,500,000	\$509,000	\$501,000	\$808,000	\$801,000	\$877,000	\$2,411,000	\$1,875,000	\$1,084,000	\$833,000	\$940,000	\$1,225,000	\$20,023,000

Note: * indicates the cost of preliminary assessments and investigations

^ This figure is the approximate summation of the total five-year cost of implementing the four Nutrient Management Strategies. This cost will be reviewed through the development of the Catchment Water Quality Action Plans.

Table 2 Indicative costs for region-wide actions

Region-wide actions	Cost \$
Regional Frontage Management Plan	\$100,000
Regional Fisheries Management Plan	\$100,000
Nine Catchment Action Plans	\$450,000
Installation of four fishways	\$1,000,000
Erosion control (pending assessments)	\$1,000,000
Instream habitat enhancement	\$500,000
Community engagement	\$2,845,000
Monitoring, evaluation and reporting	\$1,000,000

The costs associated with the delivery of Environmental Water Reserves will be determined by a range of stakeholders and will include:

- monitoring of ecological responses
- development of Environmental Operating Strategies
- investigations into options for improving environmental flows
- managing physical constants to delivering environmental flows
- costs associated with headwaters and delivery of the Environmental Water Reserve.

It is important to note that these costs are indicative and will be refined through the development of the Catchment Action Plans. The following table outlines the region-wide actions to be undertaken in addition to and based on the preliminary assessments costed in the above table.

The total indicative cost to implement the Strategy is approximately \$28,400,000 (sum of Table 69 and Table 70 totals). Although the contribution of other agencies to meet the river health targets is acknowledged, these costs are not detailed in the Strategy but will be considered in future revisions.



Monitoring and evaluation

The North Central RHS and the communication plan for community engagement will be reviewed and updated every five years, based on changes in resource condition and the level of inputs and outputs over those five years. Changes in the nature of community attitudes and capacity will be taken into account in refining recommendations for key river health objectives. An evaluation of the RiVERS decision support tool will be undertaken, led by the DSE. This will include a review of the risk-assessment approach and will consider a review of the current asset and threat database.

An effective monitoring program is essential to ensure that the actions outlined in the North Central RHS achieve the five- and ten-year targets for priority reaches that contribute to the long-term Aspirational Targets for each catchment.

The precise design of the monitoring program is beyond the scope of this Strategy. A number of actions need to be refined before a detailed monitoring program can be designed. Therefore, a flexible monitoring program will be implemented as an integral part of onground works planning.

As highlighted in the Victorian Government's 'Our Water Our Future', knowledge is a crucial resource in the management of water, for assisting agencies to regularly adopt more efficient, effective and environmentally sensitive processes. The North Central CMA is currently developing a Research and Development Strategy to provide a directive role in helping determine the focus and priorities of research agencies and to create protocols which will facilitate improved use of research and development in the future across all assets of the North Central RCS. The attainment of further knowledge will help to fill information gaps identified in the North Central RHS.



Table of contents

SECTION ONE: CONTEXT AND BACKGROUND	1
1.1 INTRODUCTION.....	1
1.2 REGIONAL OVERVIEW	2
1.2.1 RIVER BASINS	2
1.2.2 CLIMATE.....	2
1.2.3 WATER RESOURCES	3
1.2.4 LAND USE.....	4
1.2.5 FLOODPLAINS	4
1.2.6 THE NATURAL ENVIRONMENT	4
1.2.7 POPULATION.....	5
1.2.8 WATERWAY VALUES OF THE REGIONAL INDIGENOUS COMMUNITY	5
1.2.9 WATERWAY VALUES OF THE WIDER REGIONAL COMMUNITY	6
1.3 SCOPE.....	6
1.4 PROCESS OF DEVELOPMENT.....	6
1.4.1 VALUES, THREATS AND RISKS	7
1.4.2 REVIEW OF ACTION PLANS	7
1.4.3 ESTABLISHING PRIORITIES AND TARGETS	7
1.4.4 MONITORING AND REVIEW	8
1.4.5 CONSULTATION.....	8
SECTION TWO: VISION AND OBJECTIVES	9
2.1 DEFINING RIVER HEALTH.....	9
2.2 A VISION FOR THE NORTH CENTRAL REGION.....	9
2.3 OBJECTIVES OF THE NORTH CENTRAL RIVER HEALTH STRATEGY.....	10
2.3.1 COMMUNITY ENGAGEMENT	10
2.3.2 FLOW REGIMES	10
2.3.3 WATER QUALITY.....	10
2.3.4 RIPARIAN LANDS	10
2.3.5 INSTREAM BIOTA	10
2.3.6 THREATENED SPECIES AND COMMUNITIES	10
2.3.7 FLOODPLAIN, WETLANDS AND GROUNDWATER	11
2.3.8 ADAPTIVE MANAGEMENT, MONITORING AND EDUCATION.....	11
2.3.9 STRATEGIC PLANNING.....	11
2.4 IMPLEMENTING THE VISION.....	11
SECTION THREE: STRATEGIC FRAMEWORK	12
3.1 OVERVIEW OF STRATEGIC FRAMEWORK	12
3.1.1 NATIONAL AND STATE CONTEXT	12
3.1.2 REGIONAL CONTEXT	13
3.2 NORTH CENTRAL REGION PLANS AND STRATEGIES.....	13
SECTION FOUR: REGIONAL WATERWAYS	16
4.1 IDENTIFICATION OF WATERWAY VALUES, THREATS AND RISKS	16
4.1.1 SCALES OF RIVER HEALTH MANAGEMENT	16
4.1.2 INDEX OF STREAM CONDITION	19
4.1.3 RIVER VALUES AND ENVIRONMENTAL RISK SYSTEM (RIVERS) DATABASE.....	19



4.2	CURRENT CONDITION	21
4.2.1	CAMPASPE CATCHMENT	21
	<i>Community views</i>	24
4.2.2	LODDON CATCHMENT	24
	<i>Community views</i>	27
4.2.3	AVOCA CATCHMENT	27
	<i>Community views</i>	30
4.2.4	AVON-RICHARDSON CATCHMENT	30
	<i>Community views</i>	32
	SECTION FIVE: REGIONAL PRIORITIES	33
5.1	PRINCIPLE 1: PROTECT AND ENHANCE ECOLOGICALLY HEALTHY RIVERS AND REPRESENTATIVE RIVERS	34
5.1.1	'NEAR' ECOLOGICALLY HEALTHY CONDITION	34
5.1.2	REPRESENTATIVE RIVERS	35
5.2	PRINCIPLE 2: MINIMISE RISKS TO CONNECTED HIGH-VALUE ASSETS	36
5.2.1	HIGH-VALUE WETLAND ASSETS OF INTERNATIONAL SIGNIFICANCE	36
5.2.2	HIGH-VALUE WETLAND ASSETS OF NATIONAL SIGNIFICANCE	37
5.2.3	HIGH-VALUE WATERWAY ASSETS OF NATIONAL SIGNIFICANCE.....	37
5.3	PRINCIPLE 3: PROTECT AND ENHANCE REACHES AT HIGH RISK	39
5.3.1	DETERMINING THE RISK OF THREATS DEGRADING VALUES	39
5.3.2	DETERMINING LIKELIHOOD.....	39
5.3.3	DETERMINING CONSEQUENCE.....	40
5.2.3	IDENTIFYING REACHES OF HIGH RISK.....	41
5.4	PRINCIPLE 4: PROTECT REACHES OF HIGH ENVIRONMENTAL-, SOCIAL- AND ECONOMIC-VALUE	43
5.4.1	IDENTIFYING HIGH-VALUE ENVIRONMENTAL, SOCIAL AND ECONOMIC REACHES	43
5.5	PRINCIPLE 5: MAINTAIN AND ENHANCE COMMUNITY CAPACITY, AWARENESS, MOTIVATION AND INVOLVEMENT ACROSS THE REGION	45
5.6	PRINCIPLE 6: PROTECT INDIVIDUAL SITES OF SIGNIFICANCE ALONG REGIONAL WATERWAYS	45
5.7	PRINCIPLE 7: PREVENT DAMAGE AND DEGRADATION OF OUR RIVERS FROM FUTURE DEVELOPMENT ACTIVITIES	46
5.8	LIMITATIONS OF THE PRIORITISATION METHODOLOGY	46
5.9	PRIORITY WATERWAYS OF THE NORTH CENTRAL REGION	47
	SECTION SIX: TARGETS AND ACTIONS	50
6.1	ASSIGNING PRIORITY ACTIONS ALONG PRIORITY WATERWAY REACHES	50
6.2	THE TARGET-SETTING PROCESS	51
6.2.1	TARGET-SETTING ASSUMPTIONS	52
6.2.2	PROGRAM AREA TARGET TABLES	52
6.2.3	CATCHMENT ACTION PLANS	53
6.3	THREAT-MANAGEMENT INTERACTIONS	54
6.4	CAMPASPE RIVER CATCHMENT	56
6.4.1	UPPER CAMPASPE (ABOVE LAKE EPPALOCK) PROGRAM AREA	57
6.4.2	COLIBAN PROGRAM AREA	64
6.4.3	LOWER CAMPASPE (BELOW LAKE EPPALOCK) PROGRAM AREA	71
6.5	LODDON RIVER CATCHMENT	79



6.5.1	UPPER LODDON (ABOVE CAIRN CURRAN) PROGRAM AREA.....	80
6.5.2	UPPER LODDON (WESTERN TRIBUTARIES ABOVE LAANECOORIE) PROGRAM AREA.....	87
6.5.3	LOWER LODDON PROGRAM AREA.....	93
6.5.4	MID-LODDON PROGRAM AREA.....	102
6.5.5	GUNBOWER PROGRAM AREA.....	109
6.6	AVOCA RIVER CATCHMENT.....	115
6.6.1	UPPER AVOCA (UPSTREAM OF CHARLTON) PROGRAM AREA.....	116
6.6.2	LOWER AVOCA (DOWNSTREAM OF CHARLTON) PROGRAM AREA.....	123
6.7	AVON-RICHARDSON CATCHMENT.....	129
6.7.1	AVON-RICHARDSON PROGRAM AREA.....	130
6.8	REGIONAL TARGETS SUMMARY.....	135
SECTION SEVEN: COMMUNITY INVOLVEMENT.....		138
7.1	COMMUNITY ENGAGEMENT.....	138
7.1.1	COMMUNICATION OBJECTIVES.....	138
7.1.2	PHASES OF COMMUNITY ENGAGEMENT.....	138
7.2	COMMUNITY INVOLVEMENT AND CAPACITY BUILDING.....	141
7.3	COMMUNITY INVOLVEMENT TARGETS.....	142
SECTION EIGHT: IMPLEMENTATION.....		145
8.1	INTEGRATED STRATEGIC PLANNING.....	145
8.2	IMPLEMENTATION RESPONSIBILITIES AND PARTNERSHIPS.....	145
8.2.1	COMMUNITY.....	145
8.2.2	ROLES AND RESPONSIBILITIES IN THE WATER SECTOR.....	145
8.2.3	CATCHMENT MANAGEMENT AUTHORITIES.....	146
8.2.4	RURAL WATER AUTHORITIES.....	147
8.2.5	URBAN WATER AUTHORITIES.....	147
8.2.6	LOCAL GOVERNMENT.....	148
8.2.7	EPA VICTORIA.....	148
8.2.8	OTHER KEY REGIONAL PARTNERSHIPS.....	149
8.3	COST-SHARING PRINCIPLES.....	150
8.3.1	DUTY OF CARE.....	150
8.3.2	BENEFICIARY PAYS.....	150
8.3.3	GOVERNMENT CONTRIBUTIONS FOR PUBLIC BENEFIT.....	151
8.3.4	POSITIVE BENEFIT-COST.....	151
8.3.5	STATEWIDE POLICY AND MONITORING.....	151
8.4	INVESTMENT REQUIREMENTS.....	151
SECTION NINE: MONITORING AND EVALUATION.....		153
9.1	RIVER HEALTH STRATEGY REVIEW.....	153
9.2	MONITORING AND EVALUATION.....	153
9.2.1	ONGROUND ACTIVITIES.....	153
9.2.2	REPORTING.....	153
9.2.3	ADAPTIVE MANAGEMENT.....	153
9.3	MONITORING FRAMEWORK DEVELOPMENT.....	154
9.3.1	MONITORING AND EVALUATION TOOLS.....	154
9.3.2	IDENTIFIED MONITORING TOOL GAPS.....	155



9.3.3	MONITORING AND EVALUATION LIMITATIONS	155
9.4	RESEARCH AND DEVELOPMENT	155
9.4.1	INFORMATION GAPS	156
	REFERENCES.....	158
	APPENDIX 1 GLOSSARY	161
	APPENDIX 2 REGIONAL PLANS, STRATEGIES AND INVESTIGATIONS	163
	APPENDIX 3 THREATENED RIPARIAN-DEPENDENT FLORA SPECIES	167
	APPENDIX 4 THREATENED RIPARIAN-DEPENDENT FAUNA SPECIES	168
	APPENDIX 5 SUPPORTING DOCUMENT SAMPLE.....	169
	APPENDIX 6 REACHES RANKED ACCORDING TO ENVIRONMENTAL VALUE.....	170
	APPENDIX 7 REACHES RANKED ACCORDING TO SOCIAL VALUE.....	171
	APPENDIX 8 REACHES RANKED ACCORDING TO ECONOMIC VALUE	172
	APPENDIX 9 TARGET- AND COST-SETTING ASSUMPTIONS	173
	APPENDIX 10 UNIT-COST ASSUMPTIONS	175



Acknowledgements

The North Central Catchment Management Authority (CMA) would like to thank the following people who contributed to the preparation of the North Central River Health Strategy (RHS).

Members of the North Central RHS consultative committee helped to guide the completion of the Strategy by reviewing its development and providing important stakeholder input into the process.

- Alan Burns South West and Wimmera Regional Cultural Heritage Program
- Pam Clunie Department of Sustainability and Environment
- Ken Coates Community representative (currently Chair, Avon-Richardson Implementation Committee)
- Colleen Condliffe VFF representative
- Trevor Dedini Wimmera Mallee Water
- Damian Gerrans EPA Victoria
- Anne Graesser Goulburn-Murray Water
- Graham Hall North Central CMA
- Andrea Joyce Department of Sustainability and Environment
- Peter Kennedy Wotjobaluk Traditional Land Council
- Rob Loats Recreational Fishing Peak Body (VRFish)
- Tony Long Parks Victoria
- Ian MacBean Board Chair, North Central CMA
- Pam Manning Upper Loddon Landcare Coordinator - Central Goldfields and Hepburn Shire Councils
- Sally-Anne Mason Coliban Water
- John McKinstry Community representative (currently Loddon/Campaspe Dryland Implementation Committee member)
- Eain McRae Department of Primary Industries
- Des Morgan North East Regional Cultural Heritage Program
- Brien Nelson Parks Victoria
- Geoff Park North Central CMA
- Sue Phillips Environment Victoria
- Paul Ratajczyk Goulburn-Murray Water
- Joy Sloan Department of Primary Industries
- Debbie Smith Environment Victoria
- Ken Stewart North West Regional Cultural Heritage Program
- Jean Sutherland Board member, North Central CMA

The North Central CMA would also like to acknowledge the 20 submissions received providing comment on the draft Strategy from community members and various organisations during the period of public release.

North Central CMA project team:

- Angela Gladman, Rohan Hogan and Jon Leever – primary authors
- Sandra Volk – editing, designing and printing
- Brad Drust – data analysis
- Nathan Day – map production

We also acknowledge Bruce Abernethy and Avril Horne of Sinclair Knight Merz for their contribution in the development of priorities and targets, and Shelley Heron and Arthur Sovitslis for assistance with the RIVERS model. Thanks also to Alieta Donald and Deb Brown of the Department of Sustainability and Environment (DSE) for feedback and assistance.



Accompanying report

There is an accompanying report: North Central Catchment Management Authority (North Central CMA) 2004b, North Central waterways – values, threats and risks, North Central CMA, Huntly.

It provides the base data relating to the values, threats and risks for each of the 101 individual stream reaches across the North Central region. The document includes a detailed description of the RiVERS database and includes definitions of the values and threats.

A summary document of this Strategy is also available.

Acronyms and abbreviations used in this Strategy

AUSRIVAS	Australian River Assessment System
CAMBA	China-Australia Migratory Bird Agreement
CAS	Catchment and Agricultural Services
CMA	Catchment Management Authority
COAG	Council of Australian Governments
DSE	Department of Sustainability and Environment
DPI	Department of Primary Industries
EPA	Environment Protection Authority
ESD	Ecologically Sustainable Development
EVC	Ecological Vegetation Class
EWR	Environmental Water Reserve
G-MW	Goulburn-Murray Water
IC	Implementation Committee
ISC	Index of Stream Condition
JAMBA	Japan-Australia Migratory Bird Agreement
LG	Local Government
MDBC	Murray-Darling Basin Commission
ML	Megalitres
NAP	National Action Plan for Salinity and Water Quality
NHT	Natural Heritage Trust
NRE	Department of Natural Resources and Environment (now DSE/DPI)
NRM	Natural Resource Management
RCS	Regional Catchment Strategy
RHS	River Health Strategy
RiVERS	River Values & Environmental Risk System
SEPP	State Environment Protection Policy
VROT	Victorian Rare or Threatened Species
VWQMN	Victorian Water Quality Monitoring Network
WMW	Wimmera Mallee Water
WoV	Waters of Victoria

See Appendix 1 for a Glossary of the key terms used in this Strategy.



SECTION ONE: CONTEXT AND BACKGROUND

1.1 Introduction

Although rivers, creeks and wetlands are only a small portion of our landscape, their overall importance to the economy, the ecology and the social fabric of the North Central region is significant.

Until fairly recently, waterways were regarded as a resource to be exploited. They were often seen as convenient channels or drains for the supply of water or the transport of wastes. However, with great improvements in our knowledge of the complex nature of river systems and a greater awareness of the vital role they play in our daily lives, we now have a much greater appreciation of their social, economic and environmental value.

Our waterways are important to the community because they:

- provide drinking water
- provide water for both irrigation and industry
- are a focal point for recreation and tourism
- have a unique environment and biodiversity
- have strong cultural and historical associations.

It is therefore imperative that waterways are protected assets enhanced for future generations. Healthy rivers, which reflect the health of the catchment, sustain communities and agriculture in this region.

Improving the health of Victorian rivers will only be achieved by addressing environmental flows (through the Environmental Water Reserve), declining water quality and degraded riverine habitats in an integrated way. In 2002, the Government released the Victorian River Health Strategy (RHS) (DNRE 2002a). The Victorian RHS provides a statewide policy framework for managing the health of Victoria's rivers, floodplains and estuaries. It aims to restore stressed rivers and protect healthy waterways by treating the problems collectively.

Within this statewide context, community management objectives and management targets are set in regional river health strategies. These regional strategies identify the environmental, social and economic water services (or assets) in each area, their value to the State and the region, and the issues that threaten these services. They also establish priority areas for restoration, and provide an integrated program for river restoration at the regional level.

The regional planning process set out in the Victorian RHS aims to build on the current planning arrangements and represents the 'next evolutionary phase' by integrating existing plans and providing a focus on overall river health outcomes. Effectively, a hierarchy of planning was established where the national, state, regional and local scales are vertically integrated. The primary focus of decision-making was on regional planning and management.

The North Central RHS forms a key component of the North Central Regional Catchment Strategy (RCS) (North Central CMA 2003a). The North Central RCS is the primary integrated planning framework for natural resource management in the North Central region. The North Central RCS identifies both 'Waterways and wetlands' and 'Water resources' as key natural resource assets in the region.

In June 2004, the Victorian Government released 'Our Water Our Future' that sets out an action plan to secure Victoria's water future over the next 50 years. Through the framework laid out in 'Our Water Our Future', the Government aims to achieve the sustainable management of water, to allow all the benefits of water to be enjoyed today, while protecting the needs of future generations. Sustainable water management will mean:

- reliable and safe urban water and sewerage services as demanded by customers
- a high-value, low-impact irrigation industry supported by robust rural and regional communities
- healthy rivers, aquifers, floodplains, estuaries and catchments capable of delivering a wide range of water services
- communities that truly appreciate all the services water provides, that are able to make considered choices about how those services are delivered
- communities that have a stronger ethic of water conservation
- a water sector with increased efficiency and accountability, delivering diverse water services in an innovative way.



A key outcome of 'Our Water Our Future' (DSE 2004a) is the recovery of water through the sales deal to meet the Government's commitment to the Living Murray Initiative. This water recovered may optimise with environmental entitlements specified through the bulk entitlement conversion process in the Loddon and Campaspe rivers to maximise ecological outcomes.

In June 2004, the Victorian Government released 'Our Water Our Future' that sets out an action plan to secure Victoria's water future over the next 50 years through sustainable water management. This document strengthened the role of catchment management authorities as 'caretakers of river health' and the managers of the Environmental Water Reserve. Government has also recently released the 'Our Environment Our Future: Victoria's Environment Sustainability framework'. The framework strengthens Victoria's commitment to maintaining and restoring our natural assets for a prosperous and livable Victoria.

In this role, CMAs have strategic planning and priority-setting responsibilities for catchments, and deliver waterway, regional drainage and floodplain management services. This is outlined in Action 3.1 of 'Our Water Our Future' (DSE 2004a) which states the Government will improve the health of Victoria's rivers, floodplains and estuaries through 'using regional river health strategies and catchment management authorities to establish regional priorities and integrated programs for river protection and restoration within a statewide policy context'.

1.2 Regional overview

The region of the North Central Catchment Management Authority (CMA) covers approximately three million hectares or 13% of the State of Victoria. Extending from the River Murray in the north, to the Central Highlands in the south; the Mount Camel Range forms the eastern boundary of the region while the internally drained Avon-Richardson Basin forms part of the western border (see Figure 3).

1.2.1 River basins

The former Australian Water Resources Council identified 12 major drainage divisions in Australia and 246 river basins. The North Central region contains four river basins (or catchments):

- Campaspe Basin 6
- Loddon Basin 7
- Avoca Basin 8
- Wimmera Basin 15

Basin 15 is divided between the regions of the North Central CMA (Avon and Richardson rivers) and Wimmera CMA (Wimmera River and tributaries). Basin 8 is also divided between the regions of the North Central CMA (Avoca River and part of Lalbert and Tyrell Creeks) and Mallee CMA (Lake Tyrell and Lake Timboram).

The Campaspe and Loddon rivers flow directly into the River Murray. The Avoca River flows into a series of lakes and wetlands (the Avoca Marshes). During flood events, it may flow to the River Murray and via stream channels to a further series of lakes. The Avon-Richardson catchment is internally drained, with most surface water flowing into Lake Buloke in the north of the catchment.

Although not part of the North Central region, the River Murray between Echuca and Swan Hill lies on the border of the region, and the interaction between the region and the River Murray is very significant – the River Murray is the single largest source of water in the region for irrigation, while the Loddon, Campaspe and Avoca rivers all contribute water, salt and nutrients to the Murray as well as the exchange of aquatic species (i.e. migratory fish). The River Murray is a waterway of national importance and is integral to the health of the internationally significant Gunbower Forest and Kerang Lakes wetlands.

1.2.2 Climate

Rainfall ranges between about 300mm per year in the northwest and over 1200mm per year in the southeast. Average daily temperatures in the northwest range from 15 to 31 degrees Celsius in January and from 4 to 14 degrees Celsius in July. In the far south, the temperatures range between 11 and 27 degrees Celsius in January and between 2 and 10 degrees Celsius in July.



1.2.3 Water resources

The challenge to provide quality water for central Victoria began in the 1850s when gold was discovered and attracted thousands of hopeful diggers en masse. The region's waterways began to play a crucial role in supplying water to the gold rush communities. Complex water supply networks were designed and installed in the upper catchment areas to meet the water supply needs of gold mining towns that evolved independently of secure water supplies. The Coliban Water Supply System is listed on the Victorian Heritage Register for its European heritage significance.

To service the growing regional development, a number of storages were built. Three major storages are now managed by Coliban Water on the Coliban River (the Upper Coliban, Lauriston and historic Malmsbury reservoirs). Goulburn-Murray Water manages three storages on the Loddon River (Tullaroop, Cairn Curran and Laanecoorie reservoirs) and one storage, Lake Eppalock on the Campaspe River. Today, these storages provide water for domestic, commercial and agricultural uses. Irrigation water supplies from the Murray and Goulburn river systems and stock and domestic supplies from the Wimmera system supplement the region's surface water resources. Irrigated agriculture uses 1,425,000 ML/year and urban activity uses approximately 40,000 ML/year (North Central CMA 2003a).



Figure 3 Region of the North Central Catchment Management Authority (CMA)



Groundwater is a significant and valuable component of the North Central region's water resources. Where a groundwater aquifer is highly connected to surface water, a decline in groundwater levels will affect users of both the groundwater and the connected surface water. The groundwater contribution to river flow is also reduced. It also impacts on wetlands and other dependent ecosystems like native vegetation. Groundwater is used extensively for stock and irrigation purposes and increasingly for town water supplies in the North Central region. In some towns, such as Trentham, groundwater is used to augment surface water sources, while in others, it is the primary potable water source, such as Elmore. Thirteen groundwater systems of different geology and flowpath lengths have been identified within the North Central region, consisting of local, intermediate and regional types. Dependable groundwater supplies for stock and domestic bores are available at depths less than fifty metres in some areas of the North Central region.

Groundwater use is most extensive in the south of the region for the irrigation of horticultural crops and pastures. Mineral springs are also used to support both the processing and tourist industries. Increasingly, deep lead aquifers in the middle and lower reaches of the Loddon and Campaspe valleys are also employed.

1.2.4 Land use

Horticultural, dairying and mixed enterprises cover much of the lower Loddon and Campaspe riverine plains, which are supported by an extensive irrigation infrastructure. Dryland agricultural land uses, such as cropping and grazing, cover much of the middle and upper areas.

One of the greatest changes in land use in the North Central region is the development of previously undeveloped land through subdivision and rural living zones, which may have significant impacts on catchment and river health. A major increase in the number of lifestyle properties and urban expansion is obvious in a number of smaller towns, most noticeably along the Calder Highway corridor. Specifically, Bendigo has been identified in the Melbourne 2030 Strategy as an area ear-marked for accelerated development in line with the policy of 'better connected cities'. A 50% population increase over the next 30 years is predicted for Bendigo (DSE 2004a). This development may have a significant impact on both surface and groundwater quality and quantity, as well as the demand on potable supplies and wastewater treatment and reuse.



Photo: Mat Gordon

Dryland cropping is one of many landuses in the North Central region.

1.2.5 Floodplains

The catchments of the various rivers and streams within the North Central region include areas of flood-prone land, where flooding has historically caused substantial damage to both the natural and built environment. Floods are naturally occurring events. The inherent functions of the floodplains to convey and store floodwater should be recognised and preserved to minimise the deterioration of environmental values and the long-term flood-risk to floodplain production, assets and communities.

More than 5,000 square kilometres of rural and urban land across the region under public and private ownership is subject to inundation by a 1 in 100 year flood. Average annual flood damage is estimated to exceed \$23 million per year and is believed to be escalating as development in floodplains continues for urban, agricultural and infrastructure purposes. *Ad-hoc* works and inappropriate development in the past have significantly impacted on the natural floodplains by changing the flood frequency and flooding patterns, and has caused deterioration in the natural riverine, floodplain and wetland environments. Best practice floodplain management will reduce flood damage, improve the wellbeing of landowners and reduce adverse impacts on the natural environment.

1.2.6 The natural environment

Wetlands help to protect water resources by maintaining or improving water quality, maintaining channel form and flow capacity and providing habitat, energy and nutrients for aquatic ecosystems. Within the North Central region, many waterways and floodplains have been transformed by urban development and agriculture, and the distribution of wetlands has significantly contracted. Despite this, many of the waterway and wetlands of the region are acknowledged for their national and international significance.



The Kerang Wetlands and Gunbower Forest have been recognised as Wetlands of International Importance and are listed under the Convention on Wetlands (Ramsar, Iran 1971). To obtain this listing, wetlands must meet one or more internationally accepted criteria in relation to their zoology, botany, ecology, hydrology or limnology and importance to waterbirds (DSE 2003b). Many wetlands in the North Central region provide habitat for migratory birds protected under international agreements.

The North Central Wetlands Strategic Directions Paper (draft) (North Central CMA 2004a) aims to ensure strategic issues affecting wetlands are addressed as directed by the North Central RCS (North Central CMA 2003a). A more comprehensive Wetlands Strategy for the North Central region will be developed to provide more detailed direction for wetland management.

Bioregions are biogeographic areas that capture the patterns of ecological characteristics in the landscape or seascape, providing a natural framework for recognising and responding to biodiversity values (North Central CMA 2003b). There are eight bioregions represented within the North Central region, including:

- Murray Mallee
- Wimmera
- Goldfields
- Victorian Volcanic Plain
- Central Victorian Uplands
- Victorian Riverina
- Northern Inland Slopes
- Murray Fans

1.2.7 Population

The North Central region's population exceeds 200,000 people, most of whom live in the larger urban centres. The region covers over 50 urban centres including Swan Hill, Echuca, Donald, St Arnaud, Bendigo, Castlemaine, Maryborough and Creswick (Figure 1).

1.2.8 Waterway values of the regional Indigenous community

An intrinsic relationship between Indigenous culture and land has endured for over 40,000 years. The land continues to inform Indigenous identity and community today. Traditionally, Indigenous people have a strong affinity with waterways and water bodies, as a vital source of food, water and camping sites.

Within the North Central region, there are many areas of significance to Indigenous people. The connection may be traditional or contemporary (or both). Such sites are located along rivers and water edges and the margins of watercourses, billabongs, wetlands, floodplains and lunettes, which tend to have a high incidence of Indigenous artefacts.

Indeed, there are 3,188 registered places of Indigenous cultural heritage held within the Heritage Registry of Aboriginal Affairs Victoria, Department for Victorian Communities. However, it is highly likely that further additional places exist. Of these registered places of cultural heritage, scarred trees (45%), artefact scatters (23%) and mounds (22%) are the most common.

There are also 18 significant cultural landscapes, which have been placed on the 'Register of the National Estate'. These include stone quarries, rock wells, middens, burial caves, scarred trees and the Kow Swamp burial site, which is dated at between 9,000 and 13,000 years old (Australian Heritage Commission 2003).

Other Indigenous assets within the North Central region include:

- Indigenous owned and lands
- sites of ceremonial and spiritual significance e.g. sacred sites – bora rings, burial sites and birthing sites
- fishing areas – rivers and lakes
- traditional plant, animal and mineral resources
- trade and travel routes.

Protection of historical evidence of occupation sites within the region is fundamental to Indigenous cultural heritage and is required under legislation. As many sites are very specific to this area, it is essential that they be protected and honoured. It should be noted that, as these Indigenous assets are the foundation of Indigenous people's physical, spiritual and cultural existence and identity, Indigenous people within the North Central region need to be consulted regarding their protection and enhancement. Indigenous communities have also indicated a strong interest in the current



condition of water and waterways and want to be informed and involved in the management of these resources (SAMLIV Project Team 2003).

1.2.9 Waterway values of the wider regional community

European exploration and settlement of the North Central region was closely linked to waterways. Water was a vital component of many of the colony's early activities such as expedition trails, stock routes, pastoral and mining enterprises. Many of the towns of the region were settled at significant sites along waterways.

People of the North Central region today retain a strong connection to waterways and most towns have an associated waterway or waterbody that provides aesthetic appeal. Access to water is also the lifeblood of the region's primary production industries. Waterways are widely used for recreational pursuits such as boating, swimming and fishing.

Sites of European cultural heritage significance are well documented within the North Central region. In fact, the Victorian Heritage Inventory, which lists all known historic archaeological sites and relics, has 2023 on record. These sites and relics include cemeteries, mine sites, diggings, workings and mullock heaps. In addition, 758 places of significant heritage value have been placed on the 'Register of the National Estate'.

In addition to the Heritage Inventory, the Victorian Heritage Register lists Victoria's most significant places, objects and historic shipwrecks. Within the North Central region, there are 373 archaeological sites of state significance. These include sites such as Botanic Gardens, bridges, cemeteries, buildings, gold mines, water supplies and railway stations. European cultural landscapes within the region include old stock routes and expedition trails of early explorers.

The broad community places a high-value on water and waterways, from which it derives many benefits. These include irrigation, stock, domestic and industrial supply, tourism, habitat for native flora and fauna, recreational and visual amenity values, regional identity and nature conservation.

1.3 Scope

The Victorian RHS (DNRE 2002a) highlights the importance of having a regional planning process which not only builds on the crucial work undertaken to date but also encourages better integration of plans by providing a focus on integrated river health outcomes. It includes a catchment approach undertaken within a clear state policy context. The planning framework needs to be consistent with and consider policy directions taken at the local, state, Murray-Darling Basin, federal and international scales documented within:

- 'Our Water Our Future'
- North Central Regional Catchment Strategy
- Victorian catchment management arrangements
- State Environment Protection Policy (Waters of Victoria)
- Victorian Biodiversity Strategy
- Victorian Nutrient Management Strategy
- Victorian Salinity Management Strategy
- Murray-Darling Basin Integrated Catchment Management Policy
- National Action Plan for Salinity and Water Quality
- Council of Australian Governments (COAG) agreement on water reform
- International conventions – Ramsar, JAMBA, CAMBA

The North Central RHS focuses on the management and ecological condition of river systems within the region and the activities that may have an impact on their health. As floodplains, groundwater systems, wetlands and terminal lakes can all form part of river systems, their condition and priority actions for improvement are also considered in the North Central RHS and further detailed in supporting plans.

1.4 Process of development

The North Central RHS addresses several requirements of the Victorian RHS as outlined in the 'Guidelines for Preparation of a Regional River Health Strategy' (DSE 2003a). As such, the North Central RHS will:

- identify environmental, recreational, cultural, social and economic assets
- identify threats and risks to these assets
- identify existing action plans relevant to the implementation of the North Central RHS



- identify knowledge gaps
- set priorities based on a risk-assessment approach as identified in the Victorian RHS
- develop five-year management action targets and ten-year resource condition targets
- develop integrated river health objectives
- outline a monitoring, reporting and review program
- include a community awareness program.

1.4.1 Values, threats and risks

Regional priorities have been determined by the North Central CMA guided by the principles of the Victorian RHS, which consider environmental, social and economic values, threats and associated risks. The RiVERS (River Values & Environmental Risk System) database was developed jointly by DSE and the CMA Waterway Managers Forum. This included the allocation and definition of values and threats to be used by all CMAs to guide the development of regional river health strategies. This database was used to assign scores to quantify the values and threats of the major waterway reaches within the North Central region.

The RiVERS database was populated with multiple attributes relating to the environmental, social and economic values, and the threats to those values. These attributes were scored using two methods. Approximately half the scores were derived from existing statewide DSE datasets, e.g. threatened species, Index of Stream Condition data (1999). North Central CMA staff populated the remaining attributes based on relevant plans, investigations and community input. The RiVERS database is discussed in more detail Section 4.1. How this community information was collected is described in Section 7.1.2 and a summary of the results are discussed in Section 4.

The supporting document to the North Central RHS entitled '*North Central waterways – values, threats and risks*' (North Central CMA 2004b) provides a thorough explanation of the RiVERS database, value and threat definitions, and presents the values, threats and risks of each major waterway reach in the North Central region.

The priority-setting process described in Section 5, explains how the information contained in the RiVERS database was used to assist in the identification of priority reaches and priority actions to undertake along these reaches.

1.4.2 Review of action plans

The North Central RHS has been developed on a sound foundation of supporting plans and strategies that have already been completed for the North Central region. Specifically, the four catchment-based River Health Plans provide a wealth of information that will link closely with the outcomes of this document.

A number of plans and strategies were reviewed by the North Central CMA that relate either directly or indirectly to river health outcomes. These plans address specific topics including fisheries management, flow, water quality, waterways and wetlands, floodplain and vegetation. These relevant plans and strategies have been referenced in this Strategy and are briefly described Appendix 2.

1.4.3 Establishing priorities and targets

Setting priorities for management ensures that resources are allocated to the most important areas and issues. Prioritisation is especially critical where the values and/or threats are great and the resources are limited. The best use of those resources can only be directed by the information currently available. Given the array of values and threats that characterise the river management issues in the North Central region, the Strategy defines a clear method to:

- determine the location of priority waterway reaches
- the priority actions to address key values and threats along these reaches.

The prioritisation principles outlined in Section 5 of this Strategy closely reflect the prioritisation framework outlined in the Victorian RHS (DNRE 2002a).

The Victorian RHS (DNRE 2002a) states that when selecting priorities for river protection and enhancement, they will be based on:

- protection of existing high-value areas or areas in good condition
- restoration of those areas where there is:
 - the highest environmental and community gains for the resources invested
 - real community commitment towards long-term improvement of river health.



In order to allocate resources to maximise outcomes in river health, clear targets need to be set. These are described in Section 6. Targets for the North Central region have been developed to align with national, state and regional goals and targets.

Targets are defined at three scales:

- An Aspirational Target that describes the vision for the desired long-term (50+ years) condition of the natural resource within each catchment.
- A Resource Condition Target is the level of change that might reasonably be sought along a priority reach within a ten-year period.
- A Management Action Target that reflects the activities or level of effort required along a priority reach in the short term to reach the Resource Condition Target.

The cost of implementing priority actions to achieve the set targets are based on a number of cost-sharing principles (listed in Section 8.3) as defined in the Victorian RHS. Some basic cost-setting assumptions have also been made. These are outlined in Appendix 10.

1.4.4 Monitoring and review

The framework for the management of catchment health must be adaptive – one that includes the capacity to learn from management decisions and to change management strategies as we know more. Feedback on the natural system's response to decisions and outcomes is important. This requires good baseline information, continued monitoring, and evaluation of management outputs and impacts. The information collected needs to be in a form that is useful to landholders, regional communities and government. The monitoring approach for this strategy is outlined in Section 9.

1.4.5 Consultation

A key objective of the North Central RHS (as listed in Section 2.3.1) is to involve the community in planning and participating in actions to improve the health of waterways, floodplain and wetland systems. The community includes everyone who lives and works in the North Central region, those who visit and who are otherwise connected. The community is responsible for sustained management of natural resources.

Effective management involves creating and managing working partnerships within and between the various levels of government, communities and community groups, Indigenous communities and private landholders from planning to implementation. The consultation process to develop the Strategy is clearly outlined in Section 7.1. It was guided by the *Communication Plan for the North Central RHS* (North Central CMA 2004c) developed in consultation with the North Central RHS Consultative committee.

The process kickstarted with a series of River Health Forums in 2002 across the region, which gathered information about the values and threats to waterways from the wider community, Indigenous community and partner organisations. It was used as a 'reality check' of the data contained within the RIVERS database and to guide priorities and targets.

A consultative committee was formed in 2003. The goals of the consultative committee were to review the development and progress of the North Central RHS and to provide important stakeholder input. The committee comprised of representatives from the North Central community and partner organisations.

The draft Strategy, a supporting document and fact sheet, were publicly released for comment between 26 August and 29 October 2004. The draft Strategy was distributed to all partner organisations and the Consultative committee. It was presented to the North Central CMA Board and Implementation Committee's. Summary fact sheets were distributed to regional Landcare groups and attendees from the River Health Forums. Twenty submissions were received and appropriate action discussed with the Consultative committee. Changes were made to the document before it was open for a final three-week comment period to the consultative committee and key stakeholders during March 2005.

The finalised Strategy was presented for endorsement at the North Central CMA Board meeting on 15 April, after which it was sent for Ministerial endorsement. All individuals, groups and agencies that provided submission on the draft Strategy received information detailing how their comments were considered.

A Communication Plan will be developed to direct the future implementation of the Strategy in terms of community engagement and agency involvement.



SECTION TWO: VISION AND OBJECTIVES

2.1 Defining river health

The word 'health' in environmental contexts is not straightforward. People generally know what it means to be healthy; the meaning of the health of a catchment, landscape or ecosystem however is less clear. The concept of health was quickly expanded to include communities, social systems and landscapes.

The Victorian River Health Strategy (RHS) (DNRE 2002a) uses 'river health' to describe the ecological condition of a river. Health is more than what lives in a river or the quality of its water. To understand properly how healthy a river is, three aspects of the river system should be considered:

- the diversity of the habitats and biota
- the effectiveness of linkages
- the maintenance of ecological processes.

In the North Central, the CMAs role as caretakers of river health was strengthened in 'Our Water Our Future' (DSE 2004a). It is responsible for a range of functions which directly impact on the environmental condition of rivers and is expected by Government to show leadership on the management of river health in the North Central region.

Health incorporates the cumulative historical impacts on catchment condition and current conditions imposed by demands on natural resources. It implies a viable condition, a self-sustaining state or series of states, which are compatible with human use and habitation.

Our water system provides a wide range of services for all Victorians. It delivers economic value by allocating water to towns, irrigation, agriculture and industry, while healthy rivers and aquifers provide environmental, cultural and recreational value.

River health in the context of the North Central River Health Strategy (RHS) has been interpreted as consisting of three main themes which together dictate the health of a river or stream and which, if considered separately, can often lead to stream degradation. These themes are the environment, society and economy.

Combined, these themes are often referred to as the Triple Bottom Line. It is often argued that determining actions on a Triple-Bottom-Line basis involves compromise or trade-offs. However, informed decision-making must not only be economically sound, but environmentally and socially sound, in both the short and long term. The main focus of the North Central RHS is to protect and enhance the environmental assets of the North Central region as it considers social and economic values.

2.2 A vision for the North Central region

In February 2004, the North Central RHS Consultative committee discussed an overall vision for the North Central region.

The vision was built on the recognition that waterways and wetlands are key environmental assets that support varied and diverse ecological communities. It was also recognised that the waterways and wetlands within the North Central region are important economically and are valued socially. We need to strike a balance between the environmental, social and economic values of our river systems, and ensure that this balance is sustainable for the long-term future.

NORTH CENTRAL RIVER HEALTH STRATEGY – VISION

Waterways and wetlands will be managed sustainably to protect and enhance their diversity and ecological function while supporting the uses of the regional community.



2.3 Objectives of the North Central River Health Strategy

Regional objectives have been developed, based on the management framework of the Victorian RHS (DNRE 2002a) and 'Our Water Our Future'. These objectives have been developed to support and provide further direction to realise the vision of the North Central RHS. They are regional, broad and represent long-term goals.

Although objectives from 'Our Water Our Future' that relate to the actions of rural and urban water authorities are not specifically outlined, their influence on river health is acknowledged.

2.3.1 Community engagement

- To involve the community in the planning, and participating in actions to improve the health of waterway, floodplain and wetland systems. The community includes everyone who lives and works in the North Central region, visitors and those otherwise connected.
- To enhance the environmental, social and economic benefits of waterways valued by the community, e.g. recreational fishing.

2.3.2 Flow regimes

- To have improved environmental flow regimes through the processes of bulk entitlements, Environmental Water Reserves, recognition of ecological stress, risk-based approaches, and the development of the Sustainable Water Strategy for northern Victoria.
- To achieve greater fish migration, diversity of flora and fauna dependent on aquatic ecosystems, especially the region's wetlands and river reaches of high ecological value.



Photo: Brad Drust

The North Central CMA promoted river health management activities along Birch Creek on the children's television program 'Totally Wild' in 2003.

2.3.3 Water quality

- To protect and enhance waterways, water quality and the implementation of the State Environment Protection Policy (Waters of Victoria).
- To limit nutrients and sediments entering waterways by reducing soil loss from dryland and agricultural areas, and reducing the impact of urban wastewater, stormwater, irrigation and intensive animal industries. Greater involvement of stakeholders in works and extension activities will be sought.
- To reduce the frequency of algal blooms, limit sediments and nutrients at their source, and improve instream ecosystem health and diversity.
- To reduce stream salinities entering the River Murray and the impact of salinity on catchment health.

2.3.4 Riparian lands

- To establish a regional network of protected and maintained riparian vegetation corridors with high environmental value through fencing, establishing buffer strips and sharing the cost and management with landowners.
- To protect and enhance riparian vegetation according to the Principles of Best Practice outlined in the Victorian RHS (DNRE 2002a) and the North Central Vegetation Best Management Practice project (in development).

2.3.5 Instream biota

- To restore diversity, habitats, connectivity and movement of instream material, through stabilisation and restoration of channels, banks, substrate and riparian vegetation.
- To enhance the diversity and population of native aquatic fauna.

2.3.6 Threatened species and communities

- To protect and enhance threatened flora and fauna species and communities that rely on healthy waterway, floodplain and wetland systems.¹

¹ A list of the threatened flora and fauna along waterways in the North Central region is provided in Appendix 3.



2.3.7 Floodplain, wetlands and groundwater

- To better understand and improve the connection between rivers, floodplains and wetlands and the life cycle requirements of instream biota dependent upon aquatic ecosystems.
- To better understand the interactions between groundwater and surface water and the impact on river health.

2.3.8 Adaptive management, monitoring and education

- To operate effective delivery of regional monitoring, reporting, education messages, and involvement of stakeholders in river health outcomes.

2.3.9 Strategic planning

- To minimise the localised and catchment-scale impact of development to ensure the 'overall improvement' in river health.

To meet these objectives, waterways, wetlands and floodplains in the North Central region will:

- support efficient, sustainable agriculture
- supply clean and safe drinking water
- support recreational pursuits, e.g. fishing, camping, birdwatching, canoeing
- preserve Indigenous values.

2.4 Implementing the vision

Waterways and wetlands are complex, influenced by many interactions. The North Central RHS provides an integrated approach to river health management and sets a clear direction to meet the long-term vision and objectives for the North Central region.

The vision and objectives have been broadly used to set long-term targets for river health for each of the four catchments, which are outlined in Section 6. Five-year and ten-year targets aim to progress toward these long-term targets for identified priority reaches. Section 7 outlines the community involvement required to achieve the vision and objectives, from the early planning stages through to the implementation of actions to improve river health.



SECTION THREE: STRATEGIC FRAMEWORK

3.1 Overview of strategic framework

The North Central River Health Strategy (RHS) is a key regional document providing direction and management in river health across the region. There are many national, state and regional policies and strategies that influenced the development and future implementation of the Strategy. This chapter will provide contextual linkages between the North Central RHS and the strategic framework under which the region is currently operating.

3.1.1 National and state context

The Victorian River Health Strategy (RHS) (DNRE 2002a) provides the statewide framework for the future management of Victorian rivers. It shares close links with several key policies from a national and state perspective.

The Victorian Government is committed to the concept of Ecologically Sustainable Development (ESD). This means 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.'

The Victorian RHS provides the mechanism for implementing ESD as it relates to the use and protection of our waterways. The Victorian RHS will ensure rivers are managed in accordance with other Victorian Government policies including Victorian Catchment Management Arrangements, the State Environment Protection Policy (Waters of Victoria), the Victorian Biodiversity Strategy, the Victorian Nutrient Management Strategy and Victorian Salinity Management Framework.

River health will also be managed according to the relevant threatening processes identified under the *Flora and Fauna Guarantee Act 1988*, including:

- degradation of native riparian vegetation along Victorian rivers and streams
- increase in sediment input into Victorian rivers and streams due to human activities
- removal of woody debris from Victorian streams
- alteration to the natural temperature regimes of rivers and streams
- input of toxic substances into Victorian rivers and streams
- prevention of passage of aquatic biota as a result of the presence of instream structures.

Victoria is a signatory to the 1994 Agreement on Water Reform by the Council of Australian Governments (COAG). The Agreement requires considerable reform of the institutional arrangements, pricing mechanisms and policies for the management of water resources. This reform is based on the principles of ESD and requires Government's to provide EWR, manage water quality and improve the health of stressed rivers.

In developing the National Water Initiative, COAG agreed that there is a need to better assign the future risks of decline in the consumptive pool due to long-term changes in climate, and periodic natural events such as bushfires. COAG considered a risk-assignment framework to apply to future reductions in the availability of water for consumptive use. Victoria's risk-assignment framework is consistent with the COAG approach – in fact, it provides greater certainty for water users.

As outlined in 'Our Water Our Future', the Government will be responsible for:

- the sustainable management of the State's water resources
- the allocation of water resources for irrigation, urban use, the environment and for all other purposes
- establishing and maintaining the integrity of the State's water allocation system (DSE 2004a).

A key outcome of 'Our Water Our Future' is the recovery of water through the sales deal to meet the Government's commitment to the Living Murray Initiative. This water recovered may be optimised with environmental entitlements specified through the bulk



Photo: Douglas Graham

The River Murray receives flows from the rivers of the North Central region.



entitlement conversion process in the Loddon and Campaspe rivers to maximise ecological outcomes.

In terms of river health, 'Our Water Our Future' outlined two key reforms. These are the establishment of an Environmental Water Reserve (EWR) and the development of Sustainable Water Strategies.

Water will be set aside in an Environmental Water Reserve (EWR) that will:

- maintain the environmental values of the water system and the other water services that depend on environmental condition
- sustain biodiversity, ecological functioning and water quality
- have legal status and be held by the Crown.

The adoption of these principles for sustainable water allocations should be recognised as a major contribution to the National Water Initiative. The Environmental Water Reserve is a key reform, underpinning the objectives of the National Water Initiative.

In planning for water security in regions across the State, regional Sustainable Water Strategies will be developed in order to:

- identify and manage arising threats to the supply and quality of water for cities, towns and industry or rivers and aquifers
- exploit emerging opportunities to improve water security and the health of rivers and aquifers
- project what a regions' water situation may be like over the long term, and actions the community can take to improve it.

The regional strategies will further the National Water Initiative's outcomes of reflecting regional differences in the variability of water supply and the background knowledge to regional allocation decisions.

Within the North Central region, DSE will lead the development of the strategy for northern Victoria (River Murray and its tributaries) with the North Central CMA and other CMAs, urban and rural water authorities. It is expected to be completed before the 'First Step' of the Living Murray process.

Victoria is committed to Australian Government initiatives including the National Action Plan for Salinity and Water Quality, Murray-Darling Basin Integrated Catchment Management policy and the Living Murray. These initiatives are also very significant for North Central region and provide a consistent aim of achieving healthy rivers, ecosystems and catchments in accordance with the National Matters for Targets (see Section 6.1).

3.1.2 Regional context

The North Central Regional Catchment Strategy (RCS) provides a vision for the future landscape of the North Central region and the management of its natural resources (North Central CMA 2003a). The North Central RCS is the primary integrated planning framework for natural resource management in the region. It identifies key assets that are important to the region and sets targets on how to manage those assets. The North Central RHS forms a key component of the North Central RCS and provides linkages with many key assets identified in the North Central RCS, particularly 'Waterways and wetlands' and 'Water resources'.

A key target of the North Central RCS is to develop a North Central RHS to provide an integrated approach to river health management across the region. The North Central RHS is based on a process of identifying regional priority waterway reaches with high values to be protected and maintained. The roles and responsibilities of the key regional partners involved in delivering regional natural resource management are detailed in Section 8.2.

Further clarification and linkages of the various plans and strategies within the North Central region are explained in more detail in the Section 3.2. This includes an outline of the underpinning River Health Plans that contained detailed information about all of the named waterways in the region.

3.2 North Central region plans and strategies

One of the strengths of the North Central region is the extent to which plans have been developed and implemented to address many natural resources issues. These plans are acknowledged and reflected in both the North Central RCS and North Central RHS. They have been developed with considerable community and agency input.



Figure 2 shows how the various existing plans and strategies are linked with the primary and secondary assets listed in the North Central RCS (e.g. land, biodiversity, water, climate and communities) (North Central CMA 2003a). Figure 4 highlights the wealth of information and planning and the connections to the North Central RHS. Underpinning the North Central RHS are the four River Health Plans for the Campaspe, Loddon, Avoca and Avon-Richardson catchments, providing an even greater level of detail.

The development of the four catchment River Health Plans has involved over 1,600 rapid-assessment field surveys of 306 major (named) regional waterways. These surveys provide a more detailed account of the current condition than the 58 waterways surveyed using the Index of Stream Condition (ISC) method (which forms the basis for setting priorities in this Strategy). Although this detailed information was used to cross-reference the information in the RIVERS database, as the type of data collected differed between the two assessment methods, the information was not directly comparable.

As well as field surveys, other methods of data collection included aerial photo and map interpretation, a review of statewide flora and fauna databases, literature reviews (including historical literature) and input from the community via River Health Forums. This layered approach has provided the best information available to accurately describe the current condition of the region's waterways.

Each River Health Plan provides an overview of the catchment and summaries of the current condition of each major waterway. The current condition includes the environmental, social and economic values and threats of each waterway.

The North Central RHS will guide the direction of river management in the region, in terms of general principles, actions and targets. The River Health Plans will provide the additional level of detail required when planning onground activities to be developed with local communities and stakeholders in Catchment Action Plans.

Catchment Action Plans aim to clarify which works are to be undertaken, by whom and its location. Development of these plans involves engaging the local community, discussing the issues and agreeing on a course of action that aligns with the principles of the North Central RHS. This gives the community the opportunity to help improve river health at the local level.

Water quality and nutrient management is an important issue in the North Central region, and nutrient management strategies are now being implemented for each of the four catchments. Actions from these strategies are incorporated into the actions for priority reaches in Section 6. Under the Victorian RHS, guidelines will be established for developing Catchment Water Quality Action Plans, which will include broader water quality issues such as salinity, turbidity, thermal pollution and toxicants.

The urban and rural water authorities within the North Central region are also developing management plans for the water storages they manage, such as the draft Lake Eppalock Water Quality and Biodiversity Storage Management Plan (G-MW 2003).

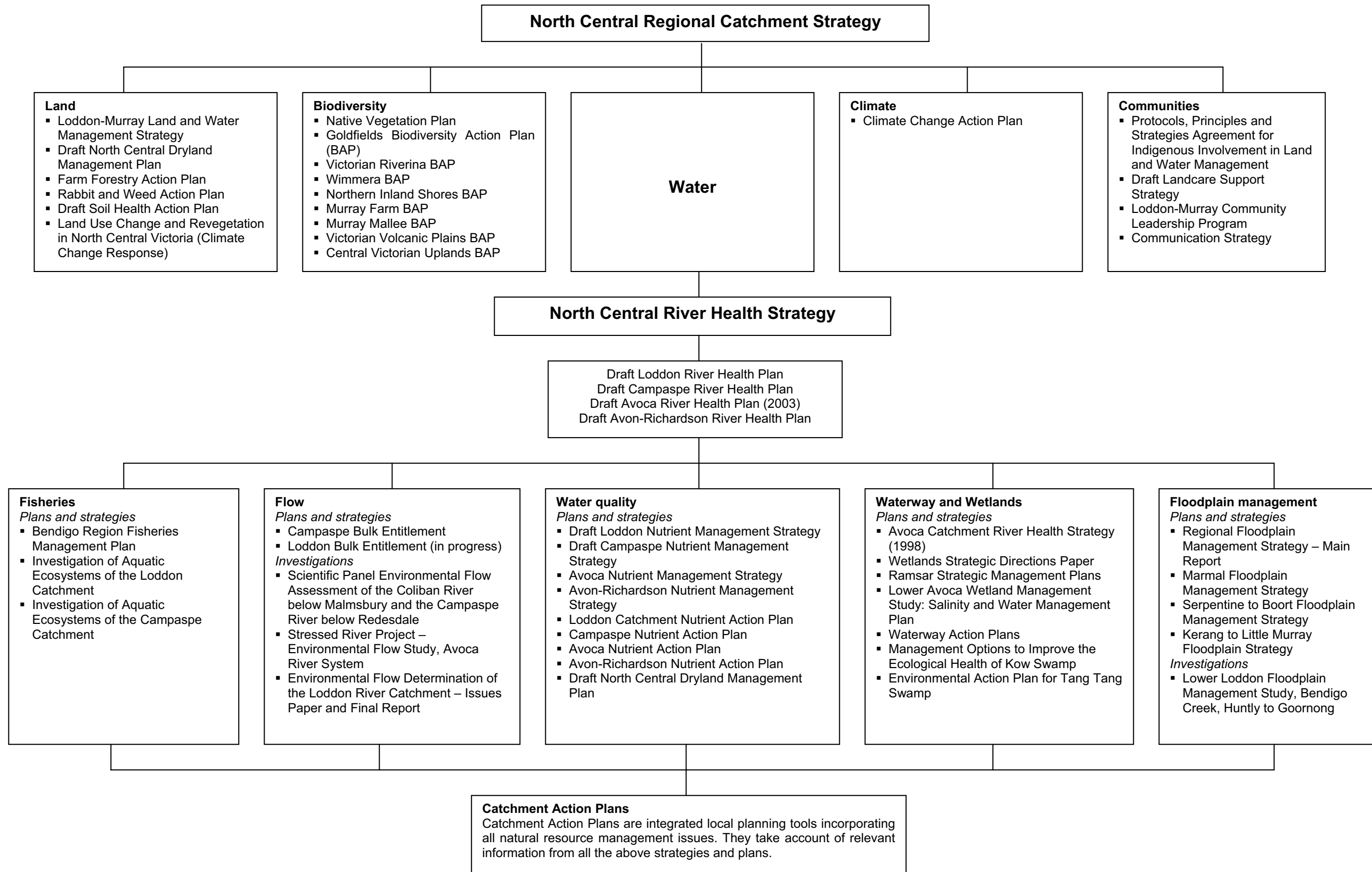
Wetland operational and management plans continue to be developed by partner agencies, such as DSE, DPI and Parks Victoria and the North Central CMA. For example, watering and operational plans have been developed for wetlands such as McDonald Swamp, Richardson's Lagoon and Murphys Swamp.

The Bendigo Region Fisheries Management Plan (DNRE 2002b) identifies performance measures and targets to achieve the best possible match between fisheries management arrangements and the recreational fisher's aspirations for fisheries in the Campaspe River and upper Loddon River catchments. The implementation of this plan is identified as an action in these areas of the region in Section 6. It is suggested that a regional-scale Fisheries Management Plan be developed to encompass the entire North Central region (Section 8.4).

An additional document to be produced within the next five years follows on from the strategic review of Crown water frontages the North Central CMA produced in 2000. Then the North Central CMA will benchmark all frontages and through the direction provided by DSE, prepare a Regional Frontage Management Plan.

A brief summary of the strategies, plans and investigations listed in Figure 4 is provided in Appendix 2.

Figure 4 North Central River Health Strategy in context with the North Central Regional Catchment Strategy





SECTION FOUR: REGIONAL WATERWAYS

4.1 Identification of waterway values, threats and risks

The development of the North Central River Health Strategy (RHS) uses a variety of tools, concepts and information sources. To appreciate the value of the Strategy, it is important to understand from where and how this information was derived.

4.1.1 Scales of river health management

River health management and planning in the North Central region occurs at several scales. As demonstrated in Figure 5, this varies from large geographic areas to individual sections of waterways.

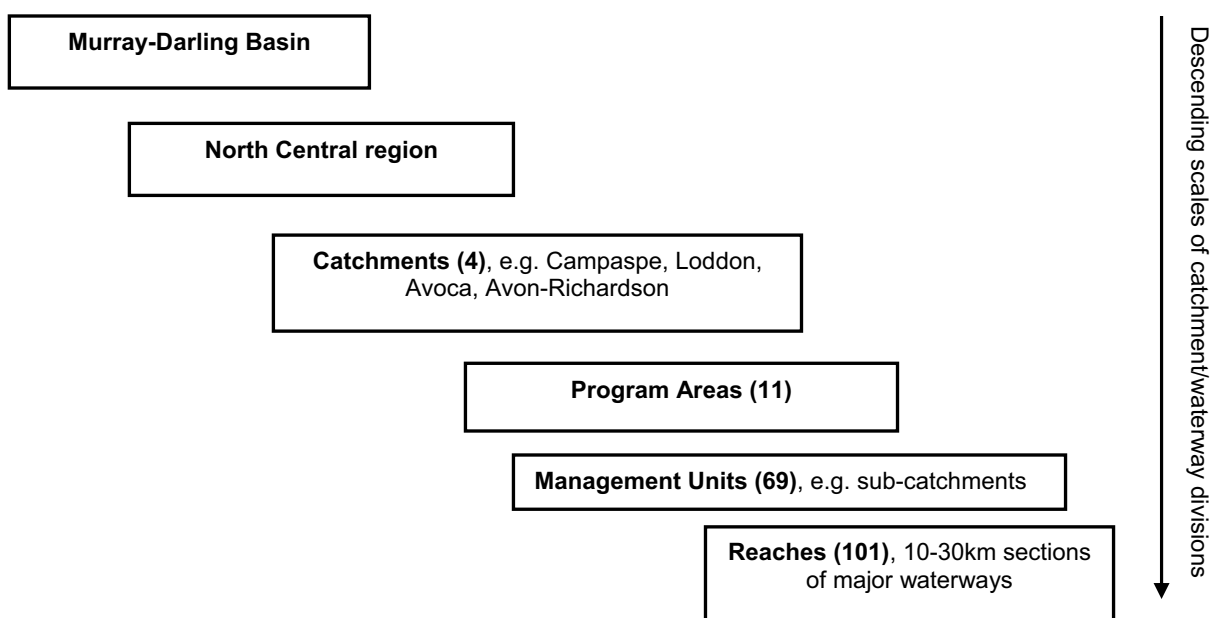


Figure 5 Means of dividing areas of catchments and waterways for management purposes.

The North Central region is an important part of the Murray-Darling Basin and therefore has a responsibility to contribute to the health of the River Murray. The region includes four major river catchments – the Campaspe, Loddon, Avoca and Avon-Richardson catchments.

In recent years, several North Central CMA catchment-based plans and strategies divided the four catchments into smaller 'Management Units' based on geographical similarities and stream management issues. Such documents include the Nutrient Management Strategies, Nutrient Action Plans and River Health Plans developed for each of the four catchments (see Appendix 2 for a summary of these documents). The 'Management Unit' scale was adequate for these documents to summarise waterway condition and to assign management actions. It remains a useful means of dividing individual catchments into manageable areas.

However, areas must still be large enough to sustain practical interest and attention. Use of the four catchments as planning units for river management does not allow sufficient regional resolution, while 69 'Management Units' provides too much detail to be manageable. Therefore, 11 Program Areas were identified within the North Central region (see Figure 6).

Program Areas were developed based on the following criteria:

- geography
- water regulation and large dam location
- river classes (upland and lowland)



- relationship to key supporting strategies (e.g. River Health Plans)
- size of area (to set meaningful targets).

The Program Areas assist in grouping a manageable number of priority reaches together in order to present Management Actions and Resource Condition targets at the reach scale (in Section 6). The concept of 'reaches' are further explained in Section 4.1.2.

The following Table 3 summarises the breakdown of reaches in each Program Area and catchment in the North Central region. To avoid confusion, the corresponding Management Units are not included in this table as they have less relevance in this strategic document. Figure 6 defines these Program Areas.

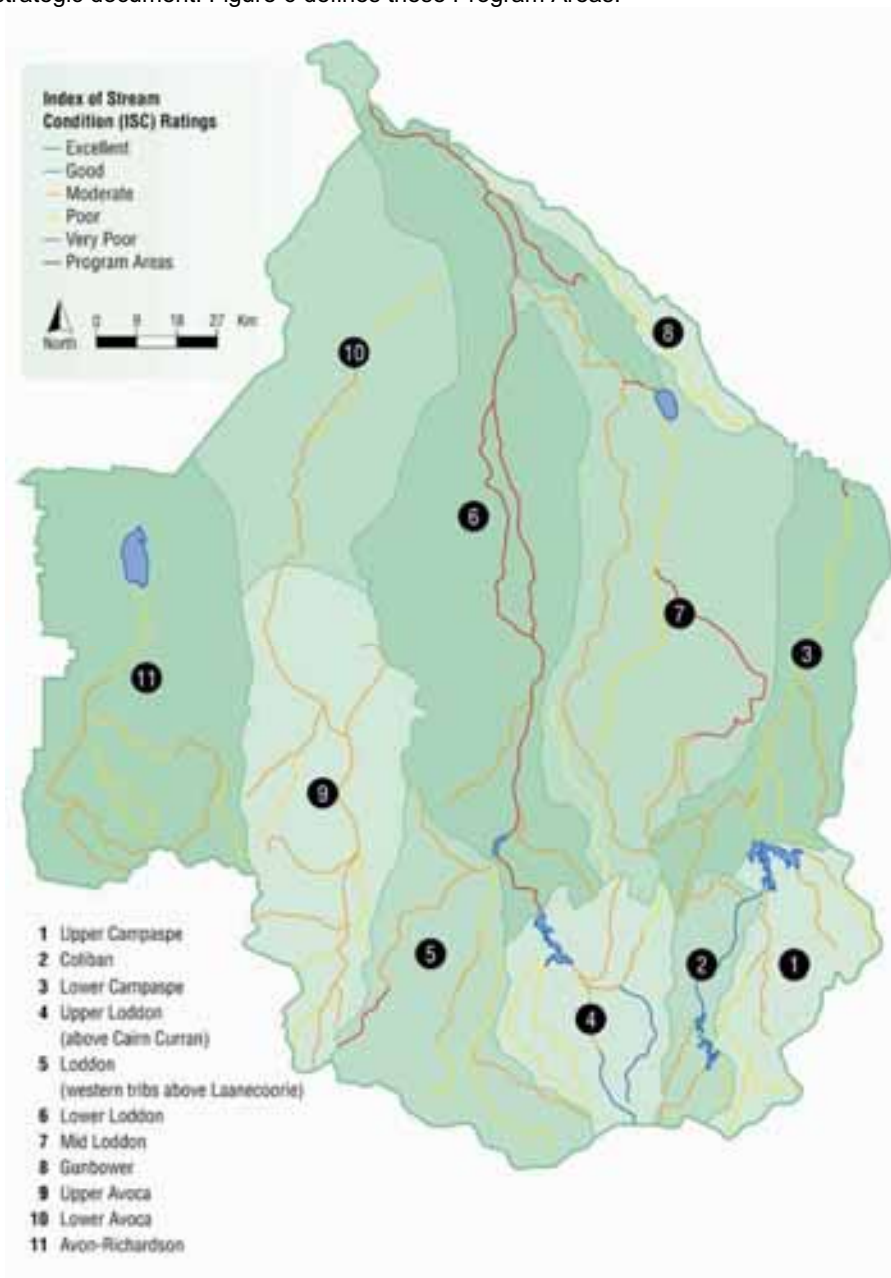


Figure 6 North Central CMA Program Areas



Table 3 List of waterways within Program Areas

Catchment	Program Area	Waterway	ISC Reach
Campaspe	Upper Campaspe (above Lake Eppalock)	Campaspe River	6, 7
		Mclvor Creek	14, 15
		Wild Duck Creek	16
		Pipers Creek	23
		Five Mile Creek	24
	Coliban	Myrtle Creek	17
		Coliban River	18, 19, 22
		Little Coliban River	20
		Kangaroo Creek	21
	Lower Campaspe (below Lake Eppalock)	Campaspe River	1, 2, 3, 4, 5
		Mt Pleasant Creek	8, 9
		Forest Creek	10, 11
		Axe Creek	12
Loddon	Upper Loddon (above Cairn Curran Reservoir)	Sheepwash Creek	13
		Loddon River	9, 10
		Middle Creek	24
		Joyces Creek	25
		Muckleford Creek	26
		Jim Crow Creek	27
		Sailors Creek	28
		Campbells Creek	29
	Loddon (western tributaries above Laanecoorie Reservoir)	Barkers Creek	30
		Bet Bet Creek	14, 15, 16
		Burnt Creek	17
		Tullaroop Creek	18, 19
		Creswick Creek	20
		Birches Creek	21
		McCallum Creek	22
	Lower Loddon	Beckworth Creek	23
		Loddon River	1, 2, 3, 4, 5, 6, 7, 8
		Serpentine Creek	11
		Bulabul Creek	12
		Bradford Creek	13
	Mid-Loddon	Barr Creek	31
		Box Creek	32
		Bullock/Pyramid Creek	33
		Bullock Creek	34, 35, 36
		Spring Creek	37
		Bendigo Creek	40, 41, 42, 43, 44
		Myers Creek	45, 46
	Gunbower	Back Creek	47
Gunbower Creek		38, 39	
Avoca	Upper Avoca (upstream of Charlton)	Avoca River	5, 6, 7, 8
		Campbell Creek	10
		Strathfillan Creek	11
		Middle Creek	12
		Fentons Creek	13, 14
		Cherry Tree Creek	15
		Homebush Creek	16
		Mountain Creek	17
		Number Two Creek	18
		Rutherford Creek	19
	Lower Avoca (downstream of Charlton)	Glenlogie Creek	20
		Avoca River	1, 2, 3, 4
		Mosquito Creek	9
		Richardson River	43, 44, 45
Wimmera	Avon-Richardson	Avon River	46, 47, 48
		Sandy Creek	49
		Wallaloo Creek	50
		Andersons Creek	51
		Richardson Creek	52



4.1.2 Index of Stream Condition

The North Central RHS sets priorities and targets for river health management at the reach scale based on the Index of Stream Condition (ISC) concept of 'reaches'.

The ISC is a rapid-assessment method developed in the mid- to late-1990s. This method was designed as a management tool to flag both waterway issues and benchmark waterway condition. It is the most comprehensive, current condition assessment tool available to waterway managers in Victoria.

The ISC operates at the reach scale. A reach is defined as a section of stream typically 10 – 30km long, which is relatively homogeneous with regard to hydrology, physical form, water quality and aquatic life. In 1999, 101 ISC reaches were defined in the North Central region, which encompass 58 of our major rivers and creeks (Table 3).

The ISC assessment is based on five sub-indices that measure the extent of change from natural or ideal conditions¹, using the following parameters:

- hydrology (flow-volume and seasonality of flow)
- physical form (stream bank and bed condition, presence of and access to physical habitat)
- streamside zone (quality and quantity of streamside vegetation, and condition of billabongs)
- water quality (nutrient concentration, turbidity, salinity and acidity)
- aquatic life (diversity of invertebrates).

There are three measuring sites (430m long) within each reach at which field data is collected. Some parameters are assessed over the whole measuring site. Each measuring site contains three 30m long transects at which field data is collected. Based on this information, an overall condition rating is assigned to a reach, i.e. excellent, good, moderate, poor or very poor.



Photo: Nathan Day

Assessing the health of the Campaspe River using the Index of Stream Condition.

In 1999, the ISC was applied for the first time Victoria-wide (to be repeated every five years). The 1999 results are available on the Victorian Water Data Warehouse web page (www.vicwaterdata.net) and are summarised in Figure 6 and 5 in Section 4.2. All regional river health strategies are based on 1999 ISC results. The 2004 ISC results are available on this website in mid-2005.

4.1.3 River Values and Environmental Risk System (RiVERS) database

The River Values and Environmental Risk System, known as RiVERS, was commissioned by the Victorian Waterway Managers Forum and DSE to develop a framework for the prioritisation of river health management programs. The RiVERS database forms the basis of all regional river health strategies across Victoria.

The aim of the RiVERS planning tool is to assist program managers to establish priorities and:

- consider the values (or assets) of the waterways (catchment to site-specific)
- consider the threats (type and magnitude)
- identify key values and threats
- identify priority catchments, sub-catchments, streams and reaches
- identify priority actions
- establish the basis for an integrated works and activity program
- establish a reporting mechanism to enable greater community/stakeholder understanding of the prioritisation of programs.

A value is defined as something considered to be of importance or beneficial to river health. A threat is defined as an action or a process likely to cause cause harm, i.e. degrade a value. After much discussion, the Victorian Waterway Managers Forum and DSE agreed on a list of values and threats to be applied statewide as part of the RiVERS model.

¹ 10 equals no change and 0 is completely altered from natural conditions.



An evaluation of the RiVERS database will be undertaken, led by the DSE. This will include a review of the risk-assessment approach and will consider a review of the current asset and threat database.

The RiVERS database was been used to assign scores to quantify the values and threats of the 101 ISC reaches within the North Central region. The database contains opportunities to enter scores (from 1 to 5) relating to the environmental, social and economic values of each ISC reach and the threats to those values (Table 4).

Table 4 Value and threat categories assigned to the RiVERS database

Values			Threats
Environmental	Social	Economic	
Significant flora	Fishing	Water supply – irrigation	Bank erosion
Bioregional conservation status of Ecological Vegetation Class	Non-motor boats	Water supply - proclaimed catchment	Bed erosion
Significant fauna	Motor boats	Infrastructure	Barriers to native fish migration
Invertebrates observed/expected	Camping	Land value	Channel modification
Width of riparian vegetation	Swimming	Tourism	Changes to flow (flow deviation)
Longitudinal continuity of riparian vegetation	Passive recreation	Power generation	Water quality trends
Structural intactness of riparian vegetation	European heritage		Water quality attainment
Native fish observed vs expected	Listed landscape		Water quality SIGNAL
Proportion of fish introduced	Flagship species		Water temperature
Native fish migration			Algal blooms
Wetland significance			Exotic flora
Wetland rarity and depletion			Degraded riparian vegetation
Heritage river or representative river			Exotic fauna
Sites of significance			Loss of instream habitat
Ecological river health			Wetland connectivity
			Uncontrolled stock access

For further information, the definitions and score rankings (1 – 5) for each listed value and threat are included in the supporting document, titled '*North Central waterways – values, threats and risks*' (North Central CMA 2004b).

Indigenous values are not listed as one of the social values in RiVERS. The decision to omit this was made by the Victorian Waterway Managers Forum and DSE due to the lack of access and sensitivity of cultural heritage information. However, the North Central CMA strongly acknowledges the importance of cultural heritage for the region's Indigenous population to maintain spiritual, physical and emotional links to the region's environment. These values were identified at the Indigenous River Health Forums (described in Section 7.1.2) and are discussed in Section 1.2.8. How these values will be incorporated into the implementation of the Strategy is outlined in Section 7.3.

For each of the 101 ISC waterway reaches in the North Central region, the 30 values and 16 threats were each given a ranking from 1 to 5. The vast majority of the environmentally based value and threat information was inputted by DSE from state datasets, such as the 1999 ISC information, and flora and fauna databases.

The North Central CMA populated the remaining social and economic attributes based on relevant plans and investigations as well as community input. The input gathered at the River Health Forums in 2002 involved surveys that were analysed prior to the finalisation of the RiVERS model. Therefore, the value and threat categories were not identically aligned. However, the information gathered was useful to cross-reference the information entered into the RiVERS database from statewide datasets and North Central CMA staff knowledge. How this community information was collected is further described in Section 7.1.2 and a summary of the results is discussed in Section 4.2.

The North Central RHS Consultative committee (agency and community representatives) also had the opportunity to review the information contained in the RiVERS database.

While the absolute (total) value indicated by the RiVERS score does not provide a useful comparison, when considered separately, the total environmental, social and economic scores indicate the relative importance of each reach (compared to the other 100). In other words, when the environmental, social and economic scores are ranked, the relative position of the reaches can be compared. This is useful to set priorities (see Section 5).



4.2 Current condition

The health of rivers, wetlands and lakes is the cumulative impact of a multitude of factors including:

- significant alteration of flow regimes by major storages, diversions, groundwater extractions, catchment dams and urbanisation
- poor water quality caused by pollution, rubbish dumping, catchment run-off, stormwater, rising groundwater tables and cold water releases from dams
- clearing of and inappropriate management of the riparian zone and catchment
- weeds and exotic species such as blackberries or European carp
- erosion, sedimentation or de-snagging practices that alter channel form and habitats
- barriers such as weirs that impede fish movement and migration
- reduced links with the floodplain, e.g. arising from wetland drainage, levee banks or development (DSE 2004a).

The 1999 ISC assessment of the health of waterways in the North Central region rated just 2% of the waterways as being in good condition, with 45% in moderate condition and 53% in poor to very poor condition (Table 5).

Table 5 Summary of waterway condition according to the 1999 ISC results

Rating	Campaspe catchment		Loddon catchment		Avoca catchment		Wimmera catchment		Total rating %
	% of length	Length (km)	% of length	Length (km)	% of length	Length (km)	% of length	Length (km)	
Excellent	0	0	0	0	0	0	0	0	0
Good	0	0	4	82	0	0	0	0	2
Moderate	53	320	28	457	76	400	46	167	45
Poor	46	309	33	693	24	135	54	163	36
Very poor	1	8	35	626	0	0	0	0	17
Total	100	637	100	1859	100	535	100	330	100

The following sections provide a general description of the geography, history, threatened species or communities and major issues of the four catchments in the North Central region. The general views of the catchment community recorded at the 2002 River Health Forums are also summarised. The information gathered at the Indigenous and agency River Health Forums were not catchment specific and are summarised in Section 7.1.2.

4.2.1 Campaspe catchment

The Campaspe River catchment lies in the east of the North Central region (Figure 7). It extends from the Great Dividing Range in the south, to the River Murray in the north, and covers a total area of approximately 4,000 square kilometres (approximately 17% of the North Central region). The catchment is some 150 kilometres long and has an average width of approximately 25km (CMPS&F Environmental 1994).

The major waterway is the Campaspe River itself which flows to its confluence with the River Murray at Echuca. Therefore, the Campaspe River has a direct influence on the health of the River Murray, including salinity, flows and exchange of aquatic species, such as native migratory fish. The Campaspe's major tributary is the Coliban River. Other significant tributaries include the Axe, Mclvor, Mount Pleasant, Wild Duck and Pipers creeks.

The northern slopes of the Great Dividing Range forms the upper catchment, with elevations rising to nearly 800 metres above sea level. The Great Divide slopes away to meet the riverine plain, characterised by flat alluvial deposits and elevations rarely in excess of 200 metres above sea level. Mount Camel (421 metres) is the only significant exception to this pattern, and is located on the central eastern boundary of the riverine plain (CMPS&F Environmental 1994).

Since 1836, when explorer Major Thomas Mitchell named the Campaspe River, the landscape has undergone significant change. The cumulative effects of the gold rush, the building of reservoirs and water supply systems, native vegetation clearing, farming systems and urban development are clearly reflected in the current condition of the waterways. Results from the 1999 ISC survey reveal that 53% of the streams in the Campaspe catchment are in moderate condition and 47% are in a poor to very poor condition.



The four bioregions represented in the Campaspe catchment as outlined in the North Central Native Vegetation Plan (draft) include the Central Victorian uplands, Goldfields, Victorian Riverina and Murray fans (North Central CMA 2003b). The vegetation in the upper catchment is dominated by box, stringybark and peppermint eucalypts protected within State parks and reserves. In comparison, the lower slopes which were once dominated by box-ironbark forests and the open grassy woodlands of the plains country, have been almost totally cleared.

Many native vegetation communities (or Ecological Vegetation Classes, EVCs) within the catchment are considered endangered or vulnerable. Some of these threatened riparian EVCs include swamp scrub, creekline grassy woodland, sedgy riparian woodland and streambank shrubland. There are also many threatened flora and fauna species that are dependent upon the aquatic and terrestrial riparian environment. Flora species include black gum, river swamp wallaby-grass and hairy anchor plant. Threatened fauna species include the murray cod, squirrel glider, royal spoonbill and the growling grass frog. The *lowland riverine fish community of the southern Murray-Darling Basin* is also listed on the *Flora and Fauna Guarantee Act 1988*. A list of the threatened flora and fauna along waterways in the North Central region is in Appendix 3.

Lake Eppalock augments the supplies in the Coliban Supply System, providing a significant volume of water for domestic use in Bendigo and surrounds. This water storage supplies water for irrigation and is popular for recreational pursuits. The Coliban Supply System includes the Malmsbury, Lauriston and Upper Coliban reservoirs along the Coliban River. This system supplies water for domestic use to towns in the Campaspe and Loddon catchments, including Bendigo, Castlemaine and Kyneton, as well as many smaller towns including Harcourt, Maldon, Chewton, Tylden, Newstead, Fryerstown, Elphinstone, Taradale, Malmsbury and Guildford.

The Campaspe catchment's economy and employment centres on:

- agricultural production
- manufacturing and service industries in the larger urban centres
- retailing
- health and education services
- tourism, personal and business services.

The catchment is agriculturally diverse, including dryland agriculture and irrigation areas which form an important component of the rural economy. Dryland farming in the south produces cereal crops, beef cattle, lambs and wool, and some potatoes. Dairy farms are concentrated in the irrigated areas in the northern part of the catchment. Intensive horticultural activities of irrigated fruit, vine and tomato production are increasingly important. There is a strong food processing sector, with major plants located at Echuca and Rochester.

The catchment also has a very high tourism profile based on the historic Port of Echuca and spectacular Mt Macedon ranges.

Mining was once a traditional industry in the catchment and has experienced a resurgence in recent years. The catchment still yields quantities of gold, particularly in the Fosterville area north of Axedale, providing wealth for the regional economy and benefits for shareholders beyond the North Central region. Site management and the impact of open-cut mining is a concern for (environmental) management.

The waterways of the Campaspe catchment are a popular location for recreational fishing, boating (e.g. canoeing and motorised), swimming and camping. Several towns along the river such as Kyneton, Elmore, Rochester and Echuca feature riverside walking tracks. Public reserves such as Turpins Falls, The Cascades and Trentham Falls remain popular tourist attractions.

The key issues in the Campaspe catchment include:

- dryland and irrigation salinity
- biodiversity decline (i.e. remnant vegetation decline, wetland degradation, flora and fauna decline)
- soil health (i.e. soil acidification, soil erosion, soil structure decline)
- water resources (i.e. water quality and river health decline, flooding due to changed land management, poor drainage, groundwater management)
- pest plants and animals
- regional development (i.e. sustainable water management, land use change).

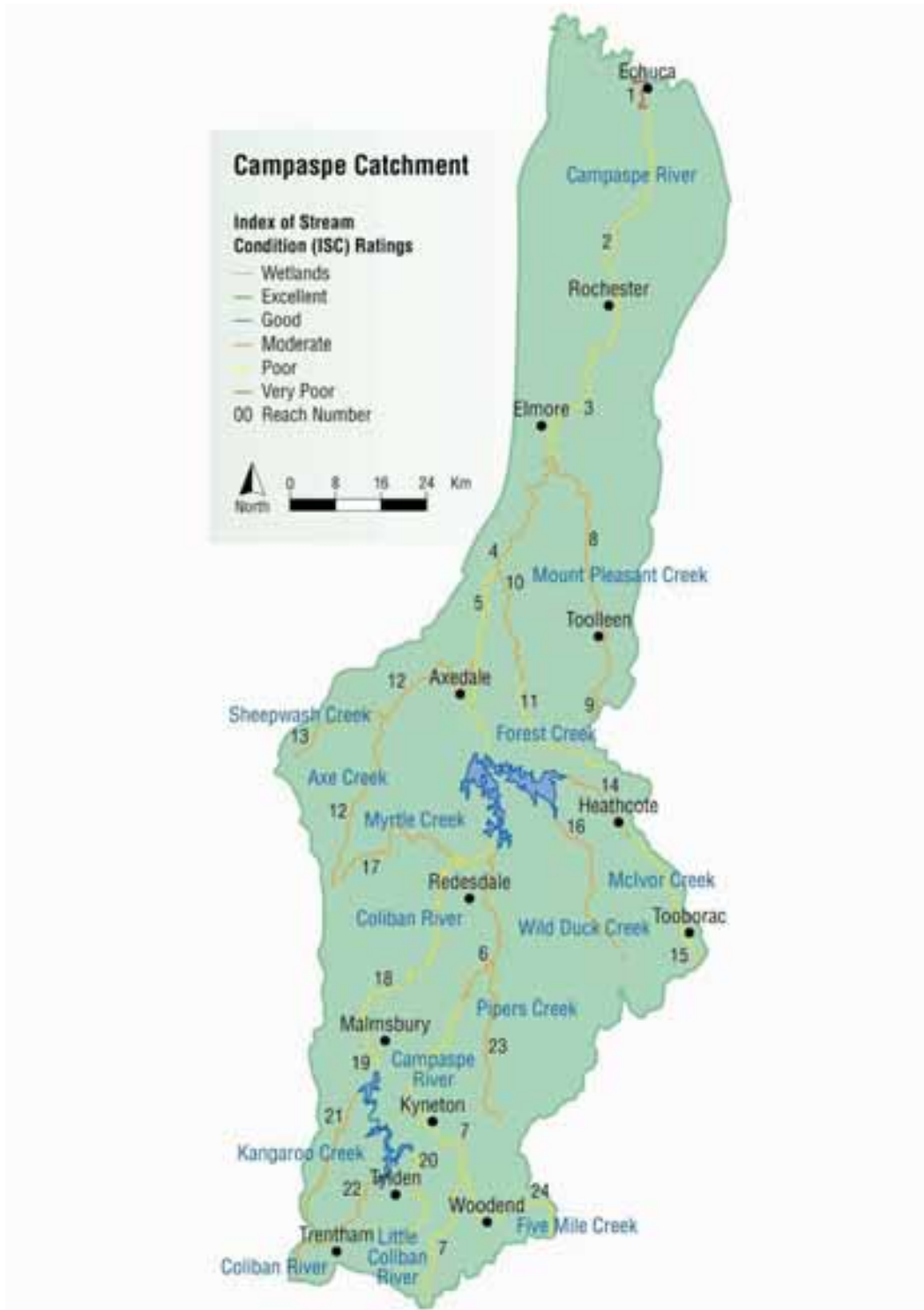


Figure 7 The Campaspe River catchment

Detailed information about all of the major waterways in the Campaspe catchment is contained in the River Health Plans.



Community views

In 2002, four community forums were held in the Campaspe catchment to understand community perceptions of river health. This information is detailed in the Campaspe River Health Plan (North Central CMA 2003c). The information provided at these forums was used to cross-check the information in the RiVERS database (the value and threat categories were not identically aligned as the forums were held prior to the finalisation of the RiVERS model).

Good water quality was generally identified as the key value attached to waterways in the Campaspe catchment, followed by scenic appearance, native vegetation and wildlife. The upper catchment community generally placed less value on native vegetation and wildlife, and greater value on recreation in the river. The lower catchment community highlighted the importance of adequate Campaspe River flows for fish habitat and stock water (North Central CMA 2003c). These values are consistent with the Campaspe catchment values in the RiVERS database (North Central CMA 2004b).

Poor water quality, pest plants and poor land management were generally considered to be the greatest threat to river health in the Campaspe catchment. The impacts of stock access, erosion (and sedimentation), native vegetation removal, pest animals and poor water quality were also regarded as much higher threats in the lower catchment (North Central CMA 2003e). Stock access and poor water quality were some of the key threats identified in the RiVERS database (North Central CMA 2004b).



Photo: Angela Gladman

The Campaspe catchment – looking north from Mount Macedon near Woodend.

The Campaspe catchment community is keen to see a range of management actions implemented to reduce these threats. Of the highest importance is native vegetation restoration, water quality monitoring and weed management. Community education and participation, technical advice and the provision of environmental flows are also important. These activities are reflected in the actions and targets outlined in Section 6.4.

4.2.2 Loddon catchment

The Loddon River catchment, home to two-thirds of the North Central population, covers 1,531,998 hectares (approximately half of the North Central region) or about 6.8% of the area of Victoria. The catchment extends about 310km from the Great Dividing Range in the south to the River Murray (Figure 8). Mount Alexander is the highest point in the catchment at 741 metres on the Divide just north of Castlemaine. The northern two-thirds of the catchment are the alluvial plains of the Murray valley, with granite outcrops at Mount Terrick Terrick, Mount Hope and Pyramid Hill rising some 80 to 100 metres above the general lie of the land.

The Loddon River is the principal watercourse. It flows north from near Daylesford on the Great Divide to the River Murray near Swan Hill. Therefore, the Loddon River has a direct influence on the health of the River Murray, including salinity, flows and exchange of aquatic species, such as native migratory fish. Major tributaries of the Loddon River are Tullaroop Creek and Bet Bet Creek, in the southwest of the catchment, and Bullock Creek and Bendigo Creek, in the east. The River Murray anabranch of Gunbower Creek and Pyramid Creek flow across the northern floodplain. Barr Creek is considered one of the saltiest inland waterways in Victoria and plays an important role in salt mitigation in the Loddon-Murray region. A pump station located along the lower reaches of Barr Creek pumps water to the storage basin of Lake Tutchewop to manage flows and salinity levels in the Loddon River and River Murray. There are several high-value wetlands, including the internationally recognised Ramsar-listed Kerang Lakes and Gunbower Forest.

Since European settlement, the cumulative effects of the gold rush, irrigated agriculture and river regulation, urban development and land clearance have fundamentally changed the nature of many of the waterways in the catchment. Results from the 1999 ISC survey reveal that only 4% of the streams in the Loddon catchment are in good condition, 28% are in moderate condition and 68% are in a poor to very poor condition.

An important characteristic of the Loddon River catchment is that it is influenced by water imported from the Goulburn and Murray rivers. Water is diverted into the Loddon River catchment from the Campaspe, Goulburn-Broken and Murray river systems to use as potable and irrigation water. Two main supply routes exist – the Waranga Western Main Channel and the Torrumbarry Irrigation System. These systems provide relatively good quality water to the lower Loddon River. In



some lower catchment waterbodies (especially in the Torrumbarry system) inflows from the Loddon River catchment only enter in times of flood.

While 80% of the catchment has been cleared for agriculture, substantial forested areas remain on the southern hill slopes. Box-ironbark forests dominate the central catchment and remnant river red gums line the northern waterways. The seven bioregions represented in the Loddon catchment as outlined in the North Central Native Vegetation Plan (draft) include the Central Victorian uplands, Victorian volcanic plain, Goldfields, Victorian Riverina, Northern inland slopes, Murray mallee and Murray fans (North Central CMA 2003b).

Many native vegetation communities (or Ecological Vegetation Classes, EVCs) within the Loddon catchment are considered endangered or vulnerable. Some of these threatened riparian EVCs include creekline grassy woodland, floodplain riparian woodland and lignum wetlands. There are also many threatened flora and fauna species that are dependent upon the aquatic and terrestrial riparian environment. Flora species include pale spike-sedge, woolly waterlily, downy swainson-pea and diosma rice-flower. Threatened fauna species include the red-backed kingfisher, murray cod, silver perch, plains wanderer and white-bellied sea-eagle. The *lowland riverine fish community of the southern Murray-Darling Basin* is also listed on the *Flora and Fauna Guarantee Act 1988* (DSE website). A list of the threatened flora and fauna along waterways in the North Central region is provided in Appendix 3.

Bendigo is the largest population centre in the Loddon catchment, maintaining its gold rush heritage and offering a wide range of arts and culture, retail and service industries. Kerang and Swan Hill in the north are also major business centres with services in health, welfare and recreation. The catchment is well-equipped with education providers, including La Trobe and Melbourne University campuses.

The Loddon catchment is agriculturally diverse. There are valuable and highly productive irrigation areas in the Loddon-Murray area with extensive dairying, pasture and irrigated horticulture. Mixed farming and cereal growing dominate the mid and upper catchment. Relatively small areas of intensive horticulture in the upper catchment also generate substantial wealth.

The Loddon catchment still yields large quantities of gold, providing significant wealth for the regional economy and benefits for shareholders beyond the region, e.g. Bendigo Mining.

The waterways of the Loddon catchment are a popular location for recreational fishing, boating (e.g. canoeing and motorised), swimming and camping. The Loddon River at Bridgewater is particularly renowned for waterskiing and recreational fishing. Several towns such as Carisbrook and Kerang feature creek and riverside walking tracks. In the southern catchment, mineral springs along the Loddon River and its tributaries are popular tourist attractions.

The key issues in the Loddon catchment include:

- dryland (e.g. Bet Bet, Timor and Bulabul areas) and irrigation salinity
- biodiversity decline (i.e. remnant vegetation decline, wetland degradation, flora and fauna decline)
- soil health (i.e. soil acidification, soil erosion, soil structure decline)
- water resources (i.e. water quality and river health decline, flooding due to changed land management, flow regulation, poor drainage, groundwater management)
- pest plants and animals
- regional development (i.e. sustainable water management, land-use change).

Detailed information about all of the major waterways in the Loddon catchment is contained in the River Health Plans.



The Loddon River floodplain near Boort in the lower catchment.

Photo: Rachel Hall



Figure 8 The Loddon River catchment



Community views

In 2002, eight community forums were held in the Loddon catchment to understand community perceptions of river health. This information is detailed in the Loddon River Health Plan (North Central CMA 2003d). The information provided at these forums aided the assigning of scores in the RiVERS database. The information provided at these forums was used to cross-check the information in the RiVERS database (the value and threat categories were not identically aligned as the forums were held prior to the finalisation of the RiVERS model).

Good water quality was identified as the key value attached to waterways in the upper to mid-Loddon catchment, followed by native wildlife and the shade and shelter provided by native riparian vegetation.

Scenic appearance was generally identified as a key waterway value in the lower Loddon catchment. Recreation and waterway access was important to the lower catchment community. These values are consistent with the Loddon catchment values in the RiVERS database such as fishing, passive recreation, wetlands and threatened flora and fauna (North Central CMA 2004b).

Pest plants were generally regarded as the major threat to waterways in the upper Loddon catchment. However, poor water quality was seen as the major waterway threat in the mid- to lower catchment, followed closely by poor land management and stock access. Therefore, the effects of salinity and blue green algal blooms are regarded as a high threat to both the waterways and the broader community. Although many of the waterways act as carriers of irrigation water in the lower catchment, this was also seen as a major threat to the health of these waterways due to the unnatural (unseasonal) flow regime and the impacts this has on native aquatic life and stream morphology. Stock access, flow deviation and algal blooms were also some of the key threats identified in the RiVERS database (North Central CMA 2004b).

The upper catchment community regards weed management as the most important management action needed to improve river health. The restoration of fish habitat and water quality monitoring were also highly regarded. Protective fencing, the provision of environmental flows and native vegetation restoration were additional river health management actions. To complement these onground actions, community education and participation, together with the provision of technical advice was prioritised. These activities are reflected in the actions and targets outlined in Section 6.5.

4.2.3 Avoca catchment

The Avoca catchment covers approximately 1.2 million hectares of the North Central region (Figure 9). It extends about 340km from the Great Dividing Range near Amphitheatre, to the Avoca Marshes and into the River Murray during associated flood events. Therefore, the Avoca River has some influence on the health of the River Murray, including salinity and flows. The average annual rainfall in the Avoca River catchment ranges from 650 mm/year in the mountainous regions in the south to 325 mm/year on the northern plains (North Central CMA 2000a).

The Avoca River is an anabranching river system and conveys the most variable flow of all the Victorian rivers in the Murray-Darling Basin. The river ceases to flow for many months on end during dry years. Twelve weirs spaced along the length of the river influences flow in the Avoca River but no major storages regulate flow in the system. Some of the smaller tributaries of the river have onstream storages for towns – however they are not considered significant.

The Avoca River rises at the foot of Mt Lonarch, near Amphitheatre. From its headwaters to Charlton, the Avoca River flows within a relatively confined valley, draining Glenlogie, Sugarloaf, Cherry Tree and Strathfillan creeks, which all flow in from the west. Approximately halfway along its length (near Glenloth), the river splits into a series of anabranching channels across a low-angle alluvial plain. Moving downstream, the channel capacity decreases, until the three main channels, namely the Avoca River and western effluent streams of Lalbert and Tyrell creeks, terminate at Lake Bael Bael, Lake Timboran and Lake Tyrell respectively. These latter creeks are ephemeral and are linked only to the main Avoca River across the floodplain during major flood events when flow in the Avoca River at Charlton exceeds 15,000 ML/month. During these times, the river passes a large proportion of the flow down Tyrell and Lalbert creeks.



The southern Avoca catchment, near Ampitheatre.

Photo: Pauline Andrews



There are 124 different wetland areas in the Avoca catchment, covering a total area of 175,000ha. The majority of these areas are located in the northern part of the catchment. The Avoca Marshes, part of the Ramsar-listed Kerang Lakes, are a series of lakes and swamps that differ in permanence, depth and salinity. Other wetlands on the plains include Lake Lalbert, Sandhill and Sandhill West lakes, Lake Marmal, Griffiths and Terappee swamps. In the south, Bradshaw Swamp is the largest remaining wetland.

Early European settlement of the southern half of the catchment was accelerated by the onset of the gold rush, which triggered widespread land clearance and intensive agricultural development. This had a profound effect on erosion and deposition processes in the catchment's waterways. Results from the 1999 ISC survey reveal that 76% of the streams in the Avoca catchment are in moderate condition, and 24% are regarded as poor.

The remaining native forests are located in the steep mountainous regions. Dry foothill forest is restricted to the south of the region, box-ironbark forest is found in a broad band across the middle of the catchment and a depleted grassy woodland community occurs around Charlton. The seven bioregions represented in the Avoca catchment outlined in the North Central Native Vegetation Plan (draft) include the Central Victorian uplands, Victorian volcanic plain, Goldfields, Victorian Riverina, Wimmera, Murray mallee and Murray fans (North Central CMA 2003b).

Many native vegetation communities (or Ecological Vegetation Classes, EVCs) within the Avoca catchment are considered endangered or vulnerable. Some of these threatened riparian EVCs include creekline grassy woodland, alluvial terrace herb-rich woodland and floodplain riparian woodland. There are also many threatened flora and fauna species that are dependent upon the aquatic and terrestrial riparian environment. Flora species include woolly buttons, pale spike-sedge, clover glycine and umbrella wattle. Threatened fauna species include the murray cod, diamond dove, intermediate egret and nankeen night heron. The *lowland riverine fish community of the southern Murray-Darling Basin* is also listed on the *Flora and Fauna Guarantee Act 1988* (DSE website). A list of the threatened flora and fauna along waterways in the North Central region is provided in Appendix 3.

Agricultural activity in the Avoca catchment is based on grazing and cropping. Broadacre grazing is the predominant agricultural land use in the catchment's south and broadacre cropping in the north. Grape production, oil seeds and pulses are important industry sectors in the south of the catchment. Irrigation areas extend to the Kerang Lakes area.

Rural industries have historically dominated the employment structure of the catchment, however the importance of manufacturing and retailing has increased in recent years.

The waterways of the Avoca catchment are a popular location for recreational fishing, swimming, canoeing and camping. The Avoca River is a natural feature of the townships of Avoca, Charlton and Quambatook, and is the location of the popular annual Charlton Fishing Competition.

The key issues in the Avoca catchment include:

- dryland salinity
- biodiversity decline (i.e. remnant vegetation decline, wetland degradation, flora and fauna decline)
- soil health (i.e. soil acidification, soil erosion, soil structure decline)
- water resources (i.e. water quality and river health decline, wetland degradation, flooding due to changed land management)
- pest plants and animals
- regional development (i.e. sustainable water management, sustainable industries / employment opportunities).

The Wimmera-Mallee Pipeline has the potential to deliver whole-of-region outcomes, which will include benefits for the environment, community and economy. This may have a significant impact on the waterways of the Avoca catchment.

Detailed information about all of the major waterways in the Avoca catchment is contained in the River Health Plans.



Figure 9 The Avoca River catchment



Community views

In 2002, three community forums were held in the Avoca catchment to understand community perceptions of river health. This information is detailed in the Avoca River Health Plan (North Central CMA 2003e). The information provided at these forums was used to cross-check the information in the RiVERS database (the value and threat categories were not identically aligned as the forums were held prior to the finalisation of the RiVERS model).

Shade and shelter provided by riparian vegetation was identified as the key value attached to waterways in the Avoca catchment, followed by scenic appearance, native vegetation and native wildlife. Good water quality and recreation, in and beside the river, were also highlighted at these forums and reflected in the outcomes of this Strategy. These values are consistent with the Avoca catchment values in the RiVERS database, such as fishing, threatened fauna (e.g. fish) and wetlands (North Central CMA 2004b).

Poor water quality is generally considered to be the greatest threat to river health, followed by pest plant and animals and poor land management. Stock access and algal blooms were also some of the key threats identified in the RiVERS database (North Central CMA 2004b).

The Avoca catchment community highlighted the need for water quality monitoring and the provision of technical advice for river health management. The community also showed enthusiasm for greater community education and participation in river health management. Onground actions highlighted included weed management, restoration of native vegetation, improved land management and the provision of environmental flows. These activities are reflected in the actions and targets outlined in Section 6.6.

4.2.4 Avon-Richardson catchment

The Avon-Richardson catchment is a land-locked river system that extends northwards from the Pyrenees foothills southwest of St Arnaud, to Lake Buloke on the margins of the mallee, and covers a total area of approximately 330,000ha (Figure 10). The Avon-Richardson catchment lies to the east of the Wimmera basin. The catchment has relatively little river regulation to modify or prevent flood flows and is connected to the Wimmera-Mallee channel system.

There are two main waterways in the catchment – the Avon River and the Richardson River. The Avon River originates in the sedimentary hills south of Beazleys Bridge, and the Richardson River flows mainly through the flat clay plains near Callawadda and Marnoo. The two rivers meet at Banyena, where the Richardson River continues flowing northward to the nationally significant Lake Buloke. The major tributaries flowing into the Avon River are Sandy, Paradise and Reedy creeks. Those flowing into the Richardson River include Wallaloo and Swedes creeks. There are over 100 lakes and wetlands within the Avon-Richardson catchment, including Lake Batyo Catyo, Lake Cope Cope and the lakes at Avon Plains.



Photo: Linton Argall

The Richardson River at Donald.

Since Major Thomas Mitchell crossed the Richardson River in 1836, European settlement has left its mark on the catchment's landscape. The impacts of the gold rush, land clearance, farming practices and the water supply system is largely demonstrated by the condition of the waterways. Results from the 1999 ISC survey reveal that 46% of the streams in the Avon-Richardson catchment are in moderate condition, and 54% regarded as poor.

The three bioregions represented in the Avon-Richardson catchment as outlined in the North Central Native Vegetation Plan (draft) include the Goldfields, Wimmera and Murray mallee (North Central CMA 2003b). Within these bioregions, many native vegetation communities (or Ecological Vegetation Classes, EVCs) are considered endangered or vulnerable. Some of these threatened riparian EVCs include creekline grassy woodland, wetland formation and red gum wetland. There are also many threatened flora and fauna species that are dependent upon the aquatic and terrestrial riparian environment. Flora species include downy swainson-pea, turnip copperburr and bow-lip spider-orchid. Threatened fauna species include the murray cod, royal spoonbill, broilga and the grey-headed flying fox. A list of the threatened flora and fauna along waterways in the North Central region is in Appendix 3.

For several months of the year water is transferred from the head-works of the Wimmera-Mallee Stock and Domestic water storage system via two open channels that outfall into the Richardson River that is utilised as a water carrying



conduit. Water is then diverted via the Rich-Avon Weir to Lake Batyo Catyo, the only water storage in the catchment or alternatively the Donald main channel to supply domestic and stock customers. This is the largest water system influencing the catchment. During high flood events, inflows from the Wimmera River are significant in terms of suspended sediments and the associated nutrient inputs introduced to the upper Avon-Richardson catchment.

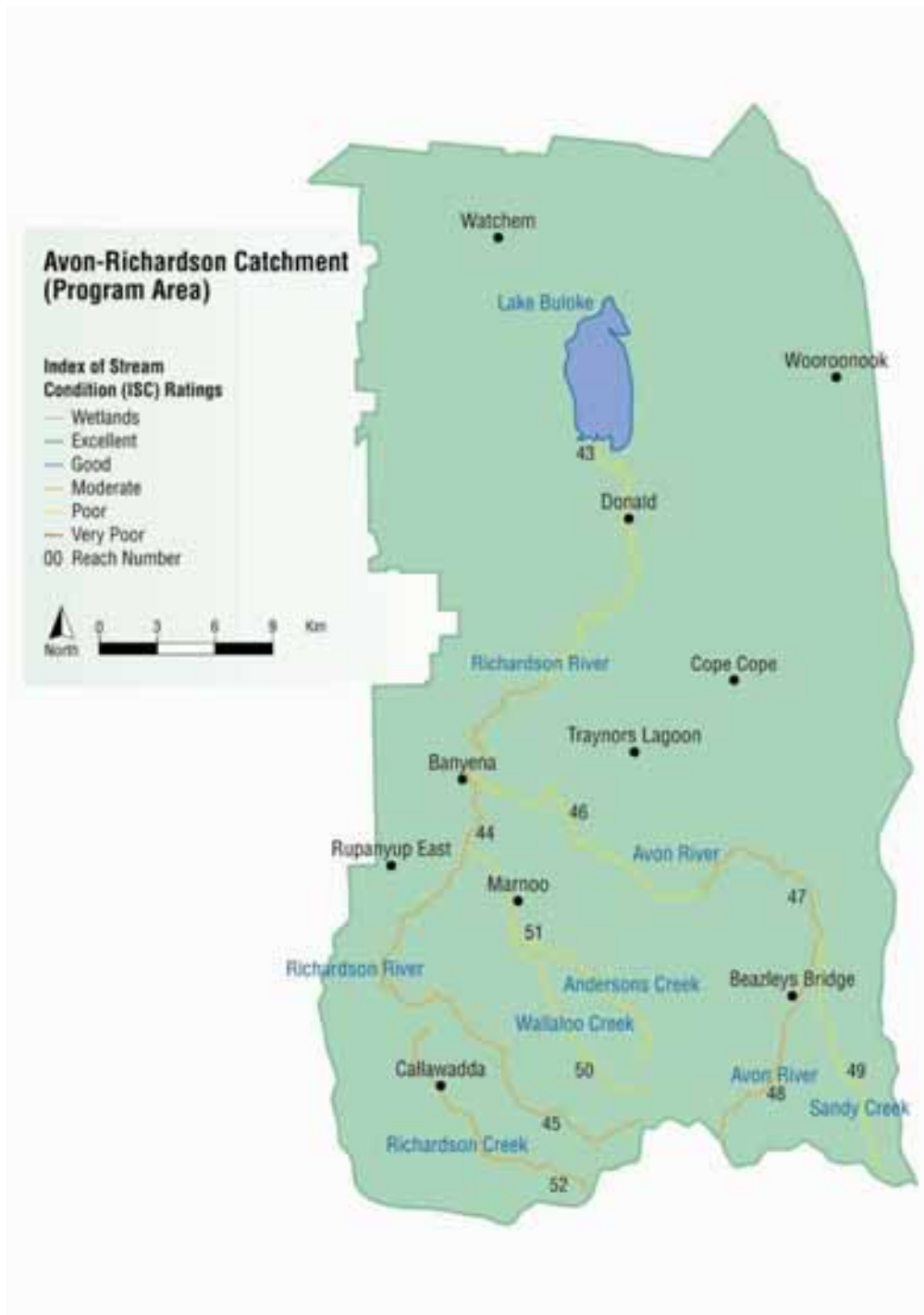


Figure 10 The Avon-Richardson catchment



The Avon-Richardson catchment is primarily a broadacre farming district used for sheep grazing and crop production (wheat, oats, legumes and barley) with a small manufacturing and service base within the townships of Donald, Marnoo and Watchem. Generally there is little diversity in the agricultural economy of this catchment. However, the catchment reveals a higher level of enterprise viability than the other three catchments in the region. The employment patterns also show a distinctive rural basis.

The waterways of the Avon-Richardson catchment are a popular location for fishing, swimming, canoeing and camping. The Richardson River at Avon Weir is particularly highly valued for recreational fishing.

The key issues in the Avon-Richardson catchment include:

- dryland salinity
- biodiversity decline (i.e. remnant vegetation decline, wetland degradation, flora and fauna decline)
- soil health (i.e. soil erosion, soil structure and fertility decline)
- water resources (i.e. water quality and river health decline, flooding due to changed land management, poor drainage, wetland decline)
- pest plants and animals
- regional development (i.e. sustainable water management, sustainable industries / employment opportunities).

The Wimmera-Mallee Pipeline has the potential to deliver whole-of-region outcomes, which will include benefits for the environment, community and economy. This may have a significant impact on the waterways of the Avon-Richardson catchment.

Detailed information about all of the major waterways in the Avon-Richardson catchment is contained in the River Health Plans.

Community views

In 2002, two community forums were held in the Avon-Richardson catchment to understand community perceptions of river health. This information is detailed in the Avon-Richardson River Health Plan (North Central CMA 2003f). The information provided at these forums was used to cross-check the information in the RIVERS database (the value and threat categories were not identically aligned as the forums were held prior to the finalisation of the RIVERS model).

Native vegetation, native wildlife and scenic appearance were generally identified as the key values of waterways in the Avon-Richardson catchment. The importance of the riparian vegetation for shade and shelter, and access to the rivers for recreation (e.g. fishing) was also highly valued. These values are consistent with the Avon-Richardson catchment values in the RIVERS database such as fishing and threatened fauna (e.g. freshwater catfish) and flora (North Central CMA 2004b).

Poor water quality, erosion and stock access to waterways were generally considered to be the greatest threats to river health in the Avon-Richardson catchment. These are some of the main threats addressed in this Strategy. Stock access was also one of the key threats identified in the RIVERS database (North Central CMA 2004b).

Erosion control was rated the most important river health management action, followed closely by native vegetation restoration, protective fencing and improved land management and access to technical advice. These activities are reflected in the actions and targets outlined in Section 6.7.



SECTION FIVE: REGIONAL PRIORITIES

Setting priorities for management ensures that resources are allocated to the most important areas and issues. Critical, where the values and threats are great and resources limited. The best use of resources are governed by the information currently available. A clear method is required to:

- determine the location of priority waterway reaches
- the priority actions to address key values and threats along these reaches.

Section 5 of the Strategy defines the methodology of determining the location of priority waterway reaches. Section 6 identifies the method of prioritising actions within these priority reaches to address key values and threats.

As outlined in Section 4.1.5 of this document, the Victorian River Health Strategy (RHS) (DNRE 2002a) states that when selecting priorities for river protection and enhancement, they will be based on:

- protection of existing high-value areas or areas in good condition
- restoration of those areas where there is:
 - the highest environmental and community gains for the resources invested
 - real community commitment towards long-term improvement of river health.

The Victorian RHS also establishes a framework to protect and actively restore, but recognises that some deterioration may occur, due to either:

- ongoing degradation of areas that are not a priority for work; or
- new development which may have a very localised impact.

The Victorian RHS recognises that there will be areas not of immediate high priority for restoration and that therefore will not be addressed in the short term. However, it should be noted that work required to comply with any legal or statutory requirements will be undertaken wherever necessary.

The prioritisation principles developed in this Strategy closely reflect the prioritisation framework outlined in the Victorian RHS. It is grounded in the notion that protection and enhancement should be directed at those reaches with the highest value. Priority shall also be given to minimise the risks to those reaches linked to high-value assets, i.e. waterways or wetlands of international or national significance. Protection and enhancement should also be directed at those reaches at high risk of degradation.

Encouraging community capacity, protecting individual sites of significance, preventing damage and degradation of rivers from future development are also important (as reflected in the Victorian RHS (DNRE 2002a)).

As such, river health priorities for the North Central region are based on the following principles. While the order of these principles generally aligns with those in the Victorian RHS, it does not necessarily mean that any one principle over-rides another as they are each legitimate reasons to undertake river health management actions. Likewise, a reach may be a priority under more than one principle although the management actions may differ according to the principle objectives.

Principle 1: Protect and enhance reaches of high value

Principle 2: Minimise risks to high value assets

Principle 3: Protect and enhance reaches of high risk

Principle 4: Protect reaches with high-environmental-, social- and economic-value

Principle 5: Maintain and enhance community capacity, awareness, motivation and involvement across the region

Principle 6: Protect individual sites of significance along regional waterways

Principle 7: Prevent damage and degradation of our rivers from future development activities

The following Sections 5.1 – 5.7 describe the process used to define priority reaches based on the aforementioned principles, key objectives for management of these reaches, and indicate the types of actions required.



5.1 Principle 1: Protect and enhance ecologically healthy rivers and representative rivers

Objective:

- to protect and enhance reaches considered in 'near' ecologically healthy condition
- to protect and enhance representative rivers.

5.1.1 'Near' ecologically healthy condition

The vision for river health set in the Victorian RHS establishes the condition of 'ecologically healthy' as the aspirational (long-term) goal for river management and restoration for rivers in Victoria. An ecologically healthy river is defined by the Victorian RHS as a river that retains its major ecological features and function, and will sustain its characteristics into the future (DNRE 2002a).

The Victorian RHS provides a number of characteristics of an ecologically healthy river. These include:

- the majority of plant and animal species are native, and no exotic species dominates the system
- natural ecosystem processes are maintained
- major natural habitat features are represented and are maintained
- native riparian vegetation communities exist sustainably for the majority of its length
- native fish and other fauna can move and migrate up and down the river
- linkages between river, floodplain and associated wetlands are able to maintain ecological processes
- natural linkages with the sea or terminal lakes are maintained
- associated estuaries and terminal lake systems are productive ecosystems.



Photo: Stephen Malone Photography

The Loddon River (reach 10)

The Victorian RHS also states that an ecologically healthy river need not be pristine. Within the definition, change from natural state can occur – in some cases, considerable. The Victorian RHS provides a number of criteria for identifying ecologically healthy rivers based on Index of Stream Condition (ISC) data. The Victorian RHS stresses that these are only a 'first-cut' conservative set of criteria. DSE plan to revise these criteria with the aim of incorporating a flow component as it is recognised that the concept of returning reaches to their pre-European state may not be possible considering today's water resources infrastructure.

Under the Victorian RHS criteria (which must be met), there are no reaches within the North Central region that can be considered ecologically healthy. However, there are a number of reaches within the North Central region that are considered 'near' ecologically healthy. Reaches are considered near ecologically healthy when either one or two criteria are not met, suggesting that they may be enhanced through a single coordinated program. The biological monitoring of aquatic invertebrates represents a gap in information for three of the five reaches.

According to the criteria, the North Central region has five reaches that are considered in 'near' ecologically healthy condition (Table 6). Therefore from an ecological perspective, these reaches are considered of high value.

Table 6 Ecologically healthy river assessment (from DNRE 2002a)

ISC Reach	Catchment	Structural intactness of riparian vegetation	Longitudinal continuity of riparian vegetation	Cover of exotic vegetation	Signal/AUSRIV AS rating at least 9	Instream habitat upland/lowland	Continuity of fish passage	Bed condition
Loddon River reach 10	Loddon	✓	✓	✓	*	✓	✓ ¹	✓
Sailors Creek reach 28	Loddon	✓	✓	✓	-	✓	✓ ¹	✓
Kangaroo Creek reach 21	Campaspe	*	✓	✓	*	✓	✓ ¹	✓
Campaspe River reach 6	Campaspe	✓	✓	✓	-	✓	*	✓
Coliban River reach 22	Campaspe	✓	✓	✓	-	✓	✓ ¹	✓

Notes: 1. If migratory fish species do not inhabit the reach then barriers are not deemed to impede longitudinal continuity

* Does not meet requirements for ecologically healthy

- Data not available



Campaspe River reach 6 is considered to be in 'near' ecologically healthy condition. This reach is located immediately upstream of Lake Eppalock. Currently the reach does not meet two of the seven criteria. Gaining more information may address one of these criteria but it is extremely unlikely that continuity of fish passage will be achieved considering the location of Lake Eppalock blocks migratory fish passage by its very nature. Nonetheless, the reach can be still considered to be in 'near' ecologically healthy condition according to the criteria adapted for the North Central region.

5.1.2 Representative rivers

Representative rivers are selected reaches that can be used to represent major river classes and types that occur throughout Victoria. The intention of the Victorian RHS is that these representative rivers will be considered to be of high ecological value and will be managed accordingly. Where the reaches do not currently meet the definition of ecologically healthy, they will be considered as an environmental asset of high value in the regional River Health Strategies and therefore as one of the priorities for restoration (DNRE 2002a).

The LCC (1991) *Rivers and Streams Special Investigation* recommended 15 rivers to be managed as representative rivers, which were endorsed by Government. The representative rivers selected as part of that study were based on a combination of geomorphic units and hydrological regions. As part of the background work for the Victorian RHS, a new preliminary classification of rivers in Victoria was undertaken to determine the major types of rivers in the State, based on river ecology.

The North Central region can be divided largely into two river regions for which the following representative reaches were identified in the Victorian RHS (DNRE 2002a):

- Northwest uplands - (upper) Avoca River (reaches 5 – 8) or Axe Creek (reach 12)
- Northwest floodplains - (lower) Avoca River (reaches 1 – 4)

The rivers suggested are those which are ecologically healthy, or as close as possible, in that river region. In cases where the length of river in good condition was not considered to be sufficiently representative of the river region, two reaches were chosen. Wherever possible, reaches of the same river system were selected, i.e. Avoca River. These representative river reaches will be reviewed by the Victorian Environment Assessment Council in light of new knowledge (DNRE 2002a).

Reflecting the intent of the Victorian RHS, all three suggested representative rivers are recognised as high-value reaches in the North Central RHS.

As such, this Strategy will aim to achieve the following key target of the Victorian RHS:

By 2021, there is at least one major river reach in each of the river regions represented in Victoria that meets the definition of ecologically healthy.

Principle 1 priority reaches:

The following table (Table 7) lists the priority reaches and a brief justification for their priority status under Principle 1. See Figure 11 for the locations of priority reaches.

Table 7 Priority reaches under Principle 1

Waterway	Catchment	Priority reaches	Justification for Principle 1 priority status
Loddon River	Loddon	10	'Near' ecologically healthy condition
Sailors Creek	Loddon	28	'Near' ecologically healthy condition
Kangaroo Creek	Campaspe	21	'Near' ecologically healthy condition
Campaspe River	Campaspe	6	'Near' ecologically healthy condition
Coliban River	Campaspe	22	'Near' ecologically healthy condition
Axe Creek	Campaspe	12	Representative river
Avoca River	Avoca	1, 2, 3, 4, 5, 6, 7, 8	Representative river

Actions for Principle 1 priority reaches

The following points are an indication of the types of actions to undertake for the priority reaches identified under Principle 1:

- protect and enhance high-value reaches where they occur on private land by addressing the key threats to achieving 'near' ecologically healthy condition in partnership with the landholder



- working with public land managers, such as DSE and Parks Victoria to protect and enhance 'near' ecologically healthy reaches within areas of public land, i.e. State forests and reserves
- addressing key unfilled criteria to achieve 'near' ecologically healthy condition, including the filling information of gaps e.g. biological monitoring of aquatic invertebrates
- review of suggested representative rivers.

5.2 Principle 2: Minimise risks to connected high-value assets

Objective:

- To reduce the risk of threats along identified waterway reaches from degrading downstream high-value assets, i.e. internationally and nationally significant waterways and wetlands.

5.2.1 High-value wetland assets of international significance

Within the North Central region, there are no waterways specifically recognised as internationally significant. However, there are a number of waterways that influence and feed into the Kerang Lakes and Gunbower Forest, which are both internationally recognised wetlands under the Ramsar Convention on Wetlands (1971). As a contracting party to the Ramsar Convention, Australia is required to meet a number of obligations including the maintenance of the ecological character of its Ramsar sites through conservation and wise use. Australia has 57 sites listed under the convention, including 11 sites in Victoria, two of which are located in the North Central region.

The North Central CMA has the responsibility of integrating wetland objectives and outcomes into regional strategies, such as the North Central RHS. Waterways that flow into the Ramsar wetlands are considered a priority under Principle 2, 'to minimise the risks to the high-value assets'. The linked waterway reaches for each of the Ramsar wetlands are listed in Table 8.

Table 8 Ramsar wetlands and their linked waterways

Kerang Lakes	Gunbower Forest
Avoca River (reaches 1 – 8) Directly linked to Lake Bael Bael and the Avoca Marshes.	Gunbower Creek (reaches 38 and 39) Forms the boundary between Gunbower Forest and the River Murray and will be critical for the future management of the forest flooding.
Loddon River (reaches 1 – 10) Linked to Reedy, Middle and Third lakes via Wandella Creek and the Torrumbarry Irrigation Supply System (particularly Loddon River reaches 1, 2, 3, 4 and 5 – although all reaches would have a potential impact for issues such as water quality).	River Murray Not within the North Central region but critical to the health of Gunbower Forest.
Pyramid Creek (reach 33) Linked to Hird Swamp and Johnson Swamp.	
River Murray Not within the North Central region but important to the health of the Kerang Lakes.	

The Kerang Lakes Ramsar site is located in the lower reaches of the Loddon and Avoca catchments, at the junction of three major floodplains associated with the Avoca, Loddon and Murray rivers. It also receives inflows from the Torrumbarry Irrigation System. The Kerang Lakes include a large number of wetlands, swamps and lakes. These include:

- | | | |
|---------------------|-------------------------|------------------|
| • Lake Tutchewop | • Top (Third) Marsh | • Reedy Lake |
| • Lake William | • Middle (Second) Marsh | • Back Swamp |
| • Lake Kelly | • Bottom (First) Marsh | • Town Swamp |
| • Little Lake Kelly | • Lake Bael Bael | • Cemetery Swamp |
| • Kangaroo Lake | • Lake Cullen | • Fosters Swamp |
| • Racecourse Lake | • Stevenson Swamp | • Johnson Swamp |
| • Little Lake Charm | • Third Lake | • Hird Swamp |
| • Lake Charm | | • Middle Lake |



The Gunbower Forest Ramsar site is located on the floodplain of the River Murray between Torrumbarry and Koondrook. Gunbower Forest is bordered to the south by Gunbower Creek, an anabranch of the Murray, and to the north by the River Murray. The health of Gunbower Forest is intrinsically linked with the health of Gunbower Creek, which will be the primary means of delivering environmental flows to Gunbower Forest. Gunbower Forest (as a part of the Gunbower-Koondrook-Perricoota Floodplain system) was also identified as a Living Murray ‘Significant Ecological Asset’ in 2003.

5.2.2 High-value wetland assets of national significance

The high-value wetlands of Australia are included on the Directory of Important Wetlands (Environment Australia 2001). A wetland may be considered nationally important if it meets at least one of a number of criteria relating to the condition, type, ecological or hydrological role, habitat for threatened flora and fauna, and historical or cultural significance.



Photo: Stephen Malone Photography

Gunbower Forest is an internationally significant wetland.

Several wetlands in the North Central region are listed on the Directory of Important Wetlands. It is therefore important to minimise the risk of threats along linked reaches from degrading the downstream asset. The linked waterway reaches and the corresponding nationally significant wetlands are listed in Table 9.

Table 9 Nationally important wetlands and their linked waterways

Nationally important wetland	Linked waterway
Lake Buloke	Avon and Richardson rivers
Bunguluke Wetlands, Tyrell Creek and Lalbert Creek Floodplains	Avoca River, Tyrell and Lalbert creeks
Lake Lalbert	Lalbert Creek and Avoca River
Woolshed Swamp	Overland flow across the Loddon River floodplain
Avoca Floodway (Tutchewop Plains)	Avoca River
Tang Tang Swamp	Bendigo and Myers creeks
Kow Swamp	Bendigo Creek
Tragowel Swamp (McPhails Swamp)	Loddon River
Creswick Swamp	Avon River
Merin Merin Swamp	Creswick Creek

Note: Ramsar-listed wetlands are included in the Directory of Important Wetlands but are not repeated in this table.

There are 128 bioregionally significant wetlands in the North Central region identified in the National Land and Water Resources Audit (Murray-Darling Basin Commission 2001). Many of these wetlands are small in area (<10 ha) but some, such as Lake Eppalock (3,912 ha) cover thousands of hectares. It is recognised that these wetlands are highly valued by the community, e.g. the York Plains red-gum swamp in the Avon-Richardson catchment. Wetland areas such as these can be considered under Principles 5, 6 and 7 and a framework for cost-effective protection and enhancement will be developed in the North Central Wetland Strategy.

5.2.3 High-value waterway assets of national significance

The North Central region of Victoria lies within the Murray-Darling Basin (MDB) which surrounds the iconic River Murray, considered the food-bowl of the nation. Victoria, South Australia, the Australian Capital Territory and New South Wales share the water in the River Murray. Significant resources are injected into the MDB to improve the health of the system. Victoria is committed to the work of the MDB Ministerial Council to properly manage the water resources, and the environment and communities they sustain. The Victorian Government is taking the lead to restore the health of the River Murray, and its actions to deliver this are outlined in ‘Our Water Our Future’ (DSE 2004).

Considering the national significance of the River Murray, the North Central CMA has a responsibility to reduce the risk of threats along the major river tributaries from degrading this downstream high-value asset. As identified in relevant strategies and plans, the major risks to the health of the River Murray from the North Central region include poor water quality (e.g. salinity, nutrients), altered flow regimes and barriers to upstream fish migrations.



The interaction between the North Central region and the River Murray is very significant – the River Murray is the single largest source of water in the region for irrigation, while the Loddon, Campaspe and Avoca rivers all contribute salt and nutrients to the Murray. Historically, the salt exported from the North Central region (especially from Barr Creek) was responsible for almost half of Victoria’s impact on the salinity of the River Murray at Morgan, South Australia. Salinity management in the region has significantly reduced salt loads exported from Barr Creek.

The Living Murray, a Murray-Darling Basin Commission initiative, aims to restore the health of the River Murray and the Murray-Darling Basin. The Living Murray initiative is about what constitutes a healthy working river and what is needed to achieve it. The decisions of the Murray-Darling Ministerial Council are expected to influence future river management in the North Central region and will be considered in future Strategy reviews.

To address the issue of barriers to upstream fish migrations from the River Murray, a Redundant Weir Review (North Central CMA 2002a) has been undertaken to provide an inventory and priority listing of potentially redundant structures within the North Central region that restrict the movement of migratory fish upstream. The removal or modification of these structures will allow improved connectivity between the River Murray and waterways of the North Central region.



Photo: Angela Gladman

The Echuca weir on the Campaspe River is a barrier to upstream migration of native fish from the River Murray during low flows.

The Campaspe and Loddon rivers flow directly into the River Murray, while the Avoca River flows to the Kerang Lakes (Avoca Marshes) and into the River Murray during associated flood events. All three rivers are considered a priority under Principle 2.

Principle 2 priority reaches:

The following table (Table 10) lists the priority reaches and a brief justification for their priority status under Principle 2. See Figure 11 for the locations of priority reaches.

Table 10 Priority reaches under Principle 2

Waterway	Catchment	Priority reaches	Justification for Principle 2 priority status
Bendigo Creek	Loddon	40, 41, 42, 43, 44	Reaches linked to nationally significant wetland
Myers Creek	Loddon	45, 46	Reaches linked to nationally significant wetland
Loddon River	Loddon	1, 2, 3, 4, 5, 6, 7, 8, 9, 10	Reaches linked to internationally and nationally significant wetlands and the nationally significant River Murray
Gunbower Creek	Loddon	38, 39	Reaches linked to internationally significant wetland
Creswick Creek	Loddon	20	Reach linked to nationally significant wetland
Pyramid Creek	Loddon	33	Reach linked to internationally significant wetland
Campaspe River	Campaspe	1, 2, 3, 4, 5, 6, 7	Reaches linked to the nationally significant River Murray
Richardson River	Wimmera	43, 44, 45	Reaches linked to nationally significant wetland
Avon River	Wimmera	46, 47, 48	Reaches linked to nationally significant wetland
Dog Trap / Richardson Creek	Wimmera	52	Reach linked to nationally significant wetland
Avoca River	Avoca	1, 2, 3, 4, 5, 6, 7, 8	Reaches linked to internationally and nationally significant wetlands and the River Murray
Tyrell Creek	Avoca		Reach linked to nationally significant wetland
Lalbert Creek	Avoca		Reach linked to nationally significant wetland

Note: Tyrell and Lalbert creeks were not assessed or assigned ISC reach numbers in the 1999 ISC assessment. However they were included in the 2004 ISC assessment.

Actions for Principle 2 priority reaches

The following points are an indication of the types of actions to undertake for the priority reaches identified under Principle 2:

- Addressing salinity, nutrient and sediment issues through the Loddon-Murray Land and Water Management Strategy, Draft North Central Land Management Plan, North Central Dryland Targeted Salinity Program and the



establishment of buffer strips along the Avon and Richardson rivers to minimise water-quality-related threats to Lake Buloke, e.g. salinity levels and algal blooms.

- Managing nutrient levels in Bendigo Creek through relevant nutrient and stormwater management programs to minimise water-quality-related threats to Kow Swamp, e.g. algal blooms.
- Addressing salinity, nutrient and sediment issues along the Loddon and Campaspe rivers to minimise the water-quality-related threats to the River Murray.
- Addressing the threats of barriers to fish movement and flow modification along the Loddon and Campaspe rivers and their impact on the River Murray.
- Working closely with the Mallee CMA to develop a Waterway Action Plan for Tyrell and Lalbert creeks.
- Supporting the development of the North Central Wetland Strategy.

5.3 Principle 3: Protect and enhance reaches at high risk

Objective:

- To minimise the risk of threats degrading values along reaches at high risk.

5.3.1 Determining the risk of threats degrading values

Identifying reaches at high risk must consider values and threats to be able to assess the risk of continued or further degradation of each reach. All value and threat data used in this risk-assessment utilises the data in the North Central RIVERS database (see description in 4.1.3). This data is presented for each of the 101 reaches in the North Central region in the supporting document *North Central waterways – a values, threats and risks* (North Central CMA 2004b) which is available on the North Central CMA website at www.nccma.vic.gov.au.

The risk-assessment is a simple process that assesses the likelihood of particular reach values being impacted by particular threats, and the consequence of those threats damaging the values of the reach. Therefore, the risk equation is:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

Sections 5.3.2 and 5.3.3 outline the process used to identify high-risk reaches.

5.3.2 Determining likelihood

The likelihood of degradation to the reach depends on the potential for the threats identified in a particular reach to impact on its values. The potential for a threat to impact on a value can be generalised across all reaches. Table 11 is an assessment of the likelihood that any given threat will degrade the values of the reach. A scale of 1 to 5 is used to represent the likelihood of a threat impacting on a value, where 1 represents 'Rare' and 5 represents an 'Almost certain' impact.

Table 11 provides a matrix where the likelihood of any threat impacting on a value can be identified. For example, it is 'Almost certain' (likelihood score of 5) that the threat of extreme water temperatures will impact on the fish proportion value (i.e. fish spawning). However, it is 'Rare' that water temperature would impact on land value (likelihood score of 1).



Table 11 Likelihood of a threat impacting on a value

		Threats																
		Waterway Physical				Water Resources		Water Quality					Waterway Biodiversity					
		Bank Erosion	Bed Erosion	Channel Mod	Barriers	Flow Deviation	Wetland Connect.	WQ Trend	WQ Attainment	Temp	WQ Signal	Algal Blooms	Exotic Flora	Introduced Fauna	Loss Instream Habitat	Stock Access	Degraded Riparian Veg.	
Values	Environmental	Significant Flora	3	2	2	1	4	4	3	3	1	2	2	5	1	1	5	5
		Statewide EVC	2	2	2	1	4	4	2	3	1	2	1	5	1	1	5	4
		Significant Fauna	4	4	2	4	4	4	5	4	4	4	4	4	5	4	4	5
		Wetland Significance	3	3	3	3	4	5	4	4	2	4	5	4	2	3	4	4
		Wetland Rarity	4	2	4	3	4	4	4	4	1	4	5	4	2	2	4	4
		Sites Significance	3	3	3	1	3	4	2	2	1	2	2	3	1	3	3	3
		Heritage/Rep. Rivers	5	4	4	1	4	3	4	5	3	4	5	5	3	3	3	5
		Invertebrates Obs. Exp.	5	5	3	2	4	4	5	5	5	5	5	3	5	4	3	3
		Width Vegetation	3	2	3	2	3	2	1	2	1	1	1	4	1	1	5	3
		Struct Intactness Veg.	5	1	2	1	2	3	1	3	1	1	1	4	1	1	5	5
		Longitudinal Continuity	5	1	3	1	2	2	1	2	1	1	1	4	1	1	5	4
		Fish Obs. Exp.	3	3	3	5	5	4	5	5	5	5	5	3	5	5	3	4
		Fish Proportion	3	3	3	5	5	5	5	5	5	5	5	3	5	5	3	4
	Fish Migrations	1	3	4	5	5	4	5	3	4	4	2	2	1	4	3	1	
	Eco. Healthy River	2	2	2	5	4	3	3	3	4	3	3	5	1	5	4	5	
	Social	Fishing	3	3	4	4	5	2	4	5	2	5	5	4	4	5	2	4
		Non-Motor Sports	2	1	1	4	5	1	2	3	1	3	5	4	4	1	1	3
		Motor Sports	2	1	1	4	5	1	2	3	1	3	5	3	1	1	1	2
		Camping	2	1	1	1	4	1	4	5	1	5	5	4	1	2	3	4
		Swimming	4	4	1	3	5	1	5	5	1	5	5	4	2	2	3	3
Passive Recreation		3	3	4	2	5	1	2	4	1	3	5	5	2	4	4	5	
European Heritage		4	3	3	1	2	1	1	3	1	2	3	3	2	1	3	3	
Flagship Species		4	3	3	1	1	1	1	1	1	1	1	4	2	1	4	3	
Listed Landscape	4	3	3	1	1	1	1	1	1	1	1	4	2	1	4	3		
Economic	Water Supply IRR	3	3	1	2	5	1	5	5	1	4	5	2	2	1	4	3	
	Water Supply PC	4	4	1	2	5	1	5	5	1	4	5	2	2	1	4	3	
	Infrastructure	5	5	5	1	2	1	4	1	1	1	1	2	2	1	2	3	
	Land Value	5	3	4	1	4	1	3	2	1	2	2	5	2	1	5	5	
	Tourism	2	3	1	1	4	1	3	5	1	4	5	4	2	3	4	4	
	Power Generation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	

5 Almost certain
 4 Likely
 3 Moderate
 2 Unlikely
 1 Rare

Note: Definitions are provided in the supporting document (North Central CMA 2004c).

5.3.3 Determining consequence

Consequence is a measure of value degradation when impacted by a threat. The level of consequence increases as the levels of the values and threats increase. The consequence of a threat degrading a value is calculated by multiplying the RiVERS score for threat by the RiVERS score for value (for each value and threat combination). The result is then translated into a consequence score from 1 to 5, where 1 represents an 'Insignificant' consequence and 5 represents 'Catastrophic' consequence (Table 12). For example, a high threat (5) impacting on a high-value (5) would have a 'Catastrophic' consequence. However, if the threat is high (5) but the value is low (1) the consequence would be 'Minor'.



Table 12 Consequence of a threat impacting on a value

		Threat				
		1	2	3	4	5
Value	1	1	1	1	1	2
	2	1	1	2	2	3
	3	1	2	2	3	4
	4	1	2	3	4	5
	5	2	3	4	5	5

5	Catastrophic (5)
4	Major (4)
3	Moderate (3)
2	Minor (2)
1	Insignificant (1)

5.2.3 Identifying reaches of high risk

Once the likelihood and consequence are known, a risk matrix can be formed for each reach across the region (see Table 13) which shows the risk of each threat impacting on each value, where:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

As the highest consequence is denoted by a score of 5 (Table 12) and the highest likelihood is denoted by a score of 5 (Table 11), the highest risk-score is denoted by a score of 25. Therefore, high-values and high threats are inherent in reaches of high risk. Table 13 provides an example of the value and threat scores from the RiVERS database for a particular reach, and demonstrates the risk relationships between the various values and threats.

Referring to the example reach shown in Table 13, the risk of barriers impacting on fish migration scores 25 (as circled in black). In this example, the value score for 'Fish Migrations' is 4 and the threat score for 'Barriers' is 5.

To justify the risk-score, consider these value and threat scores and refer to Table 11 that identifies the likelihood of barriers impacting on fish migration as 'Almost certain' (scoring 5). Then refer to Table 12 that identifies the consequence as 'Catastrophic' (scoring 5). Therefore, the risk (the consequence score multiplied by the likelihood score) score is 25 as circled in Table 13.



Table 13 Reach-scale risk matrix

		Threat	Threats															TOTAL		
			Waterway Physical				Water Resources		Water Quality					Waterway Biodiversity						
			Bank Erosion	Bed Erosion	Channel Modification	Barriers	Flow Deviation	Wetland Connectivity	WC Trend	WC Attainment	Temperature	WC Signal	Algal Blooms	Exotic Flora	Introduced Fauna	Loss Instream Habitat	Stock Access		Degraded Riparian Veg.	
		5	3	2	3	5	1	1	3	4	2	1	1	3	2	5	5	4		
Values	Environmental	Significant Flora	5	12	6	8	5	8	8	12	15	3	4	4	20	3	5	25	25	163
		Statewide EVC	5	8	6	8	5	8	8	8	15	3	4	2	20	3	5	25	20	148
		Significant Fauna	5	16	12	8	20	8	8	20	20	12	8	8	16	15	20	20	25	236
		Wetland Significance	3	6	6	6	12	4	5	8	12	4	4	5	8	4	12	16	12	124
		Wetland Rarity	5	16	6	16	15	8	8	16	20	3	8	10	16	6	10	20	20	198
		Sites Significance	1	3	3	3	2	3	4	2	2	1	2	2	3	1	6	6	3	46
		Heritage/Rep. Rivers	1	5	4	4	2	4	3	4	5	3	4	5	5	3	6	6	5	68
		Invertebrates Obs. Exp.	2	10	5	6	6	4	4	10	10	5	5	5	6	5	12	9	6	108
		Width Vegetation	1	3	2	3	4	3	2	1	2	1	1	1	4	1	2	10	3	43
		Struct Intactness Veg.	2	10	1	4	3	2	3	2	6	1	1	1	8	1	3	15	10	71
		Longitudinal Continuity	1	5	1	3	2	2	2	1	2	1	1	1	4	1	2	10	4	42
		Fish Obs. Exp.	2	6	3	6	15	5	4	10	10	5	5	5	6	5	15	9	8	117
		Fish Proportion	1	3	3	3	10	5	5	5	5	5	5	5	3	5	10	6	4	82
		Fish Migrations	4	3	6	12	25	5	4	15	12	8	4	2	6	2	20	15	4	143
	Eco. Healthy River	1	2	2	2	10	4	3	3	3	4	3	3	5	1	10	8	5	68	
	Social	Fishing	1	3	3	4	8	5	2	4	5	2	5	5	4	4	10	4	4	72
		Non Motor Sports	1	2	1	1	8	5	1	2	3	1	3	5	4	4	2	2	3	47
		Motor Sports	1	2	1	1	8	5	1	2	3	1	3	5	3	1	2	2	2	42
		Camping	3	4	2	2	4	4	1	8	15	2	5	5	8	2	8	12	12	94
		Swimming	1	4	4	1	6	5	1	5	5	1	5	5	4	2	4	6	3	61
Passive Recreation		3	6	6	8	8	5	1	4	12	2	3	5	10	4	16	16	15	121	
European Heritage		1	4	3	3	2	2	1	1	3	1	2	3	3	2	2	6	3	41	
Camping		3	8	6	6	4	1	1	2	3	2	1	1	8	4	4	16	9	76	
Economic	Listed Landscape	1	4	3	3	2	1	1	1	1	1	1	1	4	2	2	8	3	38	
	Water Supply IRR	2	6	3	2	6	5	1	10	10	1	4	5	4	2	3	12	6	80	
	Water Supply PC	1	4	4	1	4	5	1	5	5	1	4	5	2	2	2	8	3	56	
	Infrastructure	5	20	15	20	5	4	2	16	5	3	2	2	8	6	5	10	15	138	
	Land Value	4	15	6	12	5	4	1	9	8	2	2	2	15	4	5	25	20	135	
Tourism	3	4	6	2	4	4	1	6	15	2	4	5	8	4	12	16	12	105		
Power Generation	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	1	19		
TOTAL			195	130	159	212	129	88	193	233	82	104	114	216	100	217	345	265	2782	

Note: The value and threat definitions are provided in the supporting document (North Central CMA 2004b).

The supporting document *North Central waterways – values, threats and risks* (North Central CMA 2004b) contains the data for all 101 ISC reaches. An example of the information contained in this document is provided in Appendix 5.

By summing the total risk-score (indicated in bold in the lower right corner of Table 13) all 101 ISC reaches can be compared and ranked against each other. This provides an indication of the relative risk of threats potentially degrading values in each reach.

Table 14 provides a list of the top 30 waterway reaches ranked by total risk-score. Thirty reaches were chosen as a cut-off, equating to approximately one-third of the total number of reaches in the North Central region. These reaches are considered 'high-risk' reaches.



Principle 3 priority reaches:

The following table (Table 14) lists the priority reaches under Principle 3. See Figure 11 for the locations of these priority reaches.

Table 14 Priority reaches under Principle 3 - top 30 reaches ranked by total risk-score

Waterway	Reach	Total risk-score	Rank
Loddon River	7	4,757	1
Gunbower Creek	38	4,329	2
Gunbower Creek	39	4,192	3
Loddon River	8	4,050	4
Campaspe River	3	3,955	5
Campaspe River	6	3,932	6
Avoca River	1	3,869	7
Campaspe River	7	3,793	8
Loddon River	2	3,748	9
Campaspe River	5	3,738	10
Coliban River	18	3,719	11
Loddon River	6	3,649	12
Campaspe River	1	3,567	13
Campaspe River	4	3,565	14
Campaspe River	2	3,539	15
Loddon River	1	3,502	16
Birches Creek	21	3,499	17
Coliban River	19	3,444	18
Barkers Creek	30	3,400	19
Avoca River	4	3,354	20
Tullaroop Creek	18	3,341	21
Avoca River	2	3,330	22
Five Mile Creek	24	3,325	23
Bendigo Creek	44	3,315	24
Creswick Creek	20	3,312	25
Loddon River	10	3,311	26
Avoca River	7	3,252	27
Bet Bet Creek	14	3,215	28
Barr Creek	31	3,215	29
Serpentine Creek	11	3,197	30

Actions for Principle 3 priority reaches

The following points are an indication of the types of actions to undertake for the priority reaches identified under Principle 3:

- Protect and enhance the high-values specific to each priority reach at high-risk
- Mitigate the high threats specific to each priority reach at high-risk

5.4 Principle 4: Protect reaches of high environmental-, social- and economic-value

Objective:

- To minimise the environmental threats impacting on the values associated with each of the top five ranked environmental, social and economic reaches.

5.4.1 Identifying high-value environmental, social and economic reaches

Across Victoria, our water system delivers economic value by allocating water to towns, irrigation, agriculture and industry, while healthy rivers and aquifers also provide environmental, cultural and recreational value. When the health of waterways deteriorates, so does the quality of services they provide for our communities and the economy. The message is clear: degrading rivers, aquifers and floodplains seriously affect regional and urban social economies (DSE 2004).



As outlined in the Victorian RHS, it is important to protect and enhance the environmental, social and economic values associated with waterways. By using the information contained in the RiVERS database, the environmental, social and economic value scores can be totalled separately for each reach. This enables each value type to be ranked independently for each reach in descending order, where 1 is the highest ranked value and 101 is the lowest ranked value.

For the purpose of the prioritisation process, a cut-off of the top five ranked environmental, social and economic values was selected. Some reaches are ranked highly for more than one value type. The supporting document *North Central waterways – values, threats and risks* (North Central CMA 2004b) contains the data for all 101 ISC reaches and their environmental, social and economic ranking from 1 to 101. An example of the information contained in this document is provided in Appendix 5. Additionally, the comparative rankings are provided in Appendices 6, 7 and 8.

Principle 4 priority reaches:

The following table (Table 15) lists the priority reaches and a brief justification for their priority status under Principle 4. See Figure 11 for the locations of priority reaches.

Table 15 Priority reaches under Principle 4

Waterway	Catchment	Priority reach	Justification for Principle 4 priority status
Avoca River	Avoca	1	Ranked 1 for environmental value
Campaspe River	Campaspe	6	Ranked 2 for environmental value
Gunbower Creek	Loddon	38	Ranked 3 for environmental value
Loddon River	Loddon	2	Ranked 4 for environmental value
Avoca River	Avoca	4	Ranked 5 for environmental value
Loddon River	Loddon	7	Ranked 1 for social value
Gunbower Creek	Loddon	38	Ranked 2 for social value
Loddon River	Loddon	10	Ranked 3 for social value
Campaspe River	Campaspe	5	Ranked 4 for social value
Loddon River	Loddon	8	Ranked 5 for social value
Loddon River	Loddon	8	Ranked 1 for economic value
Five Mile Creek	Campaspe	24	Ranked 2 for economic value
Creswick Creek	Loddon	20	Ranked 3 for economic value
Coliban River	Campaspe	19	Ranked 4 for economic value
Campaspe River	Campaspe	7	Ranked 5 for economic value

Actions for Principle 4 priority reaches

The following points are an indication of the types of actions to undertake for the priority reaches identified under Principle 4:

- As the major threats to the environmental values associated with the Gunbower Creek reach 38 are related to barriers, flow deviation, poor water quality, stock access and degraded riparian vegetation, actions would aim to mitigate these threats. These will largely be addressed through the Gunbower Creek Rehabilitation Project, which aims to develop and implement a Waterway Action Plan with a ten-year life span, to enhance the ecological values of Gunbower Creek.
- As the major threats to the social values associated with the Loddon River reach 7 are related to barriers, flow deviation and poor water quality, actions would aim to mitigate these threats. This may include investigating the removal of instream barriers, implementing the EWR (negotiated through the BE and Living Murray processes) and implementing nutrient and salinity management actions both along the river and throughout the Loddon catchment.
- As the major threats to the economic values associated with the Coliban River reach 19 are related to poor water quality and stock access, actions would aim to mitigate these threats. These will largely be addressed through the development of a Coliban Catchment Action Plan with key stakeholders, which may include actions such as the establishment of nutrient buffer strips and stock control measures.



5.5 Principle 5: Maintain and enhance community capacity, awareness, motivation and involvement across the region

Objectives:

- To harness the enthusiasm of individuals or community groups across the region to improve the health of their local waterways
- To enhance the capacity of the community to become involved in improving river health by providing the information required to make informed decisions
- To enhance the awareness of the community by targeting key messages to areas of the region that relate to specific issues
- To motivate the community to care for their waterways by promoting the multiple benefits of healthy waterways from the paddock to the catchment scale
- To involve the community in the detailed planning of onground, river health improvement works through local area catchment and waterway action plans
- To inform the community about how to become involved in protecting and enhancing river health through incentives and community engagement activities.

These objectives apply to waterways, wetlands and floodplains across the entire North Central region (not only to those highlighted in Figure 11).

For more information about the Strategy links to community engagement and capacity building refer to Section 7. Section 7 also outlines the Community involvement targets and the costed actions to achieve these targets, including five-year and ten-year targets.

Actions for Principle 5

Although specific priority reaches are not identified under Principle 5, the following points are an indication of the types of actions appropriate to the region:

- develop and implement the North Central River Health Community Engagement Plan, involving the River Health Awareness Officer. This may involve:
 - the development of communication tools and methods of delivery
 - the identification of key community groups
 - key messages
- implement the community engagement components of partner agency NRM programs.

5.6 Principle 6: Protect individual sites of significance along regional waterways

Objective:

- To identify and minimise the environmental threats to individual sites of significance along regional waterways.

This objective applies to waterways, wetlands and floodplains across the entire North Central region (not only to those highlighted in Figure 11).

The following list provides an indication of what may be considered a site of significance (this list is not exhaustive):

- sites listed on the Victorian Heritage Register or Inventory, e.g. bridge, gold mine, ruins
- cultural heritage sites, e.g. mounds, surface scatters, scar trees
- geological sites of significance, e.g. waterfalls, rock formations
- key threatened species habitat
- key high-quality sites
- high-value sites identified by the local community.

While many sites are well documented, there are almost certainly many more that are not. This principle primarily takes into account those sites that are not currently identified and those with no clear actions to minimise the environmental threats to their particular values. This principle provides an element of flexibility in river



Photo: Angela Gladman

The Mia Mia or Redesdale Bridge over the Campaspe River is the oldest and most impressive rural Victorian iron lattice-truss bridge built in the colonial era and is listed on the Victorian Heritage Register.



health management to protect significant sites as they are identified and as opportunities arise to protect them from a river health perspective.

Actions for Principle 6

Although specific priority reaches are not identified under Principle 6, the following points are an indication of the types of actions appropriate to the region:

- To incorporate the identification of significant sites during the planning phase of undertaking on-ground river health improvement works
- To liaise with the relevant authorities/groups when proposing works that may impact upon significant sites
- To protect significant sites from identified environmental threats.

5.7 Principle 7: Prevent damage and degradation of our rivers from future development activities

Objective:

- To minimise the localised and catchment-scale impact of new development to ensure the 'overall improvement' in river health.

This objective applies to waterways, wetlands and floodplains across the entire North Central region (not only to those highlighted in Figure 11). This principle also provides some flexibility in river health management to deal with future development issues as they arise, which are relatively unforeseen. It differs from Principle 6 as this principle focuses on the impacts of future development on waterways in general, whereas Principle 6 deals with environmental threats to specific assets. It is important to emphasise the prevention of damage to our rivers from future development activities due to the expected level of population growth and development that the North Central region is expected to experience.

Actions for Principle 7

Although specific priority reaches are not identified under Principle 7, the following points are an indication of the types of actions appropriate to the region:

- develop planning controls with local government to avoid inappropriate development in environmentally sensitive waterways, wetlands and floodplain areas
- work with local government to manage the cumulative impact of any approved developments
- support the integrated water strategies outlined in 'Our Water Our Future' to ensure the continuation of healthy water resources to support growing communities and a thriving Victorian economy over the next 50 years.

5.8 Limitations of the prioritisation methodology

The nature of the information and methodology used in this priority-setting process is appropriate for regional-scale prioritisation and strategic planning. However, it must be acknowledged that the methodology is limited by the fundamental accuracy of the base data used in the RiVERS database. That database is only a tool to assist management decisions and clearly, there is scope for improvement.

The RiVERS database has the best information available. Some of the information is limited, e.g. fish populations. These gaps need to be, and will be, filled (as indicated in Section 9.4).

Locals at the River Health Forums completed surveys that were developed prior to the finalisation of the RiVERS model. Therefore, the value and threat categories were not identically aligned. However, the information gathered was useful to cross-reference the information entered into the RiVERS database from statewide datasets and local staff knowledge.

The North Central CMA is committed to further involving local communities as the database is revised.

As the prioritisation methodology is based on the 1999 ISC reaches, the North Central CMA acknowledge that:

- Non-ISC waterways (named or unnamed) upstream of priority ISC reaches shall be considered in line with the priorities of the downstream priority ISC reach.
- As is the nature of working along waterways, the effect of upstream reaches will be considered when working to protect and improve river health of downstream waterway reaches.



These aspects of river health management will be fully explored during the development of detailed Catchment Action Plans at the sub-catchment scale, along with the confirmation of key waterway values and threats identified by the local community.

5.9 Priority waterways of the North Central region

The priority-setting process described in this section so far, has determined 56 priority reaches of the total 101 ISC reaches across the North Central region according to Principles 1, 2, 3 and 4. Principles 5, 6 and 7 relate to waterways across the entire North Central region which require management flexibility (considering the dynamic nature of regional communities, waterways and future development). Table 16 provides a summary of all the priority reaches in the North Central region.

Table 16 Priority reaches in the North Central region

Catchment	Priority waterway	Reach number	Priority-setting principle/s
Campaspe	Campaspe River	1	2, 3, 5, 6 and 7
Campaspe	Campaspe River	2	2, 3, 5, 6 and 7
Campaspe	Campaspe River	3	2, 3, 5, 6 and 7
Campaspe	Campaspe River	4	2, 3, 5, 6 and 7
Campaspe	Campaspe River	5	2, 3, 5, 6 and 7
Campaspe	Campaspe River	6	1, 2, 3, 5, 6 and 7
Campaspe	Campaspe River	7	2, 3, 5, 6 and 7
Campaspe	Coliban River	18	3, 4, 5, 6 and 7
Campaspe	Coliban River	19	3, 4, 5, 6 and 7
Campaspe	Coliban River	22	1, 4, 5, 6 and 7
Campaspe	Axe Creek	12	1, 5, 6 and 7
Campaspe	Kangaroo Creek	21	1, 5, 6 and 7
Campaspe	Five Mile Creek	24	4, 5, 6 and 7
Loddon	Loddon River	1	2, 3, 5, 6 and 7
Loddon	Loddon River	2	2, 3, 4, 5, 6 and 7
Loddon	Loddon River	3	2, 5, 6 and 7
Loddon	Loddon River	4	2, 5, 6 and 7
Loddon	Loddon River	5	2, 5, 6 and 7
Loddon	Loddon River	6	2, 3, 5, 6 and 7
Loddon	Loddon River	7	2, 3, 4, 5, 6 and 7
Loddon	Loddon River	8	2, 3, 4, 5, 6 and 7
Loddon	Loddon River	9	2, 5, 6 and 7
Loddon	Loddon River	10	1, 2, 3, 4, 5, 6 and 7
Loddon	Barr Creek	31	3, 5, 6 and 7
Loddon	Serpentine Creek	11	3, 5, 6 and 7
Loddon	Bet Bet Creek	14	3, 5, 6 and 7
Loddon	Tullaroop Creek	18	3, 5, 6 and 7
Loddon	Creswick Creek	20	2, 3, 4, 5, 6 and 7
Loddon	Birches Creek	21	3, 5, 6 and 7
Loddon	Sailors Creek	28	1, 5, 6 and 7
Loddon	Barkers Creek	30	3, 5, 6 and 7
Loddon	Myers Creek	45	2, 5, 6 and 7
Loddon	Myers Creek	46	2, 5, 6 and 7
Loddon	Bendigo Creek	40	2, 5, 6 and 7
Loddon	Bendigo Creek	41	2, 5, 6 and 7
Loddon	Bendigo Creek	42	2, 5, 6 and 7
Loddon	Bendigo Creek	43	2, 5, 6 and 7
Loddon	Bendigo Creek	44	2, 3, 5, 6 and 7
Loddon	Gunbower Creek	38	2, 3, 4, 5, 6 and 7
Loddon	Gunbower Creek	39	2, 3, 5, 6 and 7
Loddon	Pyramid Creek	33	3, 5, 6 and 7



Table 16 Priority reaches in the North Central region (cont'd)

Catchment	Priority waterway	Reach number	Priority-setting principle/s
Avoca	Avoca River	1	1, 2, 4, 5, 6 and 7
Avoca	Avoca River	2	1, 2, 5, 6 and 7
Avoca	Avoca River	3	1, 2, 5, 6 and 7
Avoca	Avoca River	4	1, 2, 4, 5, 6 and 7
Avoca	Avoca River	5	1, 2, 5, 6 and 7
Avoca	Avoca River	6	1, 2, 5, 6 and 7
Avoca	Avoca River	7	1, 2, 5, 6 and 7
Avoca	Avoca River	8	1, 2, 5, 6 and 7
Avon-Richardson	Avon River	46	2, 5, 6 and 7
Avon-Richardson	Avon River	47	2, 5, 6 and 7
Avon-Richardson	Avon River	48	2, 5, 6 and 7
Avon-Richardson	Richardson Creek	52	2, 5, 6 and 7
Avon-Richardson	Richardson River	43	2, 5, 6 and 7
Avon-Richardson	Richardson River	44	2, 5, 6 and 7
Avon-Richardson	Richardson River	45	2, 5, 6 and 7

Figure 11 is a map detailing the geographic location of the 56 priority reaches. Take note that many reaches are priorities under several principles.

As mentioned in the introduction to Section 5, prioritisation is required at two levels:

- the location of priority waterway reaches
- the priority actions to address key values or threats along these reaches.

The second level of prioritisation is detailed in Section 6: actions are prioritised according to the level of risk that a threat will degrade a value that we are aiming to protect (according to the priority-setting principle). The Strategy provides an indication of the most important river health actions to target in the North Central region (realisation of targets is highly dependent upon the level of available funding).

The North Central CMA was established to give communities a strong role in managing natural resources. Community engagement and consultation is a priority. The North Central CMA has three Implementation Committees involving community representatives of the Loddon/Campaspe irrigation areas, Loddon/Campaspe dryland areas and the Avon-Richardson/Avoca catchment areas. The committees play a vital role in developing annual priority actions for river health management. North Central RHS is a guide.

Section 6 aligns each critical and high-priority action with a five-year and ten-year target, with responsible agencies and costs defined. It is important to recognise that a number of assumptions are involved in setting targets (as detailed in Appendix 9), e.g. reaching targets is strongly dependent upon the level of landholder involvement.

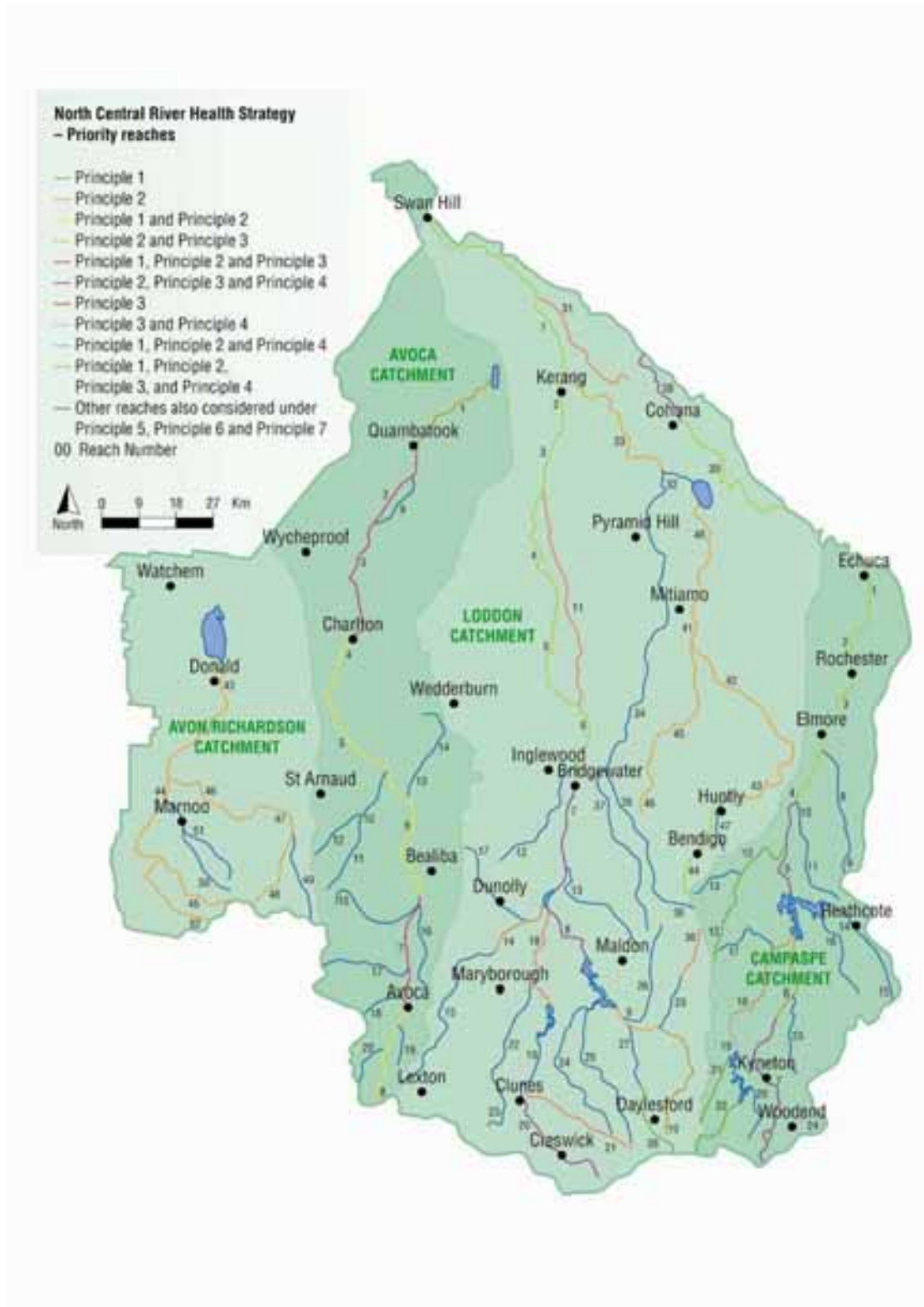


Figure 11 Priority waterway reaches and their corresponding priority-setting principles



SECTION SIX: TARGETS AND ACTIONS

In setting priorities for river health management, it is important to identify both the location of priority waterway reaches and the priority actions to address key values or threats along these reaches. The establishment of short- and long-term targets ensures a clear direction so that resources can be allocated to maximise outcomes for river health.

Section 6 details how actions are prioritised and the theory behind setting targets. To assemble the actions and targets for each priority reach in a succinct and understandable format, the information is divided into Sections 6.4 – 6.7 according to the Campaspe, Loddon, Avoca and Avon-Richardson catchments and is then further divided into 11 Program Areas.

6.1 Assigning priority actions along priority waterway reaches

Section 5 outlined the process for establishing priority waterway reaches across the North Central region. This process is based on seven key principles, each with defined objectives. The prioritisation principles developed closely reflect the prioritisation framework outlined in the Victorian River Health Strategy (RHS) (2002a).

To understand which actions to address first within these reaches, actions can be prioritised according to the level of risk that a particular threat will degrade a particular value that we are aiming to protect (according to the priority-setting principle). In this manner, the Strategy is able to provide an indication of the key river health actions to target in the North Central region, knowing that reaching targets is highly dependent upon the level of available funding.

You will recall from Section 5 that reach values and threats are assigned scores from 1 to 5 in the RiVERS database. The risk-assessment process outlined in Section 5 uses these scores to determine the likelihood for a threat to impact on a value (refer to Table 11) and the consequence of that occurring (refer to Table 12) by simply multiplying the corresponding value and threat scores.

Once the likelihood and consequence are known, a risk matrix can be formed which describes the risk of each threat impacting on each value, where:

$$\text{Risk} = \text{Likelihood} \times \text{Consequence}$$

According to the principle under which a priority reach is identified, particular threats can be targeted to protect the identified values or assets. It is the risk relationship between these values and threats that can be categorised as 'critical' or 'high', where actions addressing critical-risk relationships are prioritised higher than those addressing high-risk relationships.

For an action to be considered a 'critical' priority, the risk-score is equal to 25:

$$\text{catastrophic consequence (score 5) } \times \text{ almost certain likelihood (score 5) } = 25$$

For an action to be considered 'high' priority, the risk-score is equal to 20:

$$\text{major consequence (score 4) } \times \text{ almost certain likelihood (score 5) } = 20$$

Using the same example from Section 5.2.3, if we assume the reach is a priority under Principle 3 the objective is to protect and enhance high-risk reaches. Referring to Table 8, the value score for 'Fish Migrations' is 4 and the threat score for 'Barriers' is 5.

Table 11 that identifies the likelihood of barriers impacting on fish migration is 'almost certain' (scoring 5). Table 12 identifies the consequence of that occurring is 'catastrophic' (scoring 5). Therefore, the risk (the consequence score multiplied by the likelihood score) equals 25 (as circled in Table 13). Therefore, it is a 'critical' priority to undertake action to address this risk.

The same logic would apply, if the reach was a priority under Principles 1 – 7. The particular values and threats dealt with, are dependent on the objective of the priority-setting principle.



To provide a clear picture of the 'critical' and 'high' priority risk-relationships along each priority reach, a shaded summary table is provided in the following Sections 6.4 – 6.7 for each Program Area. This logic can be related to the action and target tables, which highlights the 'critical' and 'high' priority actions for each priority reach.

6.2 The target-setting process

In order to allocate resources to maximise outcomes in river health, clear targets need to be set. Targets for the North Central region have been developed to align with national, state and regional aspirational goals and targets.

State and Commonwealth governments require targets to be set under their bilateral agreements for the National Action Plan for Salinity and Water Quality and Natural Heritage Trust. Under these agreements, targets must be set to address each of the ten National Matters for Targets as outlined in the National Natural Resource Management (NRM) Monitoring and Evaluation Framework and the National NRM Standards and Targets Framework. The North Central River Health Strategy (RHS) addresses the following relevant aspects of the Matters for Targets:

- soil condition
- inland aquatic ecosystems integrity (rivers and other wetlands)
- nutrients and aquatic environments
- turbidity/suspended particulate matter in aquatic environments
- surface water salinity in freshwater aquatic environments
- significant native species and ecological communities.

The North Central RHS also aligns with the goals and targets set out in the Victorian RHS (DNRE 2002a) and the North Central Regional Catchment Strategy (RCS) (North Central CMA 2003a).

A target defines a specific outcome that is to be achieved. Targets are typically time-bound and measurable, and progress is indicated. An indicator is a parameter that is used to measure and observe change, usually to check or demonstrate that conditions are improving and that progress is being made. Indicators can provide direct measures of change, or may be indirectly related, and therefore provide implied measures of change (see Figure 12).

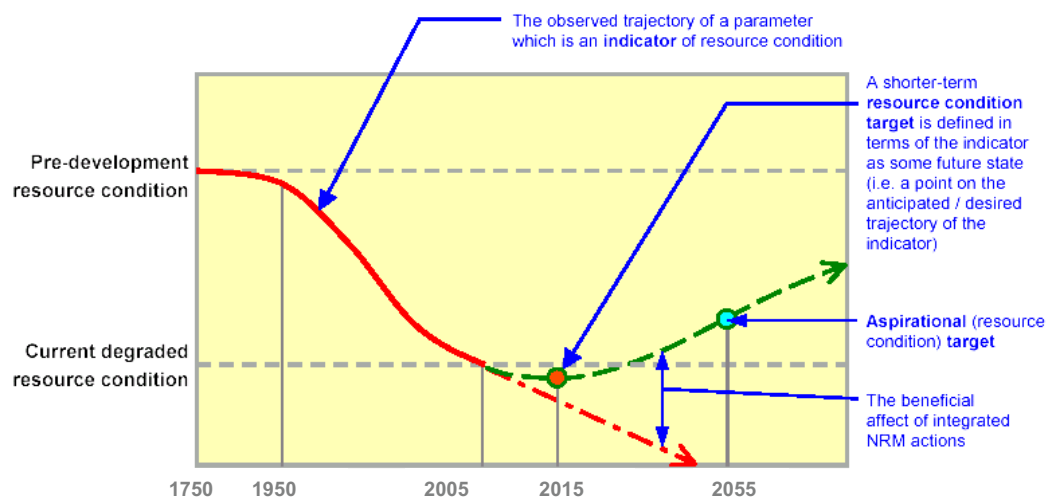


Figure 12 Diagram showing a hypothetical resource condition, and associated trends and targets (Natural Resource Management Ministerial Council 2002).

Three types of targets have been defined in the National Framework for Natural Resource Management Standards and Targets (Natural Resource Management Ministerial Council 2002). These include:

- Aspirational Targets
- Resource Condition Targets
- Management Action Targets



An **Aspirational Target** describes the vision for the desired long-term (50+ years) condition of the natural resource. Thus, Aspirational Targets relate to outcomes. It is preferable but not essential that the Aspirational Target be quantified. The Aspirational Target shown in Figure 10 is the resource condition desired in 2050.

Aspirational Targets for the North Central RHS have been set at the catchment scale (Sections 6.4 – 6.7) and stem from the vision and objectives described in Section 2. They are based on community goals, and the Aspirational Targets defined in the North Central RCS (North Central CMA 2003a) and Victorian RHS (DNRE 2002a).

A **Resource Condition Target** is the level of change that might reasonably be sought within a 5-10-year period (although it could possibly be as long as 20 years) using current management practices. Resource Condition Targets also relate to outcomes. The Resource Condition Target in Figure 10 is set for 2015. The target could be defined in terms of a monitoring parameter or as an index of a resource condition combining a number of monitoring parameters (e.g. 'an increase of 1 point in the Index of Stream Condition (ISC) score in 80% of the region's waterways by 2015').

Resource Condition Targets for the North Central RHS have been set at the reach scale within each Program Area in Sections 6.4 – 6.7. These targets particularly relate to high priority waterways in the North Central region to ensure that priority river health assets are protected and enhanced according to the priority-setting principles in Section 5. Resource Condition Targets have been set using available information from all relevant underlying plans and strategies and the risk-assessment process outlined in Section 5.

Resource Condition Targets have also been set for community involvement in Section 7.

A **Management Action Target** reflects the activities or level of effort required in the short term, to reach the Resource Condition Target. These targets relate to the effective implementation of actions including onground works and capacity building, and thus to outputs. They generally have 1-5 year timeframes so that progress can be reported in the short term, despite changes in natural resource condition occurring over longer timeframes. They are challenging but achievable, demanding that action be taken.

Management Action Targets for the North Central RHS have been set at the priority reach scale within each Program Area in Sections 6.4 – 6.7. They are specific works/outputs that are required to achieve the linked Resource Condition Target in the longer term. Management Action and subsequent Resource Condition Targets have been set to meet the objectives of the Principle (1 - 7) under which the reach was identified as a priority in Section 5.

Management Action Targets have also been set for community involvement in Section 7.

6.2.1 Target-setting assumptions

A number of general and specific assumptions have been made in order to set Management Action and Resource Condition Targets, as detailed in Appendix 9. Some of these key assumptions include:

- Achievement of targets is highly dependent upon the level of available funding
- **Achievement of targets is highly dependent upon the level of landholder uptake in river health improvement incentives/activities**
- Targets have been set using the current knowledge (when the Strategy was produced)
- Targets aim to demonstrate a progress in river health over time.

The setting of targets for riparian vegetation management considers the *Access for Recreational Fishing* (VRFish 2004) policy paper. The targets will also contribute to the Resource Condition Targets for threatened Ecological Vegetation Classes (EVCs), threatened species and native vegetation coverage as outlined in the North Central RCS (North Central CMA 2003a).

6.2.2 Program area target tables

To present the priority reaches, their actions and related targets in Sections 6.4 – 6.7, each Program Area presents two tables: onground actions; and related actions and targets. The first table presents the actual actions to undertake along priority reaches for a particular set of Resource conditions. The second table of Resource conditions relies on the implementation of actions from the first table to meet the targets. The second table does not include costed actions as they relate to the costs in the first table and are linked via a numbering system.

The Program Area target tables use the following headings (Table 17).



Table 17 Target table heading definitions

Target table heading	Definition
Resource condition	Broad target-setting category. Depending on the management objectives of the priority reaches, categories may include: <ul style="list-style-type: none"> • Hydrology (EWR) • Riparian zone • Instream habitat • Aquatic life • Water quality • River health • Wetlands • 'Near' ecologically healthy reaches • Representative reaches • High environmental-, social- and/or economic-value reaches
Value/threat	The values and threats targeted for each action for the particular priority reach (also displayed in the preceding value and threat summary table for each Program Area)
Priority reach	Numbered ISC reach identified as a priority in Section 5
Current condition and year data collected	Outlines current resource condition using available information
Action	Key broad action/s to achieve targets
Management Action Target	The activities or level of effort required in the short term (five years) to reach the Resource Condition Target along priority waterways
Resource Condition Target	The level of change that might reasonably be sought within a 10-year period along priority waterways
Monitoring requirements	Method of measuring the parameter used to measure and observe change, either directly or indirectly
Responsibility	Key organisations and groups responsible for achieving the set targets. The lead agency is shown in bold.
Cost (only for the onground actions table)	Defines the cost of the action and the cost split between the Victorian Government and 'Other'. Also provides an indication of whether the action is already costed or involves a once-off, annual, five yearly or 30-year investment.

It is important to note that the Victorian Government's 'Our Water Our Future' (DSE 2004a) guides the future management of water resources in Victoria. The roles, responsibilities and key actions from this strategic document are summarised in Section 8.2. Of the 11 Program Areas, seven areas identify 'flow deviation' as a high risk to the values along the priority reaches. To avoid excessive repetition, a regional action that applies to all Program Areas is the development and implementation of a Sustainable Water Strategy for Northern Victoria led by the DSE with the support of the CMAs and water authorities. The Management Action Target is generally to improve the environmental flow regime of waterways with the longer term (Resource Condition Target) of improving the measurement of the ISC hydrology sub-index score by one.

Specific actions under the Hydrology (EWR) resource condition category are included in relevant Program Areas where channel modification (i.e. levees) or temperature pose a high risk to the values along priority reaches.

6.2.3 Catchment Action Plans

Catchment Action Plans provide a finer scale of river health management planning than this broader, regional river health strategy. Involving close consultation with the local community and relevant stakeholder groups and agencies, these plans identify the specific location of actions along priority reaches and the biodiversity linkages throughout the landscape. These plans incorporate the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

The key points for identifying an area for a Catchment Action Plan are:



- a high level of community and agency support for an integrated approach to catchment management
- opportunities for multiple benefit (TBL) outcomes, e.g. river health, biodiversity, land management
- the area contains priority reaches identified in the North Central RHS.

A Catchment Action Plan is currently being developed for the Coliban catchment that aims to integrate current strategic direction, expert advice and community desires to enable the development of prioritised actions to protect the catchment's valuable assets and mitigate potential threats to these assets.

Two additional plans are planned in 2005/06 and are included in the Regional Catchment Investment Plan (RCIP) process to attract funding from investors. These include the upper Avoca (upstream of Avoca) and the upper Loddon River/Kangaroo Creek areas. Over the following five years, the North Central CMA aims to have developed one Catchment Action Plan within each of the 11 Program Areas.

6.3 Threat-management interactions

The purpose of Management Action and Resource Condition targets are to achieve the objective of the priority-setting principle under which the reach was identified a regional priority. If an action is to reduce risk, the threat posing the risk must be identified and targeted. The threats listed in the RiVERS database are composed of a mix of primary and subsidiary threats. That is, some of the threats directly pose a risk (i.e. an 'almost certain' likelihood), while some are the combined result of other threats. It is important that Management Action Targets are the key processes that lead to the main threats identified through the risk process, as identified in the likelihood table (Table 11).

To provide a general picture of the threatening processes that may take place in a river reach, refer to the simplified 'mud map' provided in Figure 11. There are a number of general assumptions behind the links between the degrading processes and actions proposed that are not necessarily proven in the North Central region. These are discussed in Section 9.5 in relation to research and development. The general target-setting assumptions are listed in Appendix 9. Some key assumptions relating to Figure 13 include:

- the protection and enhancement of riparian vegetation will contribute to enhanced biodiversity, improved water quality and stabilisation of stream bed and banks
- several threats are closely associated, such as stock access, bank erosion and degraded riparian vegetation and can be addressed simultaneously
- gully control structures and beaching halts bed and bank erosion, reducing the amount of sediment entering waterways
- appropriate farming practices can have a positive impact on river health
- increasing community awareness of river health can enhance the capacity of landholders and community groups to improve the health of their waterways
- by reducing nutrients (and sediments) in waterways, water quality is improved leading to fewer algal blooms
- river flows can be improved through environmental flow provisions
- wetland connectivity can be improved through an appropriate flow regime, which may involve the instalment of regulators
- water temperature in waterways downstream of storages can be regulated by the installation of multi-level offtakes
- instream habitat can be enhanced through the reintroduction of large woody debris and instream vegetation
- exotic flora includes riparian and aquatic weeds.



Photo: Matt Jackson

Protected and unprotected riparian zones can provide stark comparisons.

Threatening processes identified in action statements under the *Flora and Fauna Guarantee Act 1988* regarding river health management include:

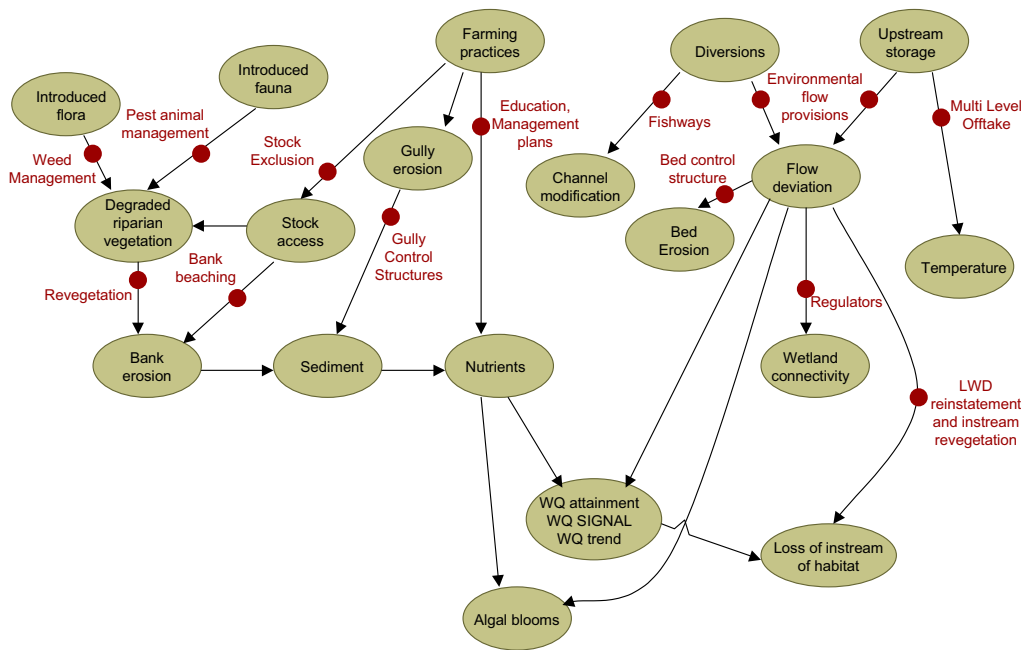
- degradation of native riparian vegetation along Victorian rivers and streams
- increase in sediment input into Victorian rivers and streams due to human activities
- removal of woody debris from Victorian streams
- alteration to the natural temperature regimes of rivers and streams



- input of toxic substances into Victorian rivers and streams
- prevention of passage of aquatic biota as a result of the presence of instream structures.

It is also important to note that some issues relating to river health are not included specifically in the following simplified 'mud map'. However, their importance is recognised and discussed in other sections of this Strategy. These include:

- the potential impacts of urban development on river health
- the relationship between groundwater and river health
- the links between specific farming practices and river health, particularly water quality.



● Point of management intervention

Figure 13 'Mud map' showing the primary and secondary threat processes and points of management intervention.

To generalise across the region, Figure 13 simplifies the processes in the waterway system. Therefore, it is important when implementing actions at the reach scale to understand how processes interact and the inevitable trade-offs. Other factors that need to be included in determining appropriate reach scale actions are:

- Is the threat caused locally or due to upstream river health?
- Is the management action going to have an adverse impact on other values?
- What is the trajectory of decline of the value?
- What is the likelihood that the value can be maintained or restored?

An action to target one threat may well impact on other aspects of waterway health, either with a positive or negative result. Careful planning is required. For example, fencing and revegetating a reach will have positive water quality benefits downstream through a reduction in the amount of sediment and nutrients entering the waterway. Likewise, riparian revegetation can lead to increased natural regeneration downstream through the movement of waterborne seed.

Addressing some threats will result in a reduced risk to some values, but may increase the risk from other threats. For example, removing instream barriers to improve native fish migration may cause invasion by European carp. This isn't to say that these actions should not be undertaken, but care should be taken in the planning and timing to minimise adverse flow-on impacts to other values.

The action required will also depend on the condition trajectory of the value being protected. If a value is deteriorating rapidly, an immediate action will be required to mitigate the threat. If the value is slowly degrading, the action could be based around a longer-term strategy.



In allocating resources to river health management, also consider the probability of system recovery. For example, if a value is at a high level of risk and the recovery potential is high, this reach could be prioritised as requiring urgent protection. However, if the value is at a high level of risk and the probability of long-term recovery is low, it may not be possible (or an effective use of resources) to try and restore this reach to its original condition.

The process for setting Management Action Targets is based on the actions required to meet the objectives of the Principle (1 - 7) under which each reach was identified as a priority in Section 5. It also considers spatial and temporal elements, and the ease and cost-effectiveness of mitigating risk on a case by case basis. Management Action Targets were developed in consultation with key stakeholder organisations at Consultative Committee meetings, during the public comment period and subsequent discussions.

6.4 Campaspe River catchment

The Campaspe River catchment extends from the Great Dividing Range in the south to the River Murray in the north, and covers a total area of around 4,000 square kilometres. The catchment is some 150 kilometres long and has an average width of around 25km (see Section 4.2.1 Figure 7).

The overall objective for managing river health in the Campaspe catchment is to minimise risks to the River Murray to which it is directly linked. In doing so, the riparian vegetation along Campaspe catchment waterways will be protected and enhanced creating better habitat for both terrestrial and aquatic species. Improved water quality will benefit the health of the river and the variety of social and economic uses it provides.

The Campaspe River itself is approximately 225km in total length. The Coliban River is the major tributary that joins the Campaspe River at Lake Eppalock. Other significant tributaries include the Axe, Mclvor, Mt Pleasant, Wild Duck and Pipers creeks. For the Index of Stream Condition (ISC) assessment, which forms the basis of the regional priority-setting process, 13 of the catchment's major waterways were divided into 24 reaches (see Section 4.2.1 Figure 7). In order to present the priority reaches, their actions, targets and costs, the Campaspe catchment was divided into three Program Areas.

Number of ISC reaches	24
Total length of ISC waterways	637km
Number of Program Areas	3

According to the priority-setting process detailed in Section 5, a number of waterway reaches were identified as priorities for river health management in the Campaspe catchment. These reaches and their corresponding priority-setting principles are listed in Table 18. Refer to Section 5 for the objectives specific to each principle that guides the management actions for each priority reach.

Table 18 Priority waterway reaches in the Campaspe catchment

Priority principle	Priority reach
Principle 1: Protect and enhance ecologically healthy rivers and representative rivers	Kangaroo Creek reach 21 Campaspe River reach 6 Coliban River reach 22 Axe Creek reach 12
Principle 2: Minimise risks to connected high-value assets	Campaspe River reaches 1, 2, 3, 4, 5, 6 and 7
Principle 3: Protect and enhance high-risk reaches	Axe Creek reach 12 Campaspe River reaches 1, 2, 3, 4, 5, 6 and 7 Coliban River reaches 18 and 19 Five Mile Creek reach 24
Principle 4: Protect reaches of high environmental-, social- and economic-value	Coliban River reaches 18 and 19 Five Mile Creek reach 24
Principles 5, 6 and 7	All waterways on a case by case basis



The desired long-term (50+ years) vision for all waterways across the Campaspe catchment are defined in the following Aspirational Targets which are measurable and time bound. These reflect the vision and objectives for river health in the North Central region as outlined in Section 2.

- Waterways will achieve full attainment of SEPP (WoV) objectives by 2055
- Axe Creek (Representative river) will meet the State-set criteria for ecologically healthy condition by 2021
- The Campaspe River (reach 6), Kangaroo Creek (reach 21) and Coliban River (reach 22) will meet the State-set criteria for ecologically healthy condition by 2021
- By 2030, average annual loads of phosphorous will be reduced by approximately 35% and nitrogen loads will be reduced by about 25% in the Campaspe catchment.

In addition, are the following long-term goals for the Campaspe catchment:

- Urban development will be carefully planned and managed according to planning controls developed with local government to minimise the impact on waterways, wetlands and floodplain areas
- Long-term water security will be achieved through the implementation of the Sustainable Water Strategy for Northern Victoria
- Water will be shared equitably and efficiently between environment and consumptive uses
- Water quality will match users' requirements and have no detrimental impact on aquatic life
- Erosion and sediment transport will be managed to reduce blue green algal blooms and sedimentation of reservoirs
- Migratory fish will breed and move freely throughout the catchment
- Large-scale fish kills will be no longer
- Populations of threatened native plant and animal species will be restored to viable levels
- Threatened vegetation communities will increase in extent and improve in quality to achieve a net gain
- Reaches of high environmental-, social- and economic-value are protected from environmental threats
- Campaspe River flows will be improved to protect aquatic habitat and improve water quality.

Many of these long-term targets and goals apply across the entire Campaspe catchment. Those particularly relating to the upper catchment include the control of sediment transport to reduce blue green algal blooms and sedimentation of reservoirs, and the management of urban development particularly along the Calder Highway corridor. Those pertinent to the lower catchment include the free movement of migratory fish species upstream from the River Murray and the elimination of large-scale fish kills.

The Management Action and Resource Condition Targets aim to progressively move toward the achievement of the listed Aspirational Targets and long-term goals.

6.4.1 Upper Campaspe (above Lake Eppalock) Program Area

The Upper Campaspe Program Area covers the southeast portion of the Campaspe River basin and includes the towns of Redesdale, Heathcote, Tooborac, Kyneton and Woodend (Figure 4). This area includes the Campaspe River (reaches 6 and 7) from its forested headwaters in the Great Dividing Range to Lake Eppalock. The river receives flows from Five Mile Creek (reach 24) and Pipers Creek (reach 23). Mclvor Creek (reaches 14 and 15) and Wild Duck Creek (reach 16) flow directly into Lake Eppalock. The location and 1999 ISC condition of these waterways are shown in Figure 14.

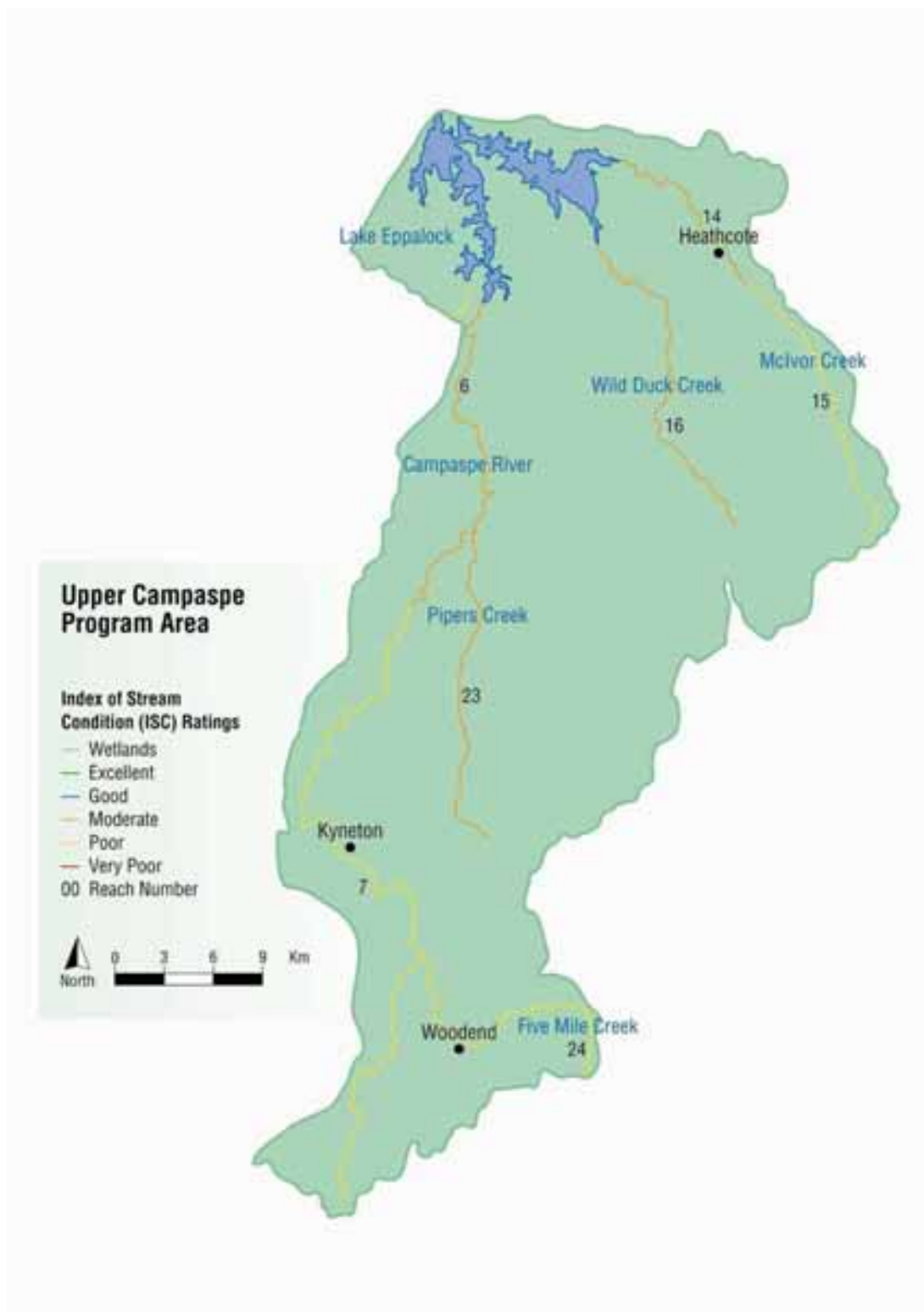


Figure 14 Upper Campaspe Program Area



According to the priority-setting process detailed in Section 5, Table 19 lists the priority reaches in the Upper Campaspe Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 19 Priority waterway reaches in the Upper Campaspe Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Campaspe River	6	26	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (social)
Campaspe River	7	70	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (economic)
Five Mile Creek	24	22	Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (economic)

The critical and high-priority opportunities for actions are highlighted for each reach in Table 20. This table identifies the key value and threat relationships for each reach. The complete value and threat data set and risk-scores are available in the supporting document titled North Central waterways – values, threats and risks (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 20) and the current understanding of threat/management interactions, Table 21 sets out actions for each priority reach and their corresponding targets, responsibilities and costs. Table 22 lists related actions that will occur as a result of the actions specified in Table 21.

This table integrates actions from key plans and strategies outlined in Section 3. They were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Hunty Barton

The Campaspe River (reach 6) near Barfold.



Table 20 Key values and threats along priority reaches and the prioritised opportunities for management intervention

		Threats										
		Bank erosion	Bed erosion	Instream barriers	Water quality trend	Water quality attainment	Water quality SIGNAL	Algal blooms	Exotic flora	Introduced fauna	Stock access	Degraded riparian vegetation
Environmental	Significant flora								6		6	7
									24		7	24
	Statewide EVC								6		6	
									7		7	
									24		24	
	Significant fauna									6		7
										7		
	Wetland rarity							6				
								7				
	Invertebrates observed/expected				6	6	6	6			6	
				7	24	24	24	7				
Width of riparian vegetation										6		
										24		
Structural intactness of riparian vegetation										6		
										7		
Longitudinal continuity of riparian vegetation										6		
Native fish observed/ expected			6	6	6	6	6		6			
Proportion of fish introduced			24	24	24	24						
Native fish migration			6	6								
			7	7								
Social	Fishing					6	6	6				
						24	24					
	Non-motor sports							6				
								7				
Swimming				6	6	6	6					
				7	7	7	7					
Passive recreation								6			24	
								24				
Economic	Water supply – irrigation				6	6		6				
					7	7						
					24	24		7				
	Water supply – proclaimed catchment				6	6		6				
					7	7						
					24	24		7				
	Infrastructure	7	24									
Land value										24		
Tourism					6		6					
					7							
					24		7					

Key

- x Critical priority
- x High priority

Note: See the supporting document for value and threat definitions.

Table 21 Upper Campaspe (above Eppalock) Program Area – on-ground actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected		Values/threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
1. Riparian zone	6	ISC (streamside zone) score 7	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> width and longitudinal continuity of riparian vegetation significant flora statewide EVC <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	1.1 To protect and enhance riparian vegetation values through fencing and enhancement plantings.	39ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 39ha of riparian land under management agreements.	20km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*	ISC (streamside zone)	North Central CMA, Landholders	\$117 over 5 years	\$39 over 5 years
	24	ISC (streamside zone) score 3	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC <p><u>Threats:</u></p> <ul style="list-style-type: none"> stock access degraded riparian vegetation 	1.2 To protect and enhance areas of degraded riparian vegetation through fencing and enhancement plantings.	33ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 33ha of riparian land under management agreements.	17km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$92 over 5 years	\$31 over 5 years
	6 24	See scores above	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC passive recreation <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic flora 	1.3 Undertake exotic flora control to protect and enhance values.	12km of these reaches (or one quarter of their total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	36km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$300 over 5 years	\$100 over 5 years
	6	See scores above	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna invertebrates native fish <p><u>Threat:</u></p> <ul style="list-style-type: none"> introduced fauna 	1.4 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	As per Rabbit Action Plan	n/a
2. Water quality	6 7 24	Campaspe catchment generates 73 tonnes per year of phosphorus and 383 tonnes of nitrogen per year.	2001	<p><u>Values:</u></p> <ul style="list-style-type: none"> wetland rarity invertebrates native fish observed/expected proportion of fish introduced native fish migration fishing non-motor sports swimming passive recreation water supply – irrigation water supply – proclaimed catchment tourism <p><u>Threats:</u></p> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	2.1 Implement the following priority programs of the draft Campaspe Nutrient Management Strategy (CNMS) related to these priority reaches: <ul style="list-style-type: none"> Nutrient management awareness Dryland riparian buffer strip and revegetation Watercourse bank and gully erosion Urban stormwater Unsewered catchment management Wastewater treatment plant. 	Reduction in phosphorus and nitrogen loads contributing to the CNMS 2025 target.	Reduction in phosphorus loads by 6 tonnes and nitrogen loads by 62 tonnes at key monitoring sites within the Campaspe catchment. This is a 2025 target from the CNMS.	VWQMN monitoring sites 406213 & 406235	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$5260 over 30 years ^o	\$0
	6 7 24	Both VWQMN sites exceed SEPP objective for total phosphorus and total nitrogen in all years.	2001		2.2 Implement the priority programs of the draft CNMS identified in the nutrient-related actions in 3.1.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	95% of monitoring sites to meet SEPP (WoV) objectives (from North Central RCS) or a target objective as determined using a risk-based approach.	VWQMN monitoring sites 406213 & 406235	EPA Victoria, North Central CMA DPI, LG, G-MW, Landholders	As per 2.1	n/a
	6 7 24	VWQMN site 406235 met SEPP turbidity objective in all years. Site 406213 met SEPP turbidity objective 9 out of 10 years.	1994 to 2003		2.3 Implement the priority programs of the draft CNMS identified in the sediment-related actions in 3.1.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	95% of monitoring sites to meet SEPP (WoV) objectives (from North Central RCS) or an adjusted target as determined using a risk-based approach.	VWQMN monitoring sites 406213 & 406235	EPA Victoria, North Central CMA, EPA Victoria, G-MW	As per 2.1	n/a
	6 7 24	Salinity load of 2,200 tonnes per year measured along Lower Campaspe River at Waranga Western Channel pumps downstream of Elmore (MDBC 1999).	1998		2.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002b).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002b).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria	n/a (under review)	n/a (under review)

Resource condition	Priority reaches	Current condition and year data collected		Values/threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
		Both VWQMN sites exceeded SEPP salinity objective in all years.	1994 to 2003			Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	95% of monitoring sites to meet SEPP (WoV) objectives (from North Central RCS) or an adjusted objective as determined using a risk-based approach.	VWQMN monitoring sites 406213 & 406235	EPA Victoria, North Central CMA, DPI	As per 2.1	n/a
3. Wetlands	6	No data – IWC and Regional Wetlands Strategy currently in development.	2005	<u>Value:</u> <ul style="list-style-type: none"> wetland rarity <u>Threat:</u> <ul style="list-style-type: none"> algal blooms 	3.1 Reduce threat of algal blooms by addressing poor water quality in upstream waterways. Undertake the IWC assessment of wetlands connected to reach 6. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Water Quality actions 2.1 – 2.4 to reduce algal bloom threat. Actions also to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	As per 2.1 for water quality actions IWC cost \$150	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target- and cost-setting, and unit-cost assumptions)

° A discount rate of 8% has been used to calculate implementation costs in the Campaspe Nutrient Management Strategy for the Campaspe catchment

Table 21 presents actual actions to undertake along priority reaches for particular Resource condition areas. The following Table 22 relies on the implementation of actions from Table 21 to meet the corresponding targets. Table 22 does not include costed actions as they relate to the costs detailed in Table 21.

Table 22 Upper Campaspe (above Eppalock) Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values/threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	6	4 of 8 sites within this Program Area along priority reaches meet all SEPP biological objectives.	<u>Value:</u> <ul style="list-style-type: none"> invertebrates <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 1.1, 1.3, 1.4, 2.1 – 2.4.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach. As per Management Action Targets for Water Quality actions 2.1 – 2.4.	An increase in attainment to be determined based on further investigations to achieve a better understanding of current condition.	EPA monitoring sites	North Central CMA, EPA Victoria
	7		See values and threats for reach 6 (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). Enhance invertebrate diversity as per Water Quality actions 2.1 – 2.4.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach. As per Management Action Targets for Water Quality actions 2.1 – 2.4.	An increase in attainment to be determined based on further investigations to achieve a better understanding of current condition.	EPA monitoring sites	North Central CMA, EPA Victoria
Aquatic life	24	4 of 8 sites within this Program Area along priority reaches meet all SEPP biological objectives.	<u>Value:</u> <ul style="list-style-type: none"> invertebrates <u>Threats:</u> <ul style="list-style-type: none"> water quality attainment and SIGNAL 	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 1.2, 1.3, 2.1 – 2.4.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach. As per Management Action Targets for Water Quality actions 2.1 – 2.4.	An increase in attainment to be determined based on further investigations to achieve a better understanding of current condition.	EPA monitoring sites	North Central CMA, EPA Victoria
	6 7		Threatened murray cod and golden perch present.	<u>Values:</u> <ul style="list-style-type: none"> native fish observed/ expected native fish migration <u>Threats:</u> <ul style="list-style-type: none"> instream barriers water quality trend, attainment and SIGNAL algal blooms introduced fauna 	Protect and enhance threatened fish populations as per Riparian Zone and Water Quality actions 1.1, 1.3, 1.4, 2.1 – 2.4.	As per Management Action Targets for Riparian Zone and Water Quality actions 1.1, 1.3, 1.4, 2.1 – 2.4.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys

Resource condition	Priority reaches	Current condition and year data collected	Values/threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	
River health	6	Moderate	1999	Refer to Table 17 for all values/threats.	Undertake integrated river management as per actions 1.1, 1.3, 1.4, 2.1 – 2.4. Develop and implement a Catchment Action Plan.	Maintain ISC condition rating of 'Moderate'.	26km of river in 'Good' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
'Near' ecologically healthy reaches	6	Campaspe River reach 6 is considered to be in 'near' ecologically healthy condition.	1999	Refer to Table 20 for all values / threats. Establish invertebrate monitoring program to fill information gaps, therefore ensuring that criteria defining 'near' ecologically healthy reaches are met.	As per Management Action Targets for actions 1.1, 1.3, 1.4, 2.1 – 2.4.	One ecologically healthy reach in 'Good' condition.	ISC	North Central CMA, EPA Victoria	
					Obtain regular invertebrate data to assess stream health.			North Central CMA, EPA Victoria	
High social values/assets	6	Second highest ranked reach in the North Central region according to social value.	1999	<u>Values:</u> • fishing • non motor sports • swimming • passive recreation <u>Threats:</u> • instream barriers • water quality trend, attainment and SIGNAL • algal blooms	Enhance riparian vegetation and water quality as per Water Quality actions 2.1 – 2.4. Consider development of a recreational plan for areas of heavy recreational pressure.	As per Management Action Targets for Water Quality actions 2.1 – 2.4.	One high-value-environmental reach protected.	As per monitoring requirements for Water Quality actions 3.1 – 3.4.	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
High economic values/assets	7	Fifth highest ranked reach in the North Central region according to economic value.	1999	<u>Values:</u> • water supply – irrigation • water supply – proclaimed catchment • infrastructure • land value • tourism <u>Threats:</u> • bank erosion • bed erosion • water quality trend and attainment • stock access	Enhance water quality as per Water Quality actions 2.1 – 2.4.	As per Management Action Targets for Water Quality actions 2.1 – 2.4.	One high-value-economic reach protected.	As per monitoring requirements for Water Quality actions 3.1 – 3.4.	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
	24	Second highest ranked reach in the North Central region according to economic value.	1999	<u>Values:</u> • water supply – irrigation • water supply – proclaimed catchment • infrastructure • land value • tourism <u>Threats:</u> • bank erosion • bed erosion • water quality trend and attainment • stock access	Protect and improve land values as per Riparian Zone actions 1.2 and 1.3.	As per Management Action Target for Riparian Zone actions 1.2 and 1.3.	One high-value-economic reach protected.	As per monitoring requirements for Riparian Zone actions 1.2 and 1.3.	North Central CMA, DSE, VicRoads, LG, Landholders



6.4.2 Coliban Program Area

The Coliban Program Area covers the southwest portion of the Campaspe catchment and includes the towns of Taradale, Malmsbury, Lauriston, Tylden and Trentham. Waterways within the area include the Coliban River (reach 22) from its forested headwaters to the Upper Coliban Reservoir and the continuation of the Coliban River (reaches 18 and 19) downstream of Malmsbury Reservoir to Lake Eppalock. The Little Coliban River (reach 20) flows directly into the Upper Coliban Reservoir. Kangaroo Creek (reach 21) descends the western forested hills and flows into the Lauriston Reservoir. The confluence of Myrtle Creek (reach 17) and the Coliban River occurs just upstream of Lake Eppalock. The location and 1999 ISC condition of these waterways are shown in Figure 15.

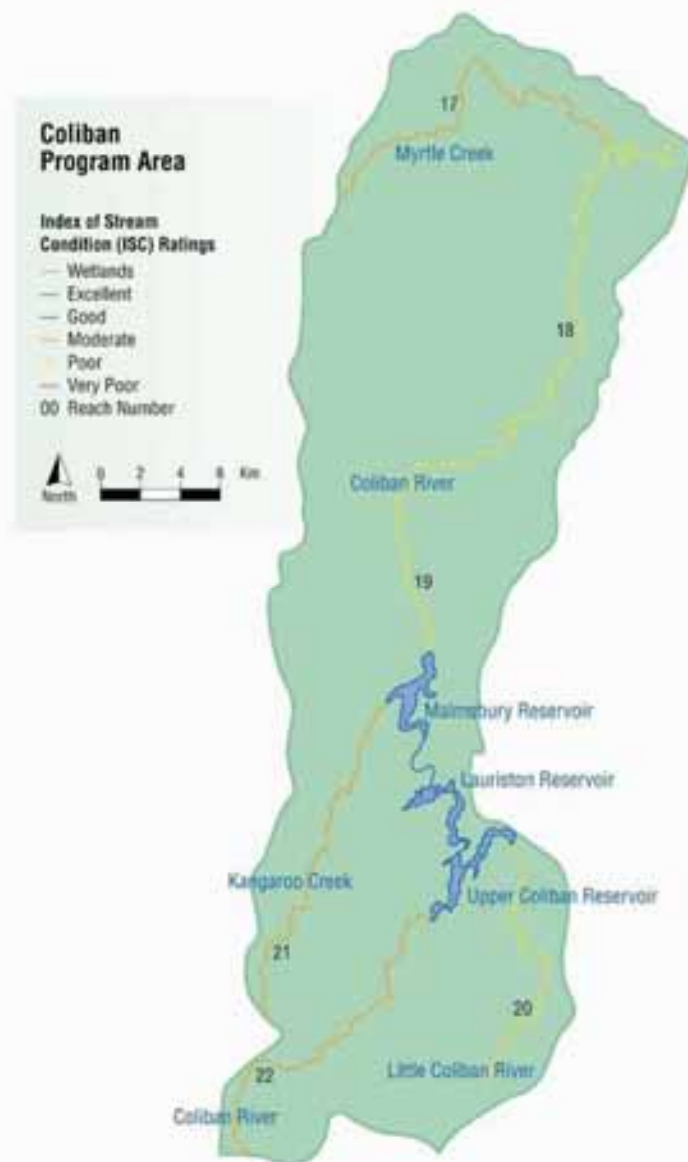


Figure 15 Coliban Program Area



According to the priority-setting process detailed in Section 5, Table 23 lists the priority reaches in the Coliban Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 23 Priority waterway reaches in the Coliban Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Kangaroo Creek	21	23	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers
Coliban River	18	46	Principle 3: Protect and enhance high-risk reaches
Coliban River	19	12	Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (economic)
Coliban River	22	17	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers

The critical and high priority opportunities for actions are noted for each reach in Table 24. It identifies the key value and threat relationships for each reach. The complete value and threat data set and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 24) and the current understanding of threat/management interactions, Table 25 sets out the actions for each priority reach and their corresponding targets, responsibilities and costs. Table 25 lists related actions that will occur as a result of the actions specified in Table 26.

This table integrates actions from key plans and strategies outlined in Section 3, which were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of the Coliban catchment action plan with the local community and relevant stakeholder groups and agencies. This plan is guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Greg Chant

Kangaroo Creek is considered in 'near' ecologically healthy condition.



Table 24 Key values and threats along priority reaches and the prioritised opportunities for management intervention

		Threats										
		Bed erosion	Instream barriers	Flow deviation	Water quality trend	Water quality attainment	Temperature	Water quality SIGNAL	Exotic flora	Introduced fauna	Stock access	Degraded riparian vegetation
Environmental	Statewide EVC			18					19		18	18
				19							19	18
											21	18
											22	18
	Significant fauna		18	18	18	18	19	18		18	18	18
			19	19	19	19		19		19	19	19
	Wetland rarity			18	18	18		18			18	18
					22	22		22			22	18
	Invertebrates observed/expected	18		18	18	18		18		18		
					19	19		19				
					22	22		22				
	Width of riparian vegetation										18	
										19		
										21		
										22		
Structural intactness of riparian vegetation										19		
										21		
										22		
Longitudinal continuity of riparian vegetation										19		
										21		
										22		
Native fish observed/expected		18			18		18					
		19			19		19					
Proportion of fish introduced		21		21	21		21					
Native fish migration		18	18	18			18					
		19	19	19			19					
Ecologically healthy river												
Fishing		21		21	18		18					
					19		19					
					21		21					
Swimming					18		18					
					19		19					
Passive recreation			18		18				19	18	18	
			19		19					19	18	
					21					21	19	
Flagship species										18		
										19		
										22		
Water supply – irrigation			18	18	18		18			18		
				19	19		19			19		
				21	21		21			21		
				22	22		22			22		
Water supply – proclaimed catchment			18	18	18		18			18		
				19	19		19			19		
				21	21		21			21		
				22	22		22			22		
Infrastructure				19								
Land value										22		
Tourism					18		18			18		
					19		19			19		
					22		22			22		

Key

- x Critical priority
- x High priority

Note: See the supporting document for value and threat definitions.

Table 25 Coliban Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
1. Hydrology (EWR)	18 19	ISC (hydrology) score 3	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna wetland rarity invertebrates passive recreation water supply – irrigation water supply – proclaimed catchment <p><u>Threat:</u></p> <ul style="list-style-type: none"> flow deviation 	1.1 To develop and implement the Sustainable Water Strategy for Northern Victoria.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in the Coliban River.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in the Coliban River.	ISC (hydrology)	DSE, North Central CMA, G-MW, Western Water, Coliban Water, LG	n/a	n/a
	19	Malmsbury Reservoir is a 'Maximum' priority for investigation into cold water releases	2001	<p><u>Value:</u></p> <ul style="list-style-type: none"> significant fauna <p><u>Threat:</u></p> <ul style="list-style-type: none"> temperature 	1.2 Continue temperature monitoring sites at sites established along the Coliban River to determine effects of cold water pollution.	Take appropriate actions to reduce the effects of cold water pollution depending on the monitoring results.	Eliminate the threat of cold water pollution to the Coliban River.	To be determined	DSE, North Central CMA, Coliban Water	n/a	n/a
2. Riparian zone	18	ISC (streamside zone) score 4	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna wetland rarity passive recreation flagship species[^] water supply – irrigation water supply – proclaimed catchment tourism <p><u>Threats:</u></p> <ul style="list-style-type: none"> stock access degraded riparian vegetation 	2.1 To protect and enhance values through fencing and enhancement plantings.	69ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 69ha of riparian land under management agreements.	35km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*. Improve the quality and coverage of all significant EVCs by 10% (from North Central RCS).	ISC (streamside zone)	North Central CMA, Landholders	\$208 over 5 years	\$69 over 5 years
	19	ISC (streamside zone) score 5	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna width and longitudinal continuity of riparian vegetation passive recreation flagship species[^] water supply – irrigation water supply – proclaimed catchment tourism <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.2 To protect and enhance values through fencing and enhancement plantings.	18ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 18ha of riparian land under management agreements.	9km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*. Improve the quality and coverage of all significant EVCs by 10% (from North Central RCS).	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$54 over 5 years	\$18 over 5 years
				<p><u>Value:</u></p> <ul style="list-style-type: none"> statewide EVC <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic flora 	2.3 Undertake exotic flora control to protect and enhance values.	3km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks (as above).	9km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$30 over 5 years	\$10 over 5 years
	18 19	See scores above	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna invertebrates <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic fauna 	2.4 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
2. Riparian zone	21	ISC (streamside zone) score 7	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> width and longitudinal continuity of riparian vegetation passive recreation water supply – irrigation water supply – proclaimed catchment <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.5 To protect and enhance riparian vegetation values through fencing and enhancement plantings.	35ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 34.5ha of riparian land under management agreements.	17km (or three quarters of the total reach length on both sides) of reach with improvement of one in the measurement of riparian condition*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$97 over 5 years	\$32 over 5 years
	22	ISC (streamside zone) score 5	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> wetland rarity width, structural intactness and longitudinal continuity of riparian vegetation passive recreation water supply – irrigation water supply – proclaimed catchment <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.6 To protect and enhance riparian vegetation and other values through fencing and enhancement plantings.	26ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 26ha of riparian land under management agreements.	13km of reach (or three quarters of the total reach length on both sides) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, Landholders	\$77 over 5 years	\$26 over 5 years
3. Instream habitat	18	ISC (physical form) score 5	1999	<p><u>Value:</u></p> <ul style="list-style-type: none"> invertebrates <p><u>Threat:</u></p> <ul style="list-style-type: none"> bed erosion 	3.1 Reduce threat of bed erosion on invertebrate population.	Assess and if necessary, address the threat of bed erosion along reach 18.	Improvement of one in the measurement of physical form.	ISC (physical form)	North Central CMA, DSE, LG	\$20 over 5 years	\$0
	18 19 21	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna proportion of introduced fish native fish migration fishing <p><u>Threat:</u></p> <ul style="list-style-type: none"> instream barriers 	3.2 Assess man-made barriers and prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a
4. Water quality	18 19 21 22	Campaspe catchment generates 73 tonnes per year of phosphorus and 383 tonnes of nitrogen per year.	2001	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna wetland rarity invertebrates native fish observed/expected proportion of fish introduced native fish migration fishing swimming passive recreation water supply – irrigation water supply – proclaimed catchment infrastructure tourism <p><u>Threats:</u></p> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL 	4.1 Implement the following priority programs of the draft Campaspe Nutrient Management Strategy CNMS:	Reduction in phosphorus and nitrogen loads contributing to the CNMS 2025 target.	Reduction in phosphorus loads by 6 tonnes and nitrogen loads by 62 tonnes at key monitoring sites within the Campaspe catchment. This is a 2025 target from the CNMS.	VWQMN monitoring site 406215	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$5260 over 30 years ^o	\$0
	18 19 21 22	VWQMN site does not meet SEPP objective for total nitrogen concentration in any years. VWQMN site meets SEPP objective for total phosphorous concentration 1 year in 10.	1994 to 2003	<p><u>Threats:</u></p> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL 	4.2 Implement the priority programs of the draft Campaspe Nutrient Management Strategy (CNMS) identified in the nutrient-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 95% compliance with the SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 406215	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
	18 19 21 22	VWQMN site meets SEPP objective for turbidity 9 years out of 10.	1994 to 2003		4.3 Implement the priority programs of the draft Campaspe Nutrient Management Strategy (CNMS) identified in the sediment-related actions (above).	Meet SEPP (WoV) objectives in all years (from North Central RCS).	Meet SEPP (WoV) objectives in all years (from North Central RCS).	VWQMN monitoring site 406215	North Central CMA, EPA Victoria, G-MW	n/a	n/a

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
	18 19 21 22	Salinity load of 2,200 tonnes per year measured along Lower Campaspe River at Waranga Western Channel pumps downstream of Elmore (MDBC 1999). VWQMN site 406215 does not meet SEPP objective in any years.	1998 1994 to 2003	4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria		
					Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 406215	North Central CMA, DPI, EPA Victoria	n/a	n/a
5. Wetlands	18 22	No data – IWC and Regional Wetlands Strategy currently in development.	2005 Value: • wetland rarity Threats: • flow deviation • water quality trend, attainment and SIGNAL • temperature • stock access • degraded riparian vegetation	5.1 Undertake the IWC assessment of wetlands connected to reaches 18 and 22. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Water Quality for reaches 6 and 7 and actions will to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)

^ Flagship species is the platypus

° A discount rate of 8% has been used to calculate implementation costs in the CNMS

~ Coliban Catchment Action Plan is already funded

Table 25 presents actions to undertake along priority reaches for particular Resource Condition areas. The following Table 26 relies on the implementation of actions from Table 25 to meet the corresponding targets. Table 26 does not include costed actions as they relate to the costs detailed in Table 25.

Table 26 Coliban Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	18	2 of 8 VWQMN sites meet all SEPP biological objectives.	1997 to 2001 Value: • invertebrates Threats: • flow deviation • water quality trend, attainment and SIGNAL	Enhance aquatic life by reducing threats as per Hydrology, Riparian Zone and Water Quality actions 1.1, 1.2, 2.1, 2.4 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).As per Management Action Targets for corresponding Resource Conditions.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
			Value: • invertebrates Threats: • bed erosion • introduced fauna	Reduce threats as per Riparian Zone and Instream Habitat actions 2.1, 2.4, 3.1 and 3.2.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).As per Management Action Targets for corresponding Resource Conditions.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
Aquatic life	19 21 22	2 of 8 VWQMN sites meet all SEPP biological objectives.	Value: • invertebrates Threats: • flow deviation • water quality trend, attainment and SIGNAL	Enhance invertebrate diversity by improving water quality as per Hydrology, Riparian Zone and Water Quality actions 1.1, 1.2, 2.2 – 2.6 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Target for corresponding Resource Condition.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	
	18 19	Threatened trout cod and macquarie perch present in both reaches. Golden perch also present in reach 18.	2000 <u>Value:</u> • native fish migration <u>Threats:</u> • instream habitat • flow deviation • water quality trend and SIGNAL	Protect and enhance threatened fish populations as Riparian Zone, Instream Habitat and Water Quality actions 2.1 – 2.4 and 4.1 – 4.4. Support the Bendigo Regional Fisheries Management Plan.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA	
	21	High proportion of introduced fish present in reach 21, e.g. brown trout.	2000 <u>Value:</u> • proportion of fish introduced <u>Threats:</u> • instream habitat • water quality trend, attainment and SIGNAL	Protect and enhance native fish populations as per Water Quality actions 4.1 – 4.4	As per Management Action Target for corresponding Resource Condition.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA	
River health	21 22	Moderate	1999 Refer to Table 24 for all values / threats for river health	Undertake integrated river management as per actions 1.1, 1.2, 2.2, 2.6, 3.2 and 4.1 – 4.4. Develop and implement the Coliban Catchment Action Plan.	Maintain ISC condition rating of 'Moderate'.	40km of river in 'Good' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders	
'Near' ecologically healthy reaches	21	Kangaroo Creek reach 21 is considered to be in 'near' ecologically healthy condition.	1999 Refer to Table 24 for all values / threats for river health	To enhance structural intactness of riparian vegetation to meet the definition.	Riparian protection and enhancement as per actions in Riparian Zone for reach 21.	Two ecologically healthy reaches in 'Good' condition.	ISC	North Central CMA, EPA Victoria	
		Enhance invertebrate population to ensure criteria defining 'near' ecologically healthy reaches are met.		Enhance invertebrate diversity as per actions in Riparian Zone, Instream Habitat and Water Quality for reach 21.					
	22	Coliban River reach 22 is considered to be in 'near' ecologically healthy condition.		To protect and enhance values currently meeting definition.					Riparian protection and enhancement as per actions in Riparian Zone for reach 22.
		Establish invertebrate monitoring program to fill information gaps, thus ensuring criteria defining 'near' ecologically healthy reaches are met.		Obtain regular invertebrate data to assess stream health.					
High economic values/assets	19	Fourth highest ranked reach in the North Central region according to economic value.	2004 <u>Values:</u> • water supply – irrigation • water supply – proclaimed catchment • infrastructure • tourism <u>Threats:</u> • flow deviation • water quality trend, attainment and SIGNAL • stock access	Minimise threats to economic values as per actions 1.1, 1.2, 2.2 – 2.4, 3.2 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	One high-value-economic reach protected.	As per monitoring requirements for relevant Resource Conditions.	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders	



6.4.3 Lower Campaspe (below Lake Eppalock) Program Area

The Lower Campaspe (below Lake Eppalock) Program Area covers the northern portion of the Campaspe River basin from Lake Eppalock to the River Murray. The area includes the towns of Axedale, Elmore, Rochester and Echuca along the Campaspe River as well as Mandurang, Axe Creek, Strathfieldsaye and Toolleen. The area includes the Campaspe River (reaches 1 to 5) and its major tributaries. Forest Creek (reaches 10 and 11) and Mount Pleasant Creek (reaches 8 and 9) enter from the east and Axe Creek (reach 12), which is fed by Sheepwash Creek (reach 13), enters from the southwest. The location and 1999 ISC condition of these waterways are shown in Figure 16.

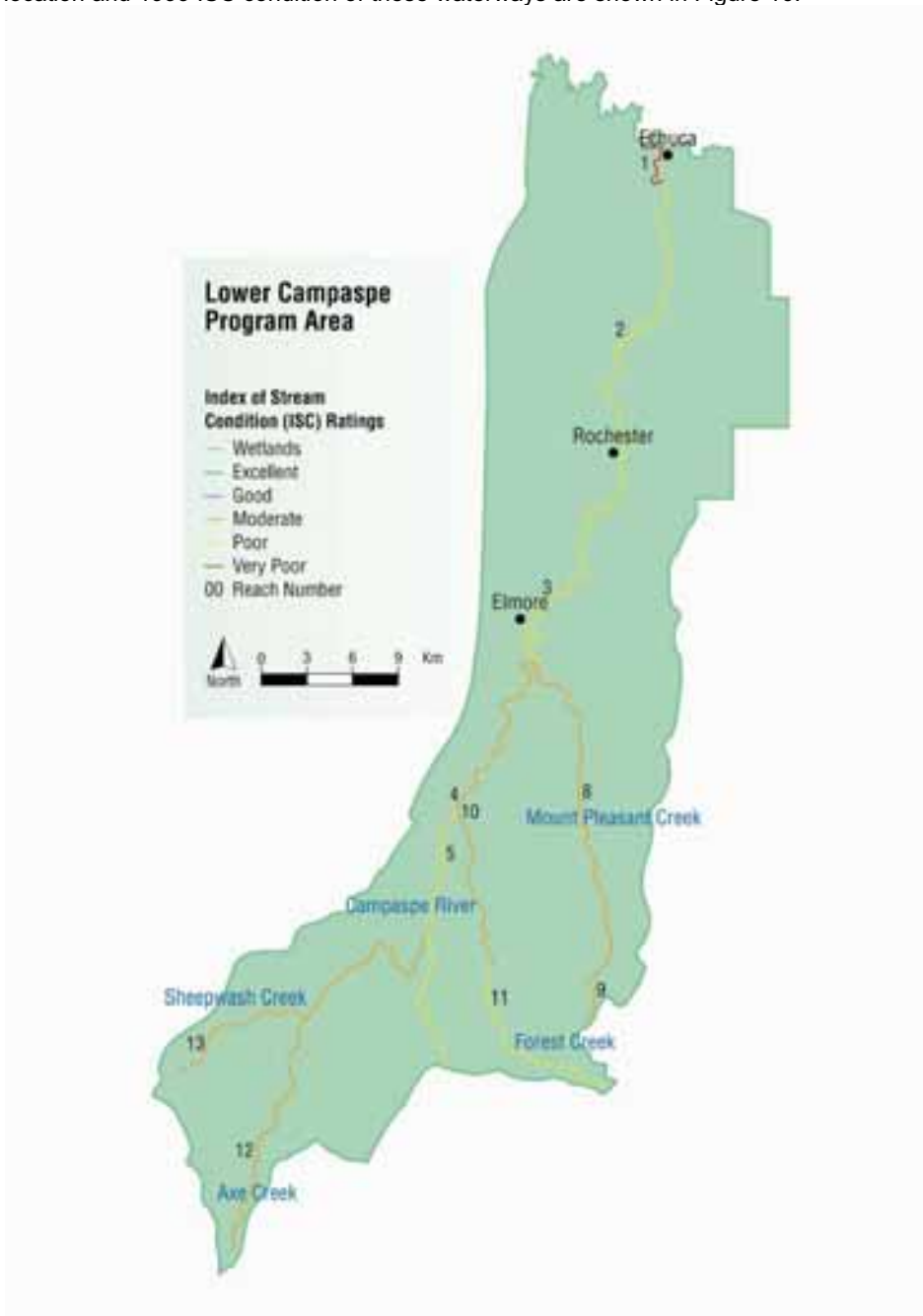


Figure 16 Lower Campaspe Program Area



According to the priority-setting process detailed in Section 5, Table 27 lists the priority reaches in the Lower Campaspe Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 27 Priority waterway reaches in the Lower Campaspe (below Lake Eppalock) Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Campaspe River	1	8	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Campaspe River	2	34	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Campaspe River	3	36	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Campaspe River	4	22	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Campaspe River	5	29	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (social)
Axe Creek	12	49	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers

The critical and high priority opportunities for actions are highlighted for each reach in Table 28. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.



Photo: Environment Australia

Improving the health of the Campaspe River (reach 1) at Echuca.

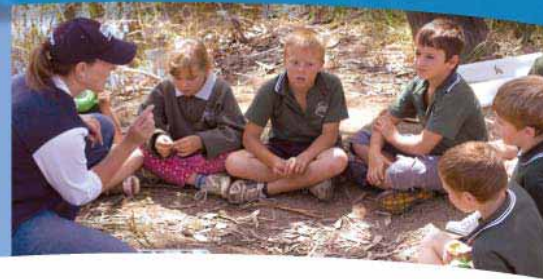


Table 28 Key values and threats along priority reaches and the prioritised opportunities for management intervention

Key

- x Critical priority
- x High priority

		Threats																	
		Bed erosion	Channel modification	Instream barriers	Flow deviation	Water quality trend	Water quality attainment	Temperature	Water quality SIGNAL	Algal blooms	Exotic flora	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation				
Values	Environmental	Statewide EVC				1										2			
						2											3		
						3											4		
						4											5		
						5											12		
	Significant fauna			3	1	1	1		5	1			1			2	1		
						2	2			2						3	2		
				4	2	3	3			3			2	1		3	3		
					3	4	4			4	1		3			4	4		
				5	4	5	5			5			5			5	5		
	Wetland rarity				2	2	2			2						2			
				3	3	3			3						3				
				4	4	4			4						4				
				5	5	5			5						5				
				12	5	12	12		12			12			12	12			
Invertebrates observed/expected		1			1	1		3	1										
					2	2			2		1								
		2			2	3	2		3										
					3	4	3		4	1		2	1						
		3			4	5	4		5			3							
Width of riparian vegetation															2				
															3				
															4				
															5				
															12				
Structural intactness of riparian vegetation															2				
															3				
															4				
															5				
															12				
Longitudinal continuity of riparian vegetation															2				
															3				
															4				
															5				
															12				
Native fish migration				3	1	1		5	1										
					2	3			2										
				4	3	4			3										
				5	4	5			4										
				12	5	12			5										
Social	Fishing			3	1	1	1		1										
					2	2	2		2										
				4	2	3	3		3	1			1						
					3	3	3		4										
				5	4	4	4		5										
	Non-motor sports				5	5	5		12										
					1														
				3	2														
	Motor sports				3					1									
Camping																			
					3	2			2										
						3			3										
Swimming																			
						2			4										
				1	1	1			1	1									



Values														
Social	Swimming					3	2			3				
		2				4	3			4				
						5	4			5				
		4				12	5			12				
Passive recreation					1					1			1	
					2						1		3	
					3							1	3	
Flagship species														
Listed landscape													5	
Economic	Water supply – irrigation				2	2				2				2
						3								3
					3	4	3			3				4
					4	5	4			4				4
					5	12	5			5				5
	Infrastructure		1	1		1								
						3								
			3			4								
			4	3		5								
	Land value				1						1			2
					2									3
					3						3			4
	Tourism					1								2
									1					3
										1				5

Note: See the supporting document for value and threat definitions.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 28) and the current understanding of threat/management interactions, Table 29 sets out the actions for each priority reach and their corresponding targets, responsibilities and costs. Table 30 lists related actions that will occur as a result of those specified in Table 29.

This table integrates actions from key plans and strategies outlined in Section 3 and were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the information contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.

Table 29 Lower Campaspe (below Lake Eppalock) Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
1. Hydrology (EWR)	1 2 3 4 5	ISC (hydrology) score 2 for reaches 1 and 2 scored 2. ISC (hydrology) score 3 for reaches 3, 4 and 5.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna wetland rarity invertebrates native fish migration fishing non-motor sports motor sports swimming passive recreation water supply – irrigation land value tourism <p><u>Threat:</u></p> <ul style="list-style-type: none"> flow deviation 	1.1 Review Campaspe Bulk Entitlement to gain the maximum flow benefits for river health through the development and implementation of a Water Management Plan by 2005.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in five high value reaches.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in five high value reaches.	ISC (hydrology)	DSE, North Central CMA, G-MW, Coliban Water, LG, community	n/a	n/a
	5	Lake Eppalock is a 'Maximum' priority for investigation into cold water releases.	2001	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna invertebrates native fish migration <p><u>Threat:</u></p> <ul style="list-style-type: none"> temperature 	1.2 Continue temperature monitoring sites at sites established along the Campaspe River to determine effects of cold water pollution.	Take appropriate actions to reduce the effects of cold water pollution depending on the monitoring results.	Eliminate the threat of cold water pollution to the Campaspe River.	To be determined	DSE, North Central CMA, G-MW	n/a	n/a
2. Riparian zone	2 3 4 5	ISC (streamside zone) score 5 for reach 2 and score 6 for reach 3, 4 and 5.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna wetland rarity width and longitudinal continuity of riparian vegetation passive recreation flagship species^A listed landscape water supply – irrigation land value tourism <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.1 To protect and enhance values through fencing and enhancement plantings.	182ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 182ha of riparian land under management agreements.	102km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$414 over 5 years	\$138 over 5 years
	12	ISC (streamside zone) score 6		<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna flagship species^A <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.2 To protect and enhance values through fencing and enhancement plantings.	76ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 76ha of riparian land under management agreements.	37km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$206 over 5 years	\$69 over 5 years
	1 3 12	ISC (streamside zone) score 5. See other scores above.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC passive recreation land value <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic flora 	2.3 Undertake exotic flora control to protect and enhance values.	23km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	60km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, Landholders	\$173 over 5 years	\$57 over 5 years
	1 2 3 12	See scores above.		<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna invertebrates <p><u>Threat:</u></p> <ul style="list-style-type: none"> introduced fauna 	2.4 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
3. Instream habitat	3 4 5 12	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<u>Values:</u> <ul style="list-style-type: none"> significant fauna native fish migration fishing motor sports non-motor sports <u>Threat:</u> <ul style="list-style-type: none"> instream barriers 	3.1 Assess man-made barriers to fish migration and prioritise their removal or modification, e.g. Echuca weir modification underway in 2005.	Remove or modify the high priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a
4. Water quality	1 2 3 4 5 12	Campaspe catchment generates 73 tonnes per year of phosphorus and 383 tonnes of nitrogen per year.	2001	<u>Values:</u> <ul style="list-style-type: none"> significant fauna wetland rarity invertebrates native fish migration fishing non-motor sports camping swimming passive recreation water supply – irrigation infrastructure tourism <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL temperature algal blooms 	4.1 Implement the following priority programs of the draft Campaspe Nutrient Management Strategy CNMS: <ul style="list-style-type: none"> Nutrient management awareness Dryland riparian buffer strip and revegetation Watercourse bank and gully erosion Urban stormwater Unsewered catchment management Nutrient reuse Drainage diversion Dairy effluent storage pond Intensive animal industry waste management awareness Upgrading unsustainable intensive animal waste management systems Water quality monitoring review 	Reduction in phosphorus and nitrogen loads contributing to the CNMS 2025 target.	Reduction in phosphorus loads by 51.3 tonnes and nitrogen loads by 339.6 tonnes at key monitoring sites within the Campaspe catchment. This is a 2025 target from the CNMS.	VWQMN monitoring site 406202	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$5260 over 30 years ^o	\$0
	1 2 3 4 5 12	VWQMN site meets SEPP objective for total nitrogen concentration 7 years out of 10. VWQMN site meets SEPP objective for total phosphorous concentration 1 year out of 10.	1994 to 2003	4.2 Implement the priority programs of the draft Campaspe Nutrient Management Strategy (CNMS) identified in the nutrient-related actions (above).	Maintain compliance with SEPP (WoV) objectives for total nitrogen (from North Central RCS). Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Maintain compliance with SEPP (WoV) objectives for total nitrogen (from North Central RCS). Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) for phosphorous concentrations or other target to be determined using a risk-based approach.	VWQMN monitoring site 406202	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a	
	1 2 3 4 5 12	VWQMN site meets SEPP objective for turbidity in all years.	1994 to 2003	4.3 Implement the priority programs of the draft Campaspe Nutrient Management Strategy (CNMS) identified in the sediment-related actions (above).	Maintain compliance with SEPP (WoV) objectives (from North Central RCS).	Maintain compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 406202	North Central CMA, EPA Victoria, G-MW	n/a	n/a	
	1 2 3 4 5 12	Salinity load of 2,200 tonnes per year measured along Lower Campaspe River at Waranga Western Channel pumps downstream of Elmore (MDBC 1999).	1998	4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a	
	4. Water quality		VWQMN site meets SEPP objective for salinity 9 years out of 10.	1994 to 2003		Maintain compliance with SEPP (WoV) objectives (from North Central RCS).	Maintain compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 406202	DPI, North Central CMA, EPA Victoria	n/a	n/a

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
5. Wetlands	2 3 4 5	No data – IWC and Regional Wetlands Strategy currently in development.	2005 <u>Value:</u> • wetland rarity <u>Threats:</u> • flow deviation • water quality trend, attainment and SIGNAL • stock access	5.1 Undertake the IWC assessment of wetlands connected to reaches 2, 3, 4 and 5. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Hydrology, Riparian Zone and Water Quality for reaches 2, 3, 4 and 5 and actions will be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)

^ Flagship species is the platypus and murray cod

° A discount rate of 8% has been used to calculate implementation costs in the CNMS

Table 29 presents actions to undertake along priority reaches for particular Resource Condition areas. The following Table 30 relies on the implementation of actions from Table 29 to meet the corresponding targets. Table 30 does not include costed actions as they relate to the costs detailed in Table 29.

Table 30 Lower Campaspe (below Lake Eppalock) Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	
Aquatic life	1 2 3 4 5	0 of 3 sites meet all SEPP biological objectives.	1997 to 2001 <u>Value:</u> • invertebrates <u>Threats:</u> • flow deviation • water quality trend and SIGNAL • temperature • algal blooms • loss of instream habitat	Enhance invertebrate diversity as per Hydrology (EWR) and Water Quality actions 1.1, 1.2 and 4.1 - 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 60% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	
			1997 to 2001 <u>Value:</u> • invertebrates <u>Threats:</u> • bed erosion • introduced fauna	Enhance invertebrate diversity by reducing threats as per Riparian Zone and Instream Habitat actions 2.1, 2.3, 2.4 and 3.1.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 60% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	
			1997 to 2001 <u>Value:</u> • invertebrates <u>Threats:</u> • water quality trend and SIGNAL	Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 2.2 – 2.4 and 4.1 - 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 60% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	
	12	Silver perch present in reaches 1 and 2. Murray cod and golden perch stocked in reaches 2 to 5.	2000 <u>Value:</u> • native fish migration <u>Threats:</u> • instream habitat • flow deviation • water quality trend and SIGNAL • temperature	Protect and enhance threatened fish populations as Riparian Zone, Instream Habitat and Water Quality actions 2.1, 2.3, 2.4, 3.1 and 4.1 - 4.4. Support the Bendigo Regional Fisheries Management Plan.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA	
River health	12	Moderate	1999	Refer to Table 28 for all values / threats for river health.	Undertake integrated river management as per actions 2.2 – 2.4, 3.1 and 4.1 - 4.4. Develop and implement a Catchment Action Plan.	Maintain ISC condition rating of 'Moderate'.	49km of river in 'Good' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
Representative river	12	Axe Creek is considered to be representative of the Victorian Northwest uplands river region.	2002	Refer to Table 28 for all values / threats for a representative river.	Representative river reaches to be reviewed by the Victorian Environment Assessment Council (DNRE 2002a).	Riparian protection and enhancement as per actions in Riparian Zone for reach 12	One representative reach in 'Good' condition.	ISC	DSE, North Central CMA

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
High social values/assets	5	Fourth highest ranked reach in the North Central region according to social value.	2004	<u>Values:</u> <ul style="list-style-type: none"> • fishing • swimming • passive recreation • flagship species^ • listed landscape <u>Threats:</u> <ul style="list-style-type: none"> • instream barriers • flow deviation • water quality trend, attainment and SIGNAL • stock access • degraded riparian vegetation 	Enhance social values per Hydrology (EWR), Riparian Zone and Water Quality actions 1.1, 1.2, 2.1 and 4.1 - 4.4.	As per Management Action Targets for corresponding Resource Conditions.	One high-value-social reach protected.	As per monitoring requirements for relevant Resource Conditions.	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders



6.5 Loddon River catchment

The Loddon River catchment covers 1,531,998 hectares or about 6.8% of the area of Victoria. The Loddon River rises on the Great Dividing Range near Trentham and flows for some 430km to the River Murray. Major tributaries include Tullaroop, Bet Bet, Bullock, Bendigo and Pyramid creeks (see Section 4.2.2 Figure 8).

The overall objective for managing river health in the Loddon catchment is to minimise risks to the Ramsar-listed Kerang Lakes and the River Murray, to which it is directly linked. In doing so, the riparian vegetation along Loddon catchment waterways will be protected and enhanced creating better habitat for both terrestrial and aquatic species. Improved water quality will benefit the health of the river and add to the variety of social and economic it provides.

For the Index of Stream Condition (ISC) assessment, which forms the basis of the regional priority-setting process, 27 of the catchment's major waterways were divided into 45 reaches (see Section 4.2.2 Figure 8). In order to present the priority reaches, their actions, targets and costs, the Loddon catchment was divided into five Program Areas.

Number of ISC reaches	45
Total length of ISC waterways	1859km
Number of Program Areas	5

According to the priority-setting process detailed in Section 5, a number of waterway reaches were identified as priorities for river health management in the Loddon catchment. These reaches and their corresponding priority-setting principles are listed in Table 31. Refer to Section 5 for the objectives specific to each principle that guides the management actions for each priority reach.

Table 31 Priority waterway reaches in the Loddon catchment

Priority principle	Priority reach
Principle 1: Protect and enhance ecologically healthy rivers and representative rivers	Loddon River reach 10 Sailors Creek reach 28
Principle 2: Minimise risks to connected high-value assets	Loddon River reaches 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 Bendigo Creek reaches 40, 41, 42, 43 and 44 Myers Creek reaches 45 and 46 Pyramid Creek reach 33 Creswick Creek reach 20 Barkers Creek reach 30 Gunbower Creek reaches 38 and 39
Principle 3: Protect and enhance high-risk reaches	Barr Creek reach 31 Serpentine Creek reach 11 Gunbower Creek reaches 38 and 39 Loddon River reaches 1, 2, 6, 7, 8 and 10 Bet Bet Creek reach 14 Creswick Creek reach 20 Bendigo Creek reach 44 Tullaroop Creek reach 18 Barkers Creek reach 30 Birches Creek reach 21
Principle 4: Protect reaches of high environmental-, social- and economic-value	Loddon River reaches 2, 7, 8 and 10 Gunbower Creek reach 38
Principles 5, 6 and 7	All waterways on a case by case basis



The desired long-term (50+ years) vision for all waterways across the Loddon catchment are defined in the following Aspirational Targets which are measurable and time bound. These reflect the vision and objectives for river health in the North Central region as outlined in Section 2.

- Waterways will achieve full attainment of SEPP (WoV) objectives by 2055.
- The Loddon River (reach 10) and Sailors Creek (reach 28) will meet the State-set criteria for ecologically healthy condition by 2021.
- By 2030, average annual loads of phosphorus will be reduced by approximately 35% and nitrogen loads will be reduced by about 25% in the Loddon catchment.

In addition, are the following long-term goals for the Loddon catchment:

- Water will be shared equitably and efficiently between environment and consumptive uses.
- Water quality will match users' requirements and have no detrimental impact on aquatic life.
- Erosion and sediment transport will be managed to reduce blue green algal blooms and sedimentation of reservoirs.
- Migratory fish will breed and move freely throughout the catchment.
- Large-scale fish kills will no longer occur.
- Minimise the impacts of the Loddon River to the River Murray and significant wetlands, e.g. Kerang Lakes.
- Many areas will be targeted through the North Central Dryland Targeted Salinity Program, testing and applying emerging scientific concepts to provide farmers in the North Central region with the best available technical options to improve their viability and environmental sustainability.
- To 'cap' dryland contributions to River Murray salt loads.
- To promote, protect and restore aquatic and terrestrial biological diversity for future sustainability in the Loddon-Murray region.
- To enhance the environmental and cultural assets of the Loddon-Murray region while tripling the value generated from its natural resources within 30 years.
- To have secure long-term productive, profitable and environmentally sustainable irrigated lands in the Loddon-Murray region for the benefit of current and future generations.
- Diverse, sustainable land use in the Loddon-Murray region, matched to land capability, providing improved environmental, economic and social outcomes.
- To build community capacity in the Loddon-Murray region by developing the skills, leadership and the social environment necessary to adapt to change, and to embrace those changes to become a vibrant and thriving community.
- Populations of threatened native plant and animal species will be restored to viable levels.
- Threatened vegetation communities will expand and improve in quality to achieve a net gain.
- Reaches of high environmental-, social- and economic-value are protected from environmental threats.
- Loddon River flows will be improved to protect aquatic habitat and improve water quality.
- Urban development will be carefully planned and managed according to local government planning controls that minimise the impact on waterways, wetlands and floodplain areas.
- Long-term water security will be achieved through the implementation of the Sustainable Water Strategy for Northern Victoria.

Many of these long-term targets and goals apply across the entire Loddon catchment. Those particularly relating to the upper catchment include the control of sediment transport to reduce blue green algal blooms and sedimentation of reservoirs as well as the protection and enhancement of 'near' ecologically healthy reaches. Those pertinent to the lower catchment include the free movement of migratory fish species upstream from the River Murray and the five long-term targets for the Loddon-Murray region (from the Loddon-Murray Land and Water Management Strategy (LMLWMS) (Loddon-Murray Forum 2002)).

The Management Action and Resource Condition Targets aim to achieve the listed Aspirational Targets and long-term goals.

6.5.1 Upper Loddon (above Cairn Curran) Program Area

The Upper Loddon (above Cairn Curran) Program Area includes the southeast portion of the Loddon River basin. Major towns include Castlemaine, Maldon, Daylesford and Eddington. The area includes the main stem of the Loddon River (reaches 9 and 10) from its forested headwaters to Cairn Curran Reservoir. Barkers Creek (reach 30) feeds into Campbells Creek (reach 29), which enters the river south of Castlemaine. Muckleford Creek (reach 26) also enters the



Loddon River from the north. Prior to entering Cairn Curran Reservoir, the river receives flows from the southern tributaries of Jim Crow Creek (reach 27), which is fed by Sailors Creek (reach 28). Joyces Creek (reach 25) flows directly into the reservoir, of which Middle Creek (reach 24) is a major tributary. The location and 1999 ISC condition of these waterways are shown in Figure 17.

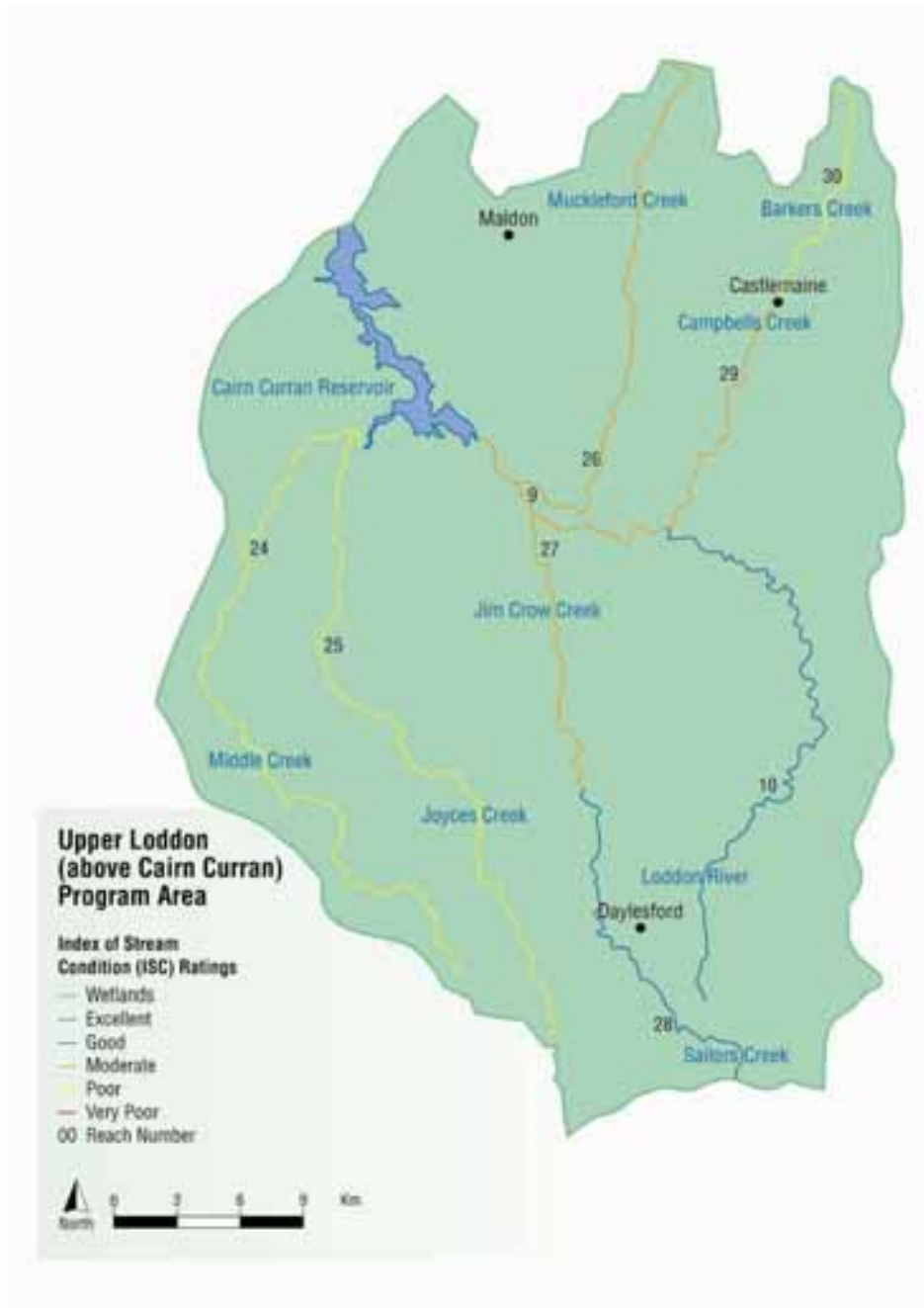


Figure 17 Upper Loddon Program Area

According to the priority-setting process detailed in Section 5, Table 32 lists the priority reaches in the Upper Loddon (above Cairn Curran) Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.



Table 32 Priority waterway reaches in the Upper Loddon (above Cairn Curran) Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Loddon River	10	52	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (social)
Loddon River	9	15	Principle 2: Minimise risks to connected high-value assets
Sailors Creek	28	30	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers
Barkers Creek	30	16	Principle 3: Protect and enhance high-risk reaches

The critical and high priority opportunities for actions are highlighted for each reach in Table 33. This table identifies the key value and threat relationships for each reach. The complete value and threat data set and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 33) and the current understanding of threat/management interactions, Table 34 sets out the prioritised actions for each reach, their targets, responsibilities and costs. Table 35 lists related actions that will occur as a result of the actions specified in Table 34.

This table integrates actions from key plans and strategies outlined in Section 3 which were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Stephen Malone Photography

The Loddon River (reach 10) is considered in 'near' ecologically healthy condition.



Table 33 Key values and threats along priority reaches and the prioritised opportunities for management intervention

		Threats											
		Bed erosion	Channel modification	Instream barriers	Water quality trend	Water quality attainment	Temperature	Water quality SIGNAL	Exotic flora	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation
Values	Environmental	Significant flora							10			10	
		Statewide EVC							9			9	9
									10			10	
		Significant fauna			10	10	10	30	30	30	30	30	30
					30	30	30					30	
		Wetland rarity				28	28		30	30			28
						30	30					30	
		Invertebrates observed/expected				9	9						
						10	10						
		Width of riparian vegetation											10
												28	
												30	
	Structural intactness of riparian vegetation											9	
												10	
												28	
											30		
Longitudinal continuity of riparian vegetation								30			10		
											28		
											30		
Native fish observed/expected			9	9	9								
			10	10	10								
Native fish migration			9	9									
			10	10									
Social	Fishing			9	9	9							
				10	10	10		30	30		30		
				28	10	28							
				30	30	30							
	Camping				10	10							
	Swimming				10	10							
Passive recreation					10			10		30	10		
					28						28		
					30			30			30		
Flagship species										9			
										10			
										28			
										30			
Economic	Water supply – irrigation				9	9							
					10	10							
	Water supply – proclaimed catchment				9	9					9		
					10	10		30			10		
					28	28					28		
				30	30					30			
	Infrastructure	9	9		9								
	30			10									
				28									
				30									
Land value								30			30		
											10		
Tourism					10		30	30			10		
					28						28		
					30						30		

Key

- | |
|---|
| x |
|---|

 Critical priority
- | |
|---|
| x |
|---|

 High priority

Note: See the supporting document for value and threat definitions.

Table 34 Upper Loddon (above Cairn Curran) Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
1. Hydrology (EWR)	30	Barkers Creek Reservoir is a 'Medium' priority for investigation into cold water releases.	2001	<u>Value:</u> <ul style="list-style-type: none"> significant fauna <u>Threat:</u> <ul style="list-style-type: none"> temperature 	1.1 Establish temperature monitoring sites along Barkers Creek to determine effects of cold water pollution.	Take appropriate actions to reduce the effects of cold water pollution depending on the monitoring results.	Eliminate the threat of cold water pollution to Barkers Creek.	To be determined	DSE, North Central CMA, G-MW	n/a	n/a
2. Riparian zone	9	ISC (streamside zone) score	1999	<u>Values:</u> <ul style="list-style-type: none"> significant fauna structural intactness of riparian vegetation flagship species^ water supply – proclaimed catchment <u>Threats:</u> <ul style="list-style-type: none"> stock access degraded riparian vegetation 	2.1 To protect and enhance riparian vegetation values through fencing and enhancement plantings.	24ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 24ha of riparian land under management agreements.	12km of reach with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$67 over 5 years	\$22 over 5 years
				<u>Value:</u> <ul style="list-style-type: none"> significant fauna <u>Threat:</u> <ul style="list-style-type: none"> exotic flora 	2.2 Undertake exotic flora control to protect and enhance values.	4km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	12km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, Landholders	\$75 over 5 years	\$25 over 5 years
	10	ISC (streamside zone) score 8.	1999	<u>Values:</u> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna width and longitudinal continuity of riparian vegetation passive recreation water supply – proclaimed catchment tourism <u>Threat:</u> <ul style="list-style-type: none"> stock access 	2.3 To protect and enhance values linked to riparian vegetation through fencing and enhancement plantings.	78ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 78ha of riparian land under management agreements.	39km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, Landholders	\$235 over 5 years	\$78 over 5 years
				<u>Values:</u> <ul style="list-style-type: none"> significant fauna statewide EVC passive recreation <u>Threat:</u> <ul style="list-style-type: none"> exotic flora 	2.4 Undertake exotic flora control to protect and enhance values.	13km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	39km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, Landholders	\$130 over 5 years	\$43 over 5 years
				<u>Values:</u> <ul style="list-style-type: none"> wetland rarity width, structural intactness and longitudinal continuity of riparian vegetation passive recreation flagship species^ water supply – proclaimed catchment tourism <u>Threat:</u> <ul style="list-style-type: none"> stock access 	2.5 To protect and enhance riparian vegetation values through fencing and enhancement plantings.	45ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 45ha of riparian land under management agreements.	23km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$126 over 5 years	\$42 over 5 years
28	ISC (streamside zone) score 8.	1999	<u>Values:</u> <ul style="list-style-type: none"> wetland rarity width, structural intactness and longitudinal continuity of riparian vegetation passive recreation flagship species^ water supply – proclaimed catchment tourism <u>Threat:</u> <ul style="list-style-type: none"> stock access 	2.5 To protect and enhance riparian vegetation values through fencing and enhancement plantings.	45ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 45ha of riparian land under management agreements.	23km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$126 over 5 years	\$42 over 5 years	

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
2. Riparian zone	30	ISC (streamside zone) score 5.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> wetland rarity longitudinal continuity of riparian vegetation passive recreation flagship species^ water supply – proclaimed catchment land value tourism <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.6 To protect and enhance riparian vegetation values through fencing and enhancement plantings.	24ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 24ha of riparian land under management agreements.	12km of reach with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$67 over 5 years	\$22 over 5 years
				<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna wetland rarity longitudinal continuity of riparian vegetation fishing passive recreation land value tourism <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic flora 	2.7 Undertake exotic flora control to protect and enhance values.	4km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	12km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$75 over 5 years	\$25 over 5 years
				<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna <p><u>Threat:</u></p> <ul style="list-style-type: none"> introduced fauna 	2.8 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a
3. Instream habitat	30	ISC (physical form) score 4.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna fishing passive recreation <p><u>Threat:</u></p> <ul style="list-style-type: none"> loss of instream habitat 	3.1 Reinstatement suitable instream habitat to protect and enhance values.	Reinstatement suitable instream habitat into 5km of reach 30.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	North Central CMA, DSE, LG	\$11 over 5 years	\$4 over 5 years
	9 10 28 30	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<p><u>Value:</u></p> <ul style="list-style-type: none"> significant fauna native fish migration <p><u>Threat:</u></p> <ul style="list-style-type: none"> instream barriers 	3.2 Assess man-made barriers to fish migration and their impact on values and to prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a
4. Water quality	9 10 28 30	Loddon catchment generates 115 tonnes per year of phosphorus and 517 tonnes of nitrogen per year.	2002	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna wetland rarity fishing camping swimming passive recreation water supply – irrigation infrastructure tourism <p><u>Threats:</u></p> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL 	4.1 Implement the following priority programs of the draft Loddon Nutrient Management Strategy (LNMS):	Reduction in phosphorus and nitrogen loads contributing to the LNMS 2025 target.	Reduction in phosphorus loads by 47 tonnes and nitrogen loads by 179 tonnes at key monitoring sites within the Loddon catchment. This is a 2025 target from the LNMS.	VWQMN monitoring site 407215	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$11,530 over 30 years°	\$0
	9 10 28 30	VWQMN site meets SEPP objective for total nitrogen concentration 3 years in 10. Site exceeds SEPP objective for total phosphorous concentration in all years.	1994 to 2003	<p><u>Threats:</u></p> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL 	4.2 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the nutrient-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 95% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 407215	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
	9 10 28 30	VWQMN site meets SEPP objective for turbidity 7 years in 10.	1994 to 2003		4.3 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the sediment-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 95% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 407215	North Central CMA, EPA Victoria, G-MW	n/a	n/a

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
	9 10 28 30	Salinity load of 9,000 tonnes per year measured at Laanecoorie (MDBC 1999).	1999		4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 8,500 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
		VWQMN site exceeds SEPP objective for salinity in all years.	1994 to 2003							Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).
5. Wetlands	28 30	No data – IWC and Regional Wetlands Strategy currently in development.	2005	<u>Value:</u> <ul style="list-style-type: none"> wetland rarity <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL exotic flora stock access 	5.1 Undertake the IWC assessment of wetlands connected to reaches 28 and 30. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Riparian Zone and Water Quality Resource Conditions for reaches 28 and 30 and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)

^ Flagship species is the platypus

° A discount rate of 8% has been used to calculate implementation costs in the LNMS

Table 34 presents actions to undertake along priority reaches for particular Resource Condition areas. The following Table 35 relies on the implementation of actions from Table 34 to meet the corresponding targets. Table 35 does not include costed actions as they relate to the costs detailed in Table 34.

Table 35 Upper Loddon (above Cairn Curran) Program Area – related actions and targets

Critical priority High priority

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	9 10	1 of 3 sites meet all SEPP biological objectives.	1997 to 2001	<u>Value:</u> <ul style="list-style-type: none"> invertebrates <u>Threats:</u> <ul style="list-style-type: none"> water quality trend and attainment 	Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 2.1 – 2.4 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
River health	10 28	Good	1999	Refer to Table 27 for all values / threats for river health	Undertake integrated river management as per all Resource Condition actions 2.3 – 2.5, 3.2 and 4.1 – 4.4. Develop and implement a Catchment Action Plan.	Maintain ISC condition rating of 'Good'.	82km of river in 'Excellent' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
'Near' ecologically healthy reaches	10 28	Loddon River reach 10 and Sailors Creek reach 28 are considered to be in 'near' ecologically healthy condition.	1999	Refer to Table 27 for all values / threats for river health	To protect and enhance values and establish invertebrate monitoring program to fill information gaps for reach 28 and enhance invertebrate diversity as per Riparian Zone, Instream Habitat and Water Quality actions 2.3 – 2.5, 3.2 and 4.1 – 4.4	Riparian protection and enhancement as per actions in Riparian Zone for reach 6. Obtain regular invertebrate data to assess stream health.	Two ecologically healthy reaches in 'Excellent' condition.	ISC	North Central CMA, EPA Victoria North Central CMA, EPA Victoria
High social values/assets	10	Third highest ranked reach in the North Central region according to social value.	2004	<u>Values:</u> <ul style="list-style-type: none"> fishing camping swimming passive recreation flagship species^ <u>Threats:</u> <ul style="list-style-type: none"> instream barriers water quality trend and attainment stock access 	Undertake integrated river management as per all Resource Condition actions 2.3, 2.4, 3.2 and 4.1 – 4.4. Consider development of a recreational plan for areas of heavy recreational pressure.	As per Management Action Targets for corresponding Resource Conditions.	One high-value-social reach protected.	As per monitoring requirements for relevant Resource Conditions.	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders



6.5.2 Upper Loddon (western tributaries above Laanecoorie) Program Area

The Upper Loddon (western tributaries above Laanecoorie) Program Area covers the southwest portion of the Loddon River basin. Maryborough, Creswick, Clunes, Lexton and Carisbrook are its major towns. Major waterways include Tullaroop Creek above (reach 19) and below (reach 18) Tullaroop Reservoir to Laanecoorie Reservoir. Tullaroop Creek is formed at the confluence of Creswick Creek (reach 20) and Birches Creek (reach 21). McCallum Creek (reach 22) enters Tullaroop Creek between the two reservoirs. Beckworth Creek (reach 23) is a tributary of McCallum Creek. Bet Bet Creek (reaches 14, 15 and 16) is the other major waterway of the area, of which Burnt Creek (reach 17) is a tributary. Bet Bet Creek also flows directly into Laanecoorie Reservoir. The location and 1999 ISC condition of these waterways are shown in Figure 18.



Figure 18 Upper Loddon (western tributaries above Laanecoorie) Program Area



According to the priority-setting process detailed in Section 5, Table 36 lists the priority reaches in the Upper Loddon (western tributaries above Laanecoorie) Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 36 Priority waterway reaches in the Upper Loddon (western tributaries above Laanecoorie) Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Bet Bet Creek	14	27	Principle 3: Protect and enhance high-risk reaches
Tullaroop Creek	18	35	Principle 3: Protect and enhance high-risk reaches
Creswick Creek	20	44	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (economic)
Birches Creek	21	43	Principle 3: Protect and enhance high-risk reaches

The critical and high priority opportunities for actions are highlighted for each reach in Table 37. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 37) and the current understanding of threat/management interactions, Table 38 sets out actions for each priority reach and their targets, responsibilities and costs. Table 39 lists related actions that will occur as a result of the actions specified in Table 38.

This table integrates actions from key plans and strategies outlined in Section 3 and were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Matt Jackson

Tullaroop Creek (reach 19) has some important values to protect.



Table 37 Key values and threats along priority reaches and the prioritised opportunities for management intervention

		Threats												
		Bank erosion	Bed erosion	Instream barriers	Flow deviation	Water quality trend	Water quality attainment	Temperature	Water quality SIGNAL	Algal blooms	Exotic flora	Stock access	Degraded riparian vegetation	
Values	Environmental	Significant flora										20	18	18
												20	18	18
												21	21	21
		Statewide EVC										20	14	20
												21	18	20
												21	20	21
												21	21	21
		Significant fauna			14		14	14		14	18	21	14	14
					20		20	18		18	21	21	18	18
					21		21	21		18	21	21	20	20
	Wetland rarity					14	14		14	18	21	14	20	
						18	18		14	21	21	18	20	
						21	21		14	21	21	20	21	
	Invertebrates observed/expected	21	14			14	14	21	14	18				
			18			18	18		18	21				
						20	18		20					
						21	21		21	21				
	Width of riparian vegetation											14		
												18		
												20		
											21			
Structural intactness of riparian vegetation											14			
											18			
											20			
											21			
Longitudinal continuity of riparian vegetation											14			
											18			
Native fish migration			14		14			14						
			18		18									
			20		20									
Fishing			14			14		14	18					
			20			21			21					
Swimming			21						21					
Passive recreation				20					18	20	20	20		
									21					
Flagship species										21	14			
											20			
											21			
Listed landscape											20			
Water supply – irrigation				20	18	18			18		18			
					20	21			21		20			
						21					21			
Water supply – proclaimed catchment				18	14	14		14	18		14			
				20	18	18			18		18			
					20	20			21		20			
						21					21			
Infrastructure	21	18			18									
					21									
Land value											14			
											18			
Tourism										18	20			
										21				

Key

- x Critical priority
- x High priority

Note: See the supporting document for value and threat definitions.

Table 38 Upper Loddon (western tributaries above Laanecoorie) Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
										Gov't	Other	
1. Hydrology (EWR)	18 20	ISC (hydrology) score 5 for reach 18, and score 6 for reach 20.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> passive recreation water supply – irrigation water supply – proclaimed catchment <p><u>Threat:</u></p> <ul style="list-style-type: none"> flow deviation 	1.1 Complete and implement the Loddon (and Tullaroop Creek) environmental flow regime (negotiated through the bulk entitlement process).	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in two high value reaches.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in two high value reaches.	ISC (hydrology)	DSE, North Central CMA, G-MW, Central Highlands Water, LG, community	n/a	n/a	
	21	Newlyn Reservoir is a 'Medium' priority for investigation into cold water releases.	2001	<p><u>Value:</u></p> <ul style="list-style-type: none"> invertebrates <p><u>Threat:</u></p> <ul style="list-style-type: none"> temperature 	1.2 Establish temperature monitoring sites along Birches Creek to determine effects of cold water pollution.	Take appropriate actions to reduce the effects of cold water pollution depending on the monitoring results.	Eliminate the threat of cold water pollution to Birches Creek.	To be determined	DSE, North Central CMA, Central Highlands Water	n/a	n/a	
2. Riparian zone	14 18	ISC (streamside zone) score 5.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna wetland rarity width and longitudinal continuity of riparian vegetation passive recreation flagship species[^] water supply – irrigation water supply – proclaimed catchment land value <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.1 To protect and enhance values through fencing and enhancement plantings.	94ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 94ha of riparian land under management agreements.	47km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$260 over 5 years	\$87 over 5 years	
	20	ISC (streamside zone) score 4.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna wetland rarity passive recreation flagship species[^] listed landscape water supply – irrigation water supply – proclaimed catchment tourism <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.2 To protect and enhance values through fencing and enhancement plantings of degraded riparian vegetation.	66ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 66ha of riparian land under management agreements.	33km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$185 over 5 years	\$62 over 5 years	
				1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC passive recreation <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic flora 	2.3 Undertake exotic flora control to protect and enhance values.	11km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks (as above).	33km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$108 over 5 years	\$36 over 5 years
				1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna wetland rarity flagship species[^] listed landscape water supply – irrigation water supply – proclaimed catchment <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.4 To protect and enhance values through fencing and enhancement plantings of degraded riparian vegetation.	65ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 65ha of riparian land under management agreements.	32km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$181 over 5 years	\$60 over 5 years
2. Riparian zone	21	ISC (streamside zone) score 3.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna wetland rarity flagship species[^] listed landscape water supply – irrigation water supply – proclaimed catchment <p><u>Threat:</u></p> <ul style="list-style-type: none"> stock access 	2.4 To protect and enhance values through fencing and enhancement plantings of degraded riparian vegetation.	65ha of riparian land enhanced (includes both banks and equates to one quarter of the total reach length). 65ha of riparian land under management agreements.	32km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition.*	ISC (streamside zone)	North Central CMA, DSE, Landholders	\$181 over 5 years	\$60 over 5 years	

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
	21	ISC (streamside zone) score 3.	1999	<u>Values:</u> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna wetland rarity flagship species[^] <u>Threat:</u> <ul style="list-style-type: none"> exotic flora 	2.5 Undertake exotic flora control to protect and enhance values.	11km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks (as above).	33km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$108 over 5 years	\$36 over 5 years
3. Instream habitat	14 18 21	ISC (physical form) score 4 for reaches 14 and 18, score 6 for reach 21.	1999	<u>Values:</u> <ul style="list-style-type: none"> invertebrates infrastructure <u>Threats:</u> <ul style="list-style-type: none"> bed erosion bank erosion 	3.1 Minimise the risk of bed and bank erosion to invertebrate diversity.	Assess, and, if necessary, address the threat of erosion.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	14 18 20 21	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<u>Values:</u> <ul style="list-style-type: none"> significant fauna native fish migration fishing <u>Threat:</u> <ul style="list-style-type: none"> instream barriers 	3.2 Assess man-made barriers to fish migration and their impact on significant fauna, native fish migration and fishing values and prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a
4. Water quality	14 18 20 21	Loddon catchment generates 115 tonnes per year of phosphorus and 517 tonnes of nitrogen per year.	2002	<u>Values:</u> <ul style="list-style-type: none"> significant fauna wetland rarity invertebrates native fish migration fishing water supply – irrigation water supply – proclaimed catchment infrastructure <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	4.1 Implement the following priority programs of the draft Loddon Nutrient Management Strategy (LNMS): <ul style="list-style-type: none"> Nutrient management awareness Dryland riparian buffer strip and revegetation Watercourse bank erosion Urban stormwater Unsewered catchment management Wastewater treatment plants Water quality monitoring review 	Reduction in phosphorus and nitrogen loads contributing to the LNMS 2025 target.	Reduction in phosphorus loads by 47 tonnes and nitrogen loads by 179 tonnes at key monitoring sites within the Loddon catchment. This is a 2025 target from the LNMS.	VWQMN monitoring site 407220	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$11,530 over 30 years ^o	\$0
	14 18 20 21	No nutrient concentration data collected at site.	n/a	<ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	4.2 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the nutrient-related actions (above).	Establish nutrient monitoring and move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 407220	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
	14 18 20 21	Site meets SEPP objective for turbidity 6 years in 10.	1994 to 2003		4.3 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the sediment-related actions (above).	Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 407220	North Central CMA, EPA Victoria, G-MW	n/a	n/a
	14 18 20 21	Salinity load of 9,000 tonnes per year measured at Laanecoorie (MDBC 1999).	1999	<u>Values:</u> <ul style="list-style-type: none"> significant fauna wetland rarity invertebrates native fish migration fishing water supply – irrigation water supply – proclaimed catchment infrastructure <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 8,500 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
4. Water quality	14 18 20 21	Site exceeds SEPP objective for salinity in all years.	1994 to 2003	<ul style="list-style-type: none"> water supply – irrigation water supply – proclaimed catchment infrastructure <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 		Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	Move toward target of achieving 95% compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 407220	DPI, North Central CMA, EPA Victoria	n/a	n/a
5. Wetlands	14 18 20 21	No data – IWC and Regional Wetlands Strategy currently in development.	2005	<u>Value:</u> <ul style="list-style-type: none"> wetland rarity <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms exotic flora stock access degraded riparian vegetation 	5.1 Undertake the IWC assessment of wetlands connected to priority reaches. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Water Quality and Riparian Zone for priority reaches and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)

[^] Flagship species is the platypus

^o A discount rate of 8% has been used to calculate implementation costs in the LNMS

Table 38 presents actions to undertake along priority reaches for particular Resource Condition areas. The following Table 39 relies on the implementation of actions from Table 38 to meet the corresponding targets. Table 39 does not include costed actions as they relate to the costs detailed in Table 38.

Table 39 Upper Loddon (western tributaries above Laanecoorie) Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	
Aquatic life	14 18 21	5 of 11 sites meet all SEPP biological objectives.	1997 to 2001	<u>Value:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • water quality trend, attainment and SIGNAL • algal blooms 	Enhance invertebrate diversity by reducing poor water quality threat as per Riparian Zone and Water Quality actions 2.1, 2.4, 2.5, and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
	20			<u>Values:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • water quality trend, attainment and SIGNAL 	Enhance invertebrate diversity by reducing poor water quality threat as per Riparian Zone and Water Quality actions 2.2, 2.3, and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
	14 18 21			<u>Value:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • bed erosion • bank erosion 	Enhance invertebrate diversity by reducing threats as per Riparian Zone and Instream Habitat actions 2.1, 2.2, 2.4, 2.5, 3.1 and 3.2.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
	14 18 20	Golden perch present in Bet Bet Creek reach 14 and Tullaroop Creek reach 18. River blackfish also present in Tullaroop Creek and Creswick Creek reach 20.	2000	<u>Value:</u> <ul style="list-style-type: none"> • native fish migration <u>Threats:</u> <ul style="list-style-type: none"> • instream barriers • water quality trend and SIGNAL 	Protect and enhance threatened fish populations as per Instream Habitat and Water Quality actions 3.1, 3.2 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA
High economic values/assets	20	Third highest ranked reach in the North Central region according to economic value.	2004	<u>Values:</u> <ul style="list-style-type: none"> • water quality – irrigation • water quality – proclaimed catchment • tourism <u>Threat:</u> <ul style="list-style-type: none"> • stock access 	Enhance riparian vegetation as per Riparian Zone actions 2.2 and 2.3.	As per Management Action Target for Riparian Zone.	One high-value-economic reach protected.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
				Enhance water quality as per Water Quality actions 4.1 – 4.4.	As per Management Action Target for Water Quality.	One high-value-economic reach protected.	VWQMN monitoring site 407220	North Central CMA, DSE, VicRoads, LG, Landholders	



6.5.3 Lower Loddon Program Area

The Lower Loddon Program Area extends from the township of Baringhup in the south to Swan Hill in the north. It includes the Loddon River between Cairn Curran Reservoir and Laanecoorie Reservoir as well as its continuation north across the floodplain through Bridgewater, Fernihurst and Kerang to the River Murray (reaches 1 to 8). The area also includes the tributaries of Bradford Creek (reach 13) and Bullabul Creek (reach 12), the Serpentine Creek anabranch (reach 11) and Barr Creek (reach 31). The location and 1999 ISC condition of these waterways are shown in Figure 19.

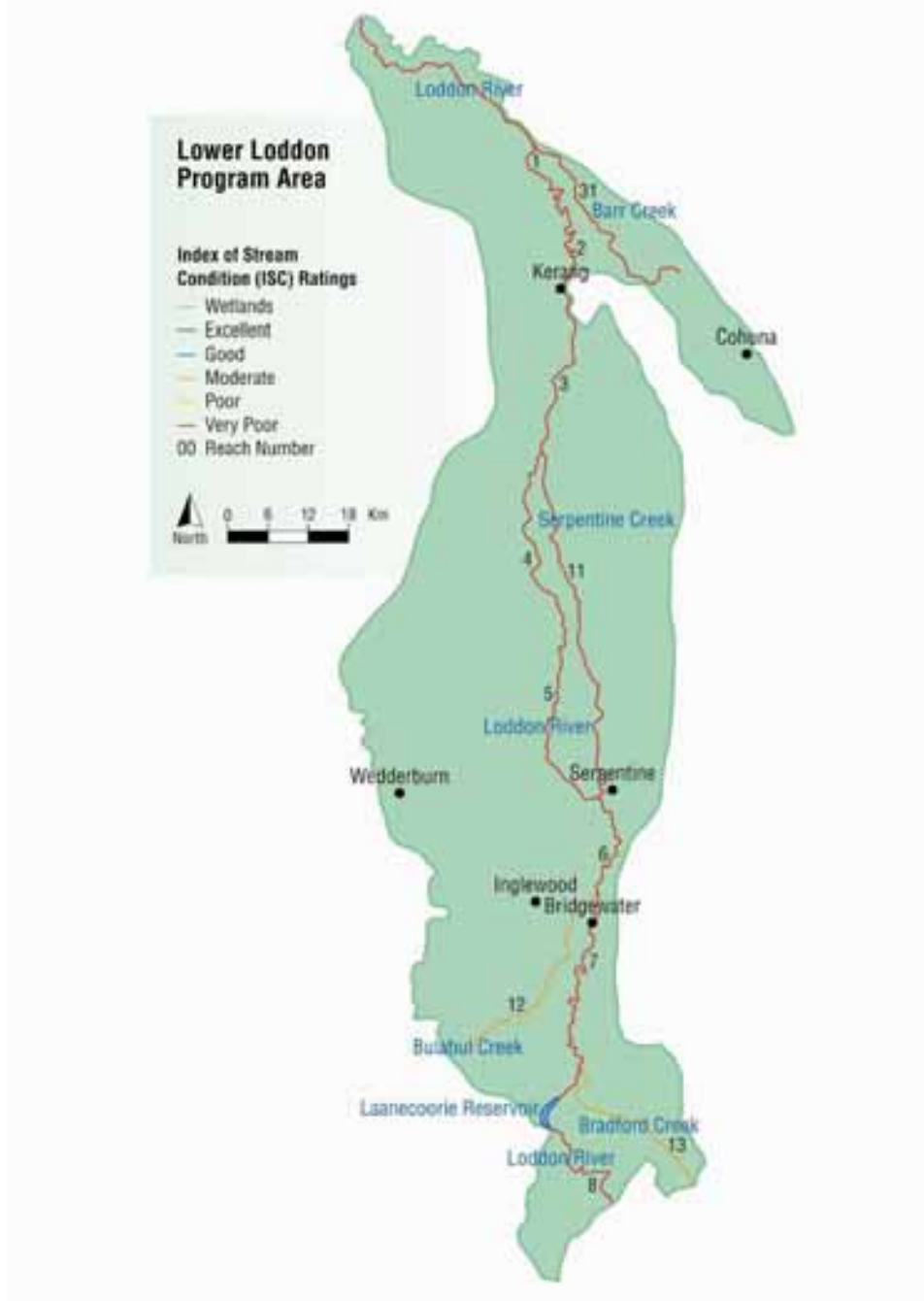


Figure 19 Lower Loddon Program Area



According to the priority-setting process detailed in Section 5, Table 40 lists the priority reaches in the Lower Loddon Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 40 Priority waterway reaches in the Lower Loddon Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Loddon River	1	66	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Loddon River	2	47	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (environmental)
Loddon River	3	27	Principle 2: Minimise risks to connected high-value assets
Loddon River	4	32	Principle 2: Minimise risks to connected high-value assets
Loddon River	5	79	Principle 2: Minimise risks to connected high-value assets
Loddon River	6	56	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (social)
Loddon River	7	38	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Loddon River	8	21	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (social and economic)
Serpentine Creek	11	79	Principle 3: Protect and enhance high-risk reaches
Barr Creek	31	47	Principle 3: Protect and enhance high-risk reaches

It is important to note that Loddon River reaches 3, 4 and 5 are themselves not considered high-risk reaches and it is only their link to the Kerang wetlands and River Murray that lead to their priority status (under Principle 2). However, as mentioned in Section 6.3, the setting of actions and targets also requires consideration of spatial (connectivity) elements. Therefore, it is logical to continue actions along reaches 3, 4 and 5 to reduce risks to the values along downstream reaches 1 and 2.

The critical and high priority opportunities for actions are highlighted for each reach in the following Table 41. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.



The Loddon River (reach 1) at Kerang.

Photo Stephen Malone Photography

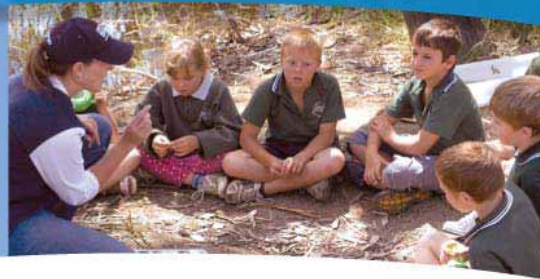


Table 41 Key values and threats along priority reaches and the prioritised opportunities for management intervention

Key

- x Critical priority
- x High priority

		Threats																	
		Bank erosion	Bed erosion	Channel modification	Instream barriers	Flow deviation	Wetland connectivity	Water quality trend	Water quality attainment	Temperature	Water quality SIGNAL	Algal blooms	Exotic flora	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation		
Values	Environmental	Significant flora					2	31								2	3		
							3											3	
							4												4
							5									4			5
							6												6
							7												7
							31												31
		Statewide EVC					1	31									1	31	
							2								6				2
							5												5
					6											6			
					7											7			
					11											11			
					31											31			
Significant fauna				1	1	1	1	7			7		1	1	1	1			
				2		2	2								2				
				7		7	7				7				7		7		
				8		8	8				8				8		8		
Wetland significance				2	2	2	2								2				
Wetland rarity			1		1	31	1	1							1	4			
					2			2	2			7	7				2		
					4			4	4								4		
					5			5	5								5		
					6			6	6								6		
					7			7	7								7		
					11			11	11			11	8				11		
					31			31	31								31		
	Invertebrates observed/expected	7	7				1		1	1									
							2		2	2									
					3		3	3			7	7							
					4		4	4											
					5		5	5						7	1				
					6		6	6											
					7		7	7											
					31		31	31			8	11	8						
Width of riparian vegetation															1				
															2				
Structural intactness of riparian vegetation															3				
															5				
															7				
															8				
															31				
Longitudinal continuity of riparian vegetation															1				
															2				
															3				
															7				
															8				



Social	Native fish migration	1	1	31	1	8	7	11	1	31															
		2			2																				
		3	2		3																				
		5	3		5																				
		6	5		6																				
		7	6		7																				
		8	7		8																				
		11	11		11																				
		31	31		31																				
		Fishing	1		1								11	1	1	7	7	11	8	7	1	2	6	8	
2	3		2	3																					
6	6		6	6																					
7	7		7	7																					
8	8		8	8																					
11	11		11	11																					
Non-motor sports	1		6	11	7	7	11	8	7	8	7	1		2	6										8
	2																								
	3																								
	6																								
	7																								
Motor sports	1	7	11	7	7	11	8	7	8	7	1	2	6	8											
	7																								
	8																								
Camping	2	7	11	7	7	11	8	7	8	7	1	2	6	8											
	7																								
	8																								
Swimming	1	7	11	7	7	11	8	7	8	7	1	2	6	8											
	2																								
	6																								
	7																								
	8																								
Passive recreation	1	7	11	7	7	11	8	7	8	7	1	2	6	8											
	2																								
	6																								
	7																								
Flagship species	1	7	11	7	7	11	8	7	8	7	1	2	6	8											
	2																								
	4																								
	6																								
	7																								
Listed landscape	1	7	11	7	7	11	8	7	8	7	1	2	6	8											
	2																								
	3																								
	4																								
	5																								
	6																								
	7																								
	8																								
Economic	Water supply – irrigation	1	7	11	7	7	11	8	7	8	7	1	2	6	8										
		2																							
		3																							
		4																							
		5																							
		6																							
		7																							
		8																							
		11																							
		31																							
Water supply – proclaimed catchment	8	7	11	7	7	11	8	7	8	7	1	2	6	8											
	8																								
Infrastructure	7	7	2																						



								7									
		31	31	31				11									
								31									
							1									1	
							2									2	4
							3									3	
							4					4			4		6
							5					6			5		7
							6					7			6		8
							7								7		8
							8									8	
							11									11	
							31									31	31
							6				2					6	
							7				6					7	
							7		7		7					7	
							8			8	8					8	

Note: See the supporting document for value and threat definitions.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 41) and the current understanding of threat/management interactions, Table 42 sets out actions for each priority reach and their targets, responsibilities and costs. Table 43 lists related actions that will occur as a result of the actions specified in Table 42.

This table integrates actions from key plans and strategies outlined in Section 3, developed alongside key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

Barr Creek is considered one of the saltiest inland waterways in Victoria and plays a major role in salt mitigation in the Loddon-Murray region. Due to this primary role, considerably few actions have been assigned to Barr Creek.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.

Table 42 Lower Loddon Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
1. Hydrology (EWR)	1, 2, 3, 4, 5, 6, 7, 8	ISC (hydrology) score 0	1999 Values: • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • invertebrates • native fish migration • fishing • Non-motor sports • motor sports • camping • swimming • passive recreation • water supply – irrigation • water supply – proclaimed catchment • land value • tourism Threat: • flow deviation	1.1 Complete and implement the Loddon environmental flow regime (negotiated through the bulk entitlement process).	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in eight high value reaches.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in eight high value reaches.	ISC (hydrology)	DSE, North Central CMA, G-MW, Coliban Water, LG, community	n/a	n/a	
				1.2 To reduce the threat of flow deviation to values and implement the North Central Regional Floodplain Management Strategy and Serpentine to Bort Floodplain Management Plan.	Reduce adverse effects of flooding through the implementation of proposed solutions identified in relevant strategies and plans.	Improved floodplain linkages and functions.	ISC (hydrology)	North Central CMA	n/a	n/a	
	7, 8	Cairn Curran and Laanecoorie reservoirs are a 'Maximum' priority for investigation into cold water releases.	2001 Values: • significant fauna • invertebrates • native fish migration Threat: • temperature	1.3 Continue temperature monitoring sites at sites established along the Loddon River to determine effects of cold water pollution.	Take appropriate actions to reduce the effects of cold water pollution depending on the monitoring results.	Eliminate the threat of cold water pollution to the Loddon River.	To be determined	DSE, North Central CMA, G-MW	n/a	n/a	
2. Riparian zone	1, 2, 7, 8	ISC (streamside zone) score 4 for reach 4, score 5 for reaches 3, 5, 6 and 11, score 6 for reaches 1, 7 and 8 and score 2 for reach 2.	1999 Values: • significant fauna • invertebrates Threats: • introduced fauna	2.1 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a	
	4, 6, 7			1999 Values: • significant flora • statewide EVC • passive recreation • land value Threats: • exotic flora	2.2 Undertake exotic flora control to protect and enhance values.	32km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	95km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$315 over 5 years	\$105 over 5 years
	1, 2, 3, 4, 5, 6, 7, 8, 11			1999 Values: • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • width and longitudinal continuity of riparian vegetation • passive recreation • flagship species^ • listed landscape • water supply – irrigation • land value • tourism Threats: • stock access • degraded riparian vegetation	2.3 To protect and enhance multiple values associated with riparian vegetation through fencing and enhancement plantings along priority reaches. Implement the Loddon-Murray Land and Water Management Strategy (LMLWMS).	768ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 768ha of riparian land under management agreements.	334km with improvement of one in the measurement of riparian condition* along priority reaches.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, G-MW, Landholders	\$2008 over 5 years	\$669 over 5 years

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
3. Instream habitat	7 31	ISC (physical form) score 5 for reaches 1, 2, 7 and 8 and score 3 for reach 31.	1999	<u>Values:</u> <ul style="list-style-type: none"> • invertebrates • infrastructure • land value <u>Threat:</u> <ul style="list-style-type: none"> • bed erosion • bank erosion • introduced fauna 	3.1 Minimise the risk of bed and bank erosion to values.	Assess, and, if necessary, address the threat of erosion to values.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	1 2 31			<u>Values:</u> <ul style="list-style-type: none"> • wetland rarity • infrastructure <u>Threat:</u> <ul style="list-style-type: none"> • channel modification 	3.2 Minimise the risk of channel modification to values.	Assess, and, if necessary, address the impact of channel modifications on key values.	Protection of all very high-value public assets (infrastructure) and other key values.	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	1 2 8			<u>Values:</u> <ul style="list-style-type: none"> • significant fauna • invertebrates • native fish migration • fishing • passive recreation <u>Threat:</u> <ul style="list-style-type: none"> • loss of instream habitat 	3.3 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 5km of each reach 1, 2 and 8.	Improvement of one in the measurement of physical form.	ISC (physical form)	North Central CMA, DSE, LG	\$33 over 5 years	\$11 over 5 years
	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<u>Values:</u> <ul style="list-style-type: none"> • significant fauna • native fish migration • fishing • non-motor sports • motor sports <u>Threat:</u> <ul style="list-style-type: none"> • instream barriers 	3.4 Assess man-made barriers to fish migration and their impact on values and prioritise their removal or modification, e.g. fishway installation in Kerang weir underway in 2005.	Remove or modify the high priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a
4. Water quality	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	Loddon catchment generates 115 tonnes per year of phosphorus and 517 tonnes of nitrogen per year.	2002	<u>Values:</u> <ul style="list-style-type: none"> • significant fauna • wetland significance • wetland rarity • invertebrates • native fish migration • fishing • non-motor sports • motor sports • camping • swimming • passive recreation • water supply – irrigation • water supply – proclaimed catchment • infrastructure <u>Threats:</u> <ul style="list-style-type: none"> • water quality trend, attainment and SIGNAL • temperature • algal blooms 	4.1 Implement the following priority programs of the draft Loddon Nutrient Management Strategy (LNMS): <ul style="list-style-type: none"> • Nutrient management awareness • Dryland riparian buffer strip and revegetation • Watercourse bank erosion • Nutrient re-use • Drainage diversion • Dairy effluent treatment ponds • Upgrading unsustainable animal industry waste management systems • Urban stormwater • Unsewered catchment management • Wastewater treatment plants • Water quality monitoring review Implement the Loddon-Murray Land and Water Management Strategy (LMLWMS).	Reduction in phosphorus and nitrogen loads contributing to the LNMS 2025 target.	Reduction in phosphorus loads by 57 tonnes (50% of current load) and nitrogen loads by 207 tonnes (40% of current load) at key monitoring sites within the Loddon catchment. This is a 2025 target from the LNMS.	VWQMN monitoring site 407202 & 407252	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$11,530 over 30 years ^o	\$0
	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	VWQMN site 407252 exceeds SEPP objective for total nitrogen concentration in all years. Site 407202 meets SEPP objective for total nitrogen concentration 5 years in 10. Both sites exceed SEPP objective for total phosphorous concentration in all years.	1994 to 2003	4.2 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the nutrient-related actions (above). Implement the Loddon-Murray Land and Water Management Strategy (LMLWMS).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 407202 & 407252	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a	

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	VWQMN site 407252 meets SEPP objective for turbidity in all years. Site 407202 exceeds SEPP objective in all years.	1994 to 2003	4.3 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the sediment-related actions (above). Implement the Loddon-Murray Land and Water Management Strategy (LMLWMS).	Maintain compliance with SEPP objective for site 407252. Establish an appropriate SEPP (WoV) objective for priority reaches using a risk-based approach for site 407202.	Maintain compliance with SEPP objective for site 407252. Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach for site 407202.	VWQMN monitoring site 407202 & 407252	North Central CMA, EPA Victoria, G-MW, DSE	n/a	n/a
	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	Salinity load of 9,000 tonnes per year measured at Laanecoorie (MDBC 1999).	1999	4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Implement the Loddon-Murray Land and Water Management Strategy (LMLWMS).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 8,500 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria, G-MW, DSE	n/a	n/a
		VWQMN site 407252 exceeds SEPP objective for salinity in all years. Site 407202 meets SEPP objective for salinity in all years.	1994 to 2003		Establish an appropriate SEPP (WoV) objective for priority reaches using a risk-based approach for site 407252. Maintain compliance with SEPP objective for site 407202.	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach for site 407252. Maintain compliance with SEPP objective for site 407202.	VWQMN monitoring site 407202 & 407252	DPI, North Central CMA, EPA Victoria, G-MW, DSE	n/a	n/a
Wetlands	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	No data – IWC and Regional Wetlands Strategy currently in development.	2005	Undertake the IWC assessment of wetlands connected to priority reaches. Implement specific wetland management actions as identified in the Regional Wetlands Strategy. Implement the Kerang Wetlands Ramsar Site Strategic Management Plan. Develop wetland operational plans as per the Loddon-Murray Land and Water Management Strategy (LMLWMS).	As per Management Action Targets for all Resource Condition categories for priority reaches and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, DPI, G-MW, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 5 and 6 for other target-setting and unit-cost assumptions)

° A discount rate of 8% has been used to calculate implementation costs in the LNMS

^ Flagship species is the murray cod

Table 42 presents actions to undertake along priority reaches for particular Resource Condition areas. The following Table 43 relies on the implementation of actions from Table 42 to meet the corresponding targets. Table 43 does not include costed actions as they relate to the costs detailed in Table 42.

Table 43 Lower Loddon Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	1, 2, 3, 4, 5, 6, 7, 8	1 of 2 sites meet all SEPP biological objectives.	1997 to 2001	Enhance invertebrate diversity as per Hydrology, Riparian Zone and Water Quality actions 1.1 – 1.3, 2.1 – 2.3 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	An increase in attainment to be determined based the completion of the ecological risk-assessment of the lower Loddon River (Bridgewater to the River Murray) to achieve a better understanding of current condition.	EPA Victoria monitoring sites	EPA Victoria, North Central CMA, G-MW, Monash University
	11			Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 2.3 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	An increase in attainment to be determined based the completion of the ecological risk-assessment of the lower Loddon River (Bridgewater to the River Murray) to achieve a better understanding of current condition.	EPA Victoria monitoring sites	EPA Victoria, North Central CMA, G-MW, Monash University

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
	7		<u>Value:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • bed erosion • bank erosion • introduced fauna 	Enhance invertebrate diversity by reducing threats to values as per Riparian Zone and Instream Habitat actions 2.1 – 2.3 and 3.1.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	An increase in attainment to be determined based the completion of the ecological risk-assessment of the lower Loddon River (Bridgewater to the River Murray) to achieve a better understanding of current condition.	EPA Victoria monitoring sites	EPA Victoria, North Central CMA, G-MW, Monash University
	1, 2, 3, 4, 5, 6, 7, 8, 11, 31	Golden perch and murray cod present in Loddon River reaches 1 to 8. Golden perch also present in Serpentine Creek reach 11.	<u>Value:</u> <ul style="list-style-type: none"> • native fish migration <u>Threats:</u> <ul style="list-style-type: none"> • instream barriers • flow deviation • wetland connectivity • water quality trend and SIGNAL • temperature • algal blooms • stock access 	Protect and enhance threatened fish populations as per all Resource Condition actions 1.1 – 1.3, 2.1 – 2.3, 3.1 – 3.3 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA
High environmental values/assets	2	Fourth highest ranked reach in the North Central region according to environmental value.	<u>Values:</u> <ul style="list-style-type: none"> • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • invertebrates • width and longitudinal continuity of riparian vegetation • native fish migration <u>Threats:</u> <ul style="list-style-type: none"> • channel modification • flow deviation • wetland connectivity • water quality trend, attainment and SIGNAL • algal blooms • stock access • degraded riparian vegetation 	Undertake integrated river management as per all Resource Condition actions 1.1, 1.2, 2.1, 2.3, 3.2, 3.3 and 4.1 – 4.4. Implement the Loddon-Murray Land and Water Management Strategy (LMLWMS).	As per Management Action Targets for corresponding Resource Conditions.	One high-value environmental reach protected. Promoted, protected and restored aquatic and terrestrial biological diversity for future sustainability in the Loddon-Murray region.	As per monitoring requirements for relevant Resource Conditions	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
High social values/assets	7 8	Ranked in top five reaches in the North Central region according to social value.	<u>Values:</u> <ul style="list-style-type: none"> • fishing • non-motor sports • motor sports • camping • swimming • passive recreation <u>Threats:</u> <ul style="list-style-type: none"> • instream barriers • flow deviation • water quality attainment and SIGNAL • temperature • algal blooms • exotic flora • stock access 	Undertake integrated river management as per all Resource Condition actions 1.1 – 1.3, 2.1 – 2.3, 3.1, 3.3 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Two high-value-social reaches protected.	As per monitoring requirements for relevant Resource Conditions	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
High economic values/assets	8	Highest ranked reach in the North Central region according to economic value.	<u>Values:</u> <ul style="list-style-type: none"> • water quality – irrigation • water quality – proclaimed catchment • land value • tourism <u>Threats:</u> <ul style="list-style-type: none"> • flow deviation • water quality trend and attainment • algal blooms • stock access 	Undertake integrated river management as per all Resource Condition actions 1.1 – 1.3, 2.1, 2.3, 3.3 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	One high-value-economic reach protected.	As per monitoring requirements for relevant Resource Conditions	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders



6.5.4 Mid-Loddon Program Area

The Mid-Loddon Program Area extends 100km north from south of Bendigo to Kow Swamp and Macorna North near the River Murray. Bendigo is the major town in the area. Other towns include Huntly, Goornong, Raywood, Mitiamo, Marong, Pyramid Hill, Macorna and East Loddon.

The area includes Bendigo Creek (reaches 40 to 44), which flows from Bendigo to Kow Swamp, and its major tributaries of Back Creek (reach 47) and Myers Creek (reaches 45 and 46). The area also includes Bullock Creek (reaches 34 to 36), which is fed by Spring Creek (reach 37) in the south. Box Creek (reach 32) is a regulated waterway connecting Kow Swamp to Bullock Creek to form what is known as Pyramid Creek (reach 33) to its confluence with the Loddon River downstream of Kerang. The location and 1999 ISC condition of these waterways are shown in Figure 20.



Figure 20 Mid-Loddon Program Area



According to the priority-setting process detailed in Section 5, Table 44 lists the priority reaches in the Mid-Loddon Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 44 Priority waterway reaches in the Mid-Loddon Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Bendigo Creek	40	32	Principle 2: Minimise risks to connected high-value assets
Bendigo Creek	41	14	Principle 2: Minimise risks to connected high-value assets
Bendigo Creek	42	48	Principle 2: Minimise risks to connected high-value assets
Bendigo Creek	43	53	Principle 2: Minimise risks to connected high-value assets
Bendigo Creek	44	29	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Myers Creek	45	39	Principle 2: Minimise risks to connected high-value assets
Myers Creek	46	23	Principle 2: Minimise risks to connected high-value assets
Pyramid Creek	33	127	Principle 2: Minimise risks to connected high-value assets

The critical and high priority opportunities for actions are highlighted for each reach in Table 45. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 45) and the current understanding of threat/management interactions, Table 46 sets out actions for each priority reach and their targets, responsibilities and costs. Table 47 lists related actions that will occur as a result of the actions specified in Table 46.

This table integrates actions from key plans and strategies outlined in Section 3 and were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Angela Gladman

Bendigo Creek (reach 41) near Drummartin.



Table 45 Key values and threats along priority reaches and the highlighted opportunities for management intervention

		Threats																
		Bank erosion	Bed erosion	Channel modification	Instream barriers	Flow deviation	Wetland connectivity	Water quality trend	Water quality attainment	Water quality SIGNAL	Exotic flora	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation			
Values	Environmental	Significant flora													40	40		
																41	41	
																44	44	
		Statewide EVC					42										40	40
							43	33									41	41
							33										44	44
																	40	40
																	41	41
		Significant fauna				40	42			40	40						40	40
						41	42			41	41	40					41	41
					42	43	33		42	42	42					43	43	
				33	43	43			43	43	43	44				44	44	
					44	44			44	44	44					44	44	
	Wetland rarity				40	42			40	40						40	40	
					44	42			42	42						42	42	
					45	43	33		44	44	44					44	44	
					33	33			45	45	45	44				45	45	
						33			33	33	33					33	33	
		Invertebrates observed/expected		40	40					40	40							
										41	43							
									44	44								
									45	45								
									46	46								
Width of riparian vegetation															40	40		
															42	42		
															43	43		
															44	44		
															46	46		
Structural intactness of riparian vegetation															40	40		
															41	41		
															42	42		
															43	43		
															44	44		
Longitudinal continuity of riparian vegetation															46	46		
															42	42		
															46	46		
															42	42		
															46	46		
Social	Passive recreation			44						44			44		44	44		
	Water supply – irrigation					43				41					43	43		
Economic	Infrastructure									43					44	44		
										44					44	44		
										45					45	45		
										33					33	33		
	Land value		44	46	41											40	40	
				33	43											41	41	
					44											42	42	



Values	Economic	Land value												44	45	
																46
																33
		Tourism								44	44				44	

Note: See the supporting document for value and threat definitions.

Table 46 Mid-Loddon Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
1. Hydrology (EWR)	42 43	ISC (hydrology) score 3 for reach 42, score 4 for reach 43.	1999 <u>Values:</u> • statewide EVC • significant fauna • wetland rarity <u>Threat:</u> • flow deviation	1.1 To reduce the threat of flow deviation to values and implement the North Central Regional Floodplain Management Strategy and other relevant plans.	Reduce adverse effects of flooding through the implementation of proposed solutions identified in relevant strategies and plans.	Improved floodplain linkages and functions.	ISC (hydrology)	North Central CMA	n/a	n/a
2. Riparian zone	40, 41, 42, 43, 44, 45, 46, 33	ISC (streamside zone) score 3 for reach 45, score 4 for reaches 41, 44 and 33, score 5 for reaches 40, 42 and 43, score 6 for reach 46.	1999 <u>Values:</u> • significant flora • statewide EVC • significant fauna • wetland rarity • width and longitudinal continuity of riparian vegetation • passive recreation • water supply – irrigation • land value • tourism <u>Threats:</u> • stock access • degraded riparian vegetation	2.1 To protect and enhance multiple values associated with riparian vegetation through fencing and enhancement plantings along priority reaches.	548ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 548ha of riparian land under management agreements.	274km with improvement of one in the measurement of riparian condition* along priority reaches.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$1588 over 5 years	\$529 over 5 years
	44	See scores above	1999 <u>Values:</u> • significant flora • statewide EVC • significant fauna • wetland rarity • passive recreation • land value <u>Threat:</u> • exotic flora	2.2 Undertake exotic flora control to protect and enhance values.	7km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	22km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$73 over 5 years	\$24 over 5 years
	40 41	See scores above	1999 <u>Values:</u> • significant flora • statewide EVC <u>Threat:</u> • exotic flora	2.3 Undertake exotic flora control to protect and enhance values.	12km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks (as above).	35km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$115 over 5 years	\$38 over 5 years
	41 44 33	See scores above	1999 <u>Value:</u> • significant fauna <u>Threat:</u> • introduced fauna	2.4 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a
3. Instream habitat	40 44 46 33	ISC (physical form) score 3 for reaches 43 and 45, score 4 for reaches 40 and 46, score 5 for reaches 41 and 42.	1999 <u>Values:</u> • invertebrates • infrastructure • land value <u>Threats:</u> • bank erosion • bed erosion	3.1 Minimise the risk of bed and bank erosion to invertebrate diversity, very high-value infrastructure and land value.	Assess, and, if necessary, address the threat of erosion to values.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	41, 43, 44, 45			<u>Values:</u> • wetland rarity • fishing • land value <u>Threat:</u> • channel modification	3.2 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 5km of each reach 41, 43, 44 and 45.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	North Central CMA, DSE, LG	\$44 over 5 years
3. Instream habitat	40, 41, 44, 45	ISC (physical form) score 3 for reaches 43 and 45, score 4 for reaches 40 and 46, score 5 for reaches 41 and 42.	<u>Values:</u> • wetland rarity • passive recreation • infrastructure • land value <u>Threat:</u> • channel modification	3.3 Minimise the risk of channel modification to values.	Assess and if necessary address the impact of channel modifications on key values.	Protection of all very high-value public assets (infrastructure), social and economic values along reach.	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
	40, 41, 42, 43, 44, 45, 33	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<u>Value:</u> • significant fauna <u>Threat:</u> • instream barriers	3.4 Assess man-made barriers to fish migration and their impact on values.	Remove or modify the high priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a
4. Water quality	40, 41, 42, 43, 44, 45, 46, 33	Loddon catchment generates 115 tonnes per year of phosphorus and 517 tonnes of nitrogen per year.	2002	<u>Values:</u> • significant fauna • wetland rarity • invertebrates • passive recreation • water supply – irrigation • tourism <u>Threats:</u> • water quality trend, attainment and SIGNAL	4.1 Implement the following priority programs of the draft Loddon Nutrient Management Strategy (LNMS): • Nutrient management awareness • Dryland riparian buffer strip and revegetation • Watercourse bank erosion • Nutrient re-use • Drainage diversion • Dairy effluent treatment ponds • Upgrading unsustainable animal industry waste management systems • Urban stormwater • Unsewered catchment management • Wastewater treatment plants • Water quality monitoring review	Reduction in phosphorus and nitrogen loads contributing to the LNMS 2025 target.	Reduction in phosphorus loads by 57 tonnes (50% of current load) and nitrogen loads by 207 tonnes (40% of current load) at key monitoring sites within the Loddon catchment. This is a 2025 target from the LNMS.	VWQMN monitoring sites 407236 & 407255	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$11,530 over 30 years ^o	\$0
	40, 41, 42, 43, 44, 45, 46, 33	Both sites exceed SEPP objective for total nitrogen concentration in all years. Both sites exceed SEPP objective for total phosphorous concentration in all years.	1994 to 2003		4.2 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the nutrient-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring sites 407236 & 407255	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
	40, 41, 42, 43, 44, 45, 46, 33	VWQMN site 407236 exceeds SEPP objective for turbidity in all years. Site 407255 meets SEPP objective in all years.	1994 to 2003		4.3 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the sediment-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach) for VWQMN site 407236. Maintain achievement of SEPP objective at site 407255.	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach for VWQMN site 407236. Maintain achievement of SEPP objective at site 407255.	VWQMN monitoring sites 407236 & 407255	North Central CMA, EPA Victoria, G-MW	n/a	n/a
	40, 41, 42, 43, 44, 45, 46, 33	Salinity load of 9,000 tonnes per year measured at Laanecoorie (MDBC 1999).	1999		4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 8,500 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
	40, 41, 42, 43, 44, 45, 46, 33	VWQMN site 407236 meets SEPP objective for salinity 6 years in 10. Site 407255 meets SEPP objective 7 years in 10.	1994 to 2003			Maintain 60% compliance with SEPP (WoV) objective (from North Central RCS).	Maintain 60% compliance with SEPP (WoV) objective (from North Central RCS).	VWQMN monitoring sites 407236 & 407255	DPI, North Central CMA, EPA Victoria	n/a	n/a
	5. Wetlands	40, 42, 44, 45	No data – IWC and Regional Wetlands Strategy currently in development.	2005	<u>Value:</u> • wetland rarity <u>Threats:</u> • channel modification • flow deviation • water quality attainment and SIGNAL • exotic flora • stock access • degraded riparian vegetation	5.1 Undertake the IWC assessment of wetlands connected to priority reaches. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for for all Resource Condition categories for reaches 40, 42, 44 and 45 and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)

^o A discount rate of 8% has been used to calculate implementation costs in the LNMS

Table 46 presents actions to undertake along priority reaches for particular Resource Condition areas. The following Table 47 relies on the implementation of actions from Table 45 to meet the corresponding targets. Table 46 does not include costed actions as they relate to the costs detailed in Table 46.

Table 47 Mid-Loddon Program Area – related actions and targets

Critical priority High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
Aquatic life	40	1 of 6 sites meet all SEPP biological objectives.	<u>Value:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • bank erosion • bed erosion • water quality trend 	Enhance invertebrate diversity as per Riparian Zone, Instream Habitat and Water Quality actions 2.1, 2.3, 3.1, 3.3, 3.4 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	n/a	n/a
	41, 42, 43, 44, 45, 46		<u>Value:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • water quality attainment and SIGNAL 	Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 2.1 – 2.4 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	n/a	n/a
	40		<u>Value:</u> <ul style="list-style-type: none"> • invertebrates <u>Threats:</u> <ul style="list-style-type: none"> • water quality attainment and SIGNAL 	Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 2.1, 2.3 and 4.1 – 4.4	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	n/a	n/a



6.5.5 Gunbower Program Area

The Gunbower Program Area focuses on Gunbower Creek (reaches 38 and 39), an anabranch of the River Murray that forms the Ramsar-listed Gunbower Forest wetland. The area includes the towns of Gunbower, Cohuna and Koondrook. The location and 1999 ISC condition of these waterways are shown in Figure 21.



Figure 21 Gunbower Program Area

According to the priority-setting process detailed in Section 5, Table 48 lists the priority reaches in the Gunbower Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.



Table 48 Priority waterway reaches in the Gunbower Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Gunbower Creek	38	57	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches of high environmental-, social- and economic-value (environmental and social)
Gunbower Creek	39	91	Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches

The critical and high priority opportunities for actions are noted for each reach in Table 49. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Table 49 Key values and threats along priority reaches and the prioritised opportunities for management intervention

Key

x	Critical priority
x	High priority

		Threats													
		Channel modification	Instream barriers	Flow deviation	Wetland connectivity	Water quality trend	Water quality attainment	Water quality SIGNAL	Algal blooms	Exotic flora	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation	
Values	Environmental	Significant flora			38	38					39			38	38
					39	39								39	39
		Statewide EVC			38	38					39			38	
					39	39								39	
		Significant fauna		38	38	38	38	38	38			38		38	38
				39	39	39	39	39	39			39		39	39
		Wetland significance			38	38		38	38	38				38	
					39	39		39	39	39				39	
	Wetland rarity	39		38	38		38	38	38				38		
				39	39		39	39	39				39		
	Structural intactness of riparian vegetation												39		
	Longitudinal continuity of riparian vegetation												39		
	Native fish migration		38	38				38							
			39	39				39							
	Social	Fishing	39	38	38			38	38	38			38		
				39	39			39	39	39					
Non-motor sports			38	38					38						
			39	39					39						
Motor sports			38	38					38						
			39	39					39						
Camping				38			38	38	38						
				39			39	39	39						
Swimming			39			38	38	38							
						39	39	39							
Passive recreation			38			38	38	38				38	38		
			39			39	39	39	39			39	39		
Flagship species												38			
												39			
Economic	Water supply – irrigation			38			38	38	38				38		
				39			39	39	39				39		
	Infrastructure	39													
	Land value			38						39			38	38	
				39									39	39	
Tourism			39			38	38	38				38			
						39	39	39				39			

Note: See the supporting document for value and threat definitions.



Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 49) and the current understanding of threat/management interactions, Table 50 sets out the prioritised actions for each priority reach and their targets, responsibilities and costs. Table 51 lists related actions that will occur as a result of the actions specified in Table 50.

This table integrates actions from key plans and strategies outlined in Section 3, which were developed with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Emer Campbell

Gunbower Creek (reach 38) downstream of Cohuna.

Table 50 Gunbower Program Area – Actions and Targets

Critical priority
 High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
1. Hydrology (EWR)	38 39	ISC (hydrology) score 3 for reach 38 and score 1 for reach 39.	1999 <u>Values:</u> • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • native fish migration • fishing • non-motor sports • motor sports <u>Threat:</u> • flow deviation	1.1 Complete the Water Management and Operational Plan for Flooding Enhancement of Gunbower Forest.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in two high value reaches.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in two high value reaches.	ISC (hydrology)	DSE, North Central CMA, G-MW, Western Water, Coliban Water, LG, community	n/a	n/a
2. Riparian zone	38 39	ISC (streamside zone) score 6.	1999 <u>Values:</u> • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • longitudinal continuity of riparian vegetation • passive recreation • flagship species ^A • water supply – irrigation • land value • tourism <u>Threat:</u> • stock access	2.1 To protect and enhance values linked to riparian vegetation through fencing and enhancement plantings.	223ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 223ha of riparian land under management agreements.	111km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, Landholders	\$668 over 5 years	\$223 over 5 years
				2.2 Undertake exotic flora control to protect and enhance values.	37km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	111km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$370 over 5 years	\$123 over 5 years
				2.3 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a
3. Instream habitat	39	ISC (physical form) score 6 for reach 39.	1999 <u>Values:</u> • wetland rarity • fishing • land value <u>Threats:</u> • channel modification	3.1 Minimise the risk of channel modification to rare wetlands, fishing and land values.	Assess and if necessary address the impact of channel modifications on key values.	Protection of all very high-value public assets (infrastructure), social and economic values along reach 39.	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	38	ISC (physical form) score 5 for reach 38.	1999 <u>Value:</u> • fishing <u>Threat:</u> • loss of instream habitat	3.2 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 5km of each reach 38.	Improvement of one in the measurement of physical form.	ISC (physical form)	North Central CMA, DSE, LG	\$11 over 5 years	\$4 over 5 years
	38 39	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999 <u>Values:</u> • significant fauna • native fish migration • fishing • non-motor sports • motor sports <u>Threat:</u> • instream barriers	3.3 Assess man-made barriers to fish migration and their impact on values, e.g. Cohuna, Gunbower and Koondrook weirs.	Remove or modify the high priority man-made fish barriers as identified in the Gunbower Creek Waterway Action Plan (in prep).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	\$15 for assessment	n/a

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
4. Water quality	38 39	Loddon catchment generates 115 tonnes per year of phosphorus and 517 tonnes of nitrogen per year.	<u>Values:</u> <ul style="list-style-type: none"> significant fauna wetland significance wetland rarity invertebrates native fish migration fishing non-motor sports motor sports camping swimming passive recreation water supply – irrigation tourism <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	4.1 Implement the following priority programs of the draft Loddon Nutrient Management Strategy (LNMS): <ul style="list-style-type: none"> Nutrient management awareness Dryland riparian buffer strip and revegetation Watercourse bank erosion Nutrient re-use Drainage diversion Dairy effluent treatment ponds Upgrading unsustainable animal industry waste management systems Urban stormwater Unsewered catchment management Water quality monitoring review 	Reduction in phosphorus and nitrogen loads contributing to the LNMS 2025 target.	Reduction in phosphorus loads by 57 tonnes (50% of current load) and nitrogen loads by 207 tonnes (40% of current load) at key monitoring sites within the Loddon catchment. This is a 2025 target from the LNMS.	VWQMN monitoring site 407209	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$11,530 over 30 years ^o	\$0
		VWQMN site meets SEPP objective for total nitrogen concentration in all years. Site exceeds SEPP objective for total phosphorous concentration in all years.		1994 to 2003	4.2 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the nutrient-related actions (above).	Maintain achievement of SEPP objective for total nitrogen at site 407255. Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach) for VWQMN site 407236.	Maintain achievement of SEPP objective for total nitrogen at site 407255. Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach for VWQMN site 407236.	VWQMN monitoring site 407209	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a
	VWQMN site meets SEPP objective for turbidity 3 years in 10.	1994 to 2003		4.3 Implement the priority programs of the draft Loddon Nutrient Management Strategy (LNMS) identified in the sediment-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 407209	North Central CMA, EPA Victoria, G-MW	n/a	n/a
	Salinity load of 9,000 tonnes per year measured at Laanecoore (MDBC 1999).	1999		4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 8,500 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Further reduce salt loads according to end-of-valley targets (to be determined).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
	VWQMN site meets SEPP objective for salinity in all years.	1994 to 2003		Maintain achievement of SEPP objective at site 407209.	Maintain achievement of SEPP objective at site 407209.	Maintain achievement of SEPP objective at site 407209.	VWQMN monitoring site 407209	DPI, North Central CMA, EPA Victoria	n/a	n/a
Wetlands	38 39	No data – IWC and Regional Wetlands Strategy currently in development.	<u>Values:</u> <ul style="list-style-type: none"> wetland significance wetland rarity <u>Threats:</u> <ul style="list-style-type: none"> channel modification flow deviation wetland connectivity water quality attainment and SIGNAL algal blooms stock access 	Undertake the IWC assessment of wetlands connected to reaches 38 and 39. Implement specific wetland management actions as identified in the Regional Wetlands Strategy. Implement the Gunbower Forest Ramsar Site Strategic Management Plan. Complete the Water Management and Operational Plan for Gunbower Forest.	As per Management Action Targets for all Resource Condition categories and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high environmental value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)

^o A discount rate of 8% has been used to calculate implementation costs in the LNMS

[^] Flagship species is the Murray cod

Table 50 presents actual actions to undertake along priority reaches for particular Resource Condition areas. The following Table 51 relies on the implementation of actions from Table 50 to meet the corresponding targets. Table 51 does not include costed actions as they relate to the costs detailed in Table 50.

 Critical priority  High priority

Table 51 Gunbower Program Area – related actions and targets

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	38 39	Golden perch, silver perch and murray cod present in Gunbower Creek.	2000 <u>Values:</u> • native fish observed /expected • native fish migration <u>Threats:</u> • instream barriers • flow deviation • water quality trend and SIGNAL • algal blooms	Protect and enhance threatened fish populations as per Hydrology, Instream Habitat, Riparian Zone and Water Quality actions 1.1, 2.1 – 2.3, 3.1 – 3.4 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA
High environmental values/assets	38	Third highest ranked reach in the North Central region according to environmental value.	<u>Values:</u> • wetland significance • wetland rarity <u>Threats:</u> • channel modification • instream habitat • flow deviation • wetland connectivity • water quality trend, attainment and SIGNAL • exotic flora • introduced fauna • stock access • degraded riparian vegetation	Protect and enhance environmental values by undertaking integrated river management as per all Resource Condition actions 1.1, 2.1 – 2.3, 3.2 – 3.4 and 4.1 – 4.4	As per Management Action Targets for corresponding Resource Conditions.	One high-value environmental reach protected.	As per monitoring requirements for relevant Resource Conditions	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
High social values/assets	38	Second highest ranked reach in the North Central region according to social value.	2004 <u>Values:</u> • fishing • non-motor sports • motor sports • camping • swimming • passive recreation • flagship species^ <u>Threats:</u> • channel modification • instream barriers • flow deviation • water quality attainment and SIGNAL • algal blooms • exotic flora • loss of instream habitat • stock access • degraded riparian vegetation	Protect and enhance social values by undertaking integrated river management as per all Resource Condition actions 1.1, 2.1 – 2.3, 3.1, 3.3, 3.4 and 4.1 – 4.4. Consider development of a recreational plan for areas of heavy recreational pressure.	As per Management Action Targets for corresponding Resource Conditions.	One high-value social reach protected.	As per monitoring requirements for relevant Resource Conditions	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders



6.6 Avoca River catchment

The Avoca River drains Victoria's fifth largest catchment, the Avoca Basin, which occupies an area of 1.2 million hectares. The North Central CMA is responsible for 690,000ha of the basin, the rest of which falls within the adjacent Mallee CMA region. Major tributaries entering the river include Glenlogie, Number Two, Cherry Tree, Fentons and Campbells creeks (see Section 4.2.3 Figure 9).

The overall objective for managing river health in the Avoca catchment is to minimise risks to the Ramsar-listed Kerang Lakes and to protect river values that contribute to its status as 'Representative', e.g. the natural hydrology. In doing so, the riparian vegetation along Avoca catchment waterways will be protected and enhanced creating better habitat for both terrestrial and aquatic species. Improved water quality will benefit the health of the river and the variety of social and economic uses it provides.

For the Index of Stream Condition (ISC) assessment, which forms the basis of the regional priority-setting process, 12 of the catchment's major waterways were divided into 20 reaches (see Section 4.2.3 Figure 9). In order to present the priority reaches, their actions, targets and costs, the Avoca catchment was divided into two Program Areas.

Number of ISC reaches	20
Total length of ISC waterways	535km
Number of Program Areas	2

According to the priority-setting process detailed in Section 5, a number of waterway reaches were identified as priorities for river health management in the Avoca catchment. These reaches and their corresponding priority-setting principles are listed in Table 52. Refer to Section 5 for the principle objectives that guide management actions for each priority reach.

Table 52 Priority waterway reaches in the Avoca catchment

Priority principle	Priority reach
Principle 1: Protect and enhance ecologically healthy rivers and representative rivers	Avoca River reaches 1, 2, 3, 4, 5, 6, 7 and 8
Principle 2: Minimise risks to connected high-value assets	Avoca River reaches 1, 2, 3, 4, 5, 6, 7 and 8
Principle 3: Protect and enhance high-risk reaches	Avoca River reaches 1, 2, 4 and 7
Principle 4: Protect reaches with high-environmental, social and economic value	Avoca River reaches 1 and 4
Principles 5, 6 and 7	All waterways on a case by case basis

The desired long-term (50+ years) vision for all waterways across the Avoca catchment are defined in the following Aspirational Targets which are measurable and time bound. These reflect the vision and objectives for river health in the North Central region as outlined in Section 2.

- The Avoca River (a representative river) will meet the State-set criteria for ecologically healthy condition by 2021.
- Waterways will achieve full attainment of SEPP (WoV) objectives by 2055.
- By 2030, average annual loads of phosphorous will be reduced by approximately 25% and nitrogen loads will be reduced by approximately 32% in the Avoca catchment.

In addition to these are the following long-term goals for the Avoca catchment:

- Water quality will match users' requirements and have no detrimental impact on aquatic life.
- Migratory fish will breed and move freely throughout the catchment.
- Minimise the impacts of the Avoca River to the River Murray and significant wetlands, e.g. Kerang Lakes.
- Erosion and sediment transport will be managed to reduce blue green algal blooms in waterways and wetlands.



- Many areas will be targeted through the North Central Dryland Targeted Salinity Program, testing and applying emerging scientific developments to provide farmers in the North Central region with the best available technical options to improve their viability and environmental sustainability.
- To 'cap' dryland contributions to River Murray salt loads.
- Flood water will be allowed to flow naturally over the lower Avoca floodplain.
- Populations of threatened native plant and animal species will be restored to viable levels.
- Threatened vegetation communities will increase in extent and improve in quality to achieve a net gain.
- Reaches of high-environmental, social and economic value are protected from environmental threats.
- Urban development will be carefully planned and managed according to planning controls developed with local government to minimise the impact on waterways, wetlands and floodplain areas.
- Long-term water security will be achieved through the implementation of the Sustainable Water Strategy for Northern Victoria.

Many of these long-term targets and goals apply across the entire Avoca catchment. Those particularly relating to the upper catchment, include the control of sediment and nutrient transport to reduce blue green algal blooms in waterways and wetlands. Those pertinent to the lower catchment include distribution of flood water and the protection of significant wetlands.

The Management Action and Resource Condition Targets aim to achieve Aspirational Targets and long-term goals.

6.6.1 Upper Avoca (upstream of Charlton) Program Area

The Upper Avoca Program Area includes the southern portion of the Avoca River catchment, extending about 250km north from the Great Dividing Range near Amphitheatre to Charlton. The area includes the townships of St Arnaud, Logan, Emu, Bealiba and Natte Yallock.

The area includes the main stem of the Avoca River (reaches 5, 6, 7 and 8) to the township of Charlton and ten of its major tributaries. Upstream of Avoca, Glenlogie Creek (reach 20) enters near Amphitheatre followed by Rutherford Creek (reach 19). Downstream of Avoca, Number Two Creek (18), Mountain Creek (reach 17) and Cherry Tree Creek (reach 15) enter from the west and Homebush Creek (reach 16) flows from the east. Fentons Creek (reaches 13 and 14) enters the Avoca River at Logan, while Strathfillan Creek (reach 11) is fed by Middle Creek (reach 12) and meets the river downstream of Logan. The location and 1999 ISC condition of these waterways are shown in Figure 22.

According to the priority-setting process detailed in Section 5, Table 53 lists the priority reaches in the Upper Avoca Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.



Photo: Stephen Malone Photography

Avoca River (reach 8) near Amphitheatre.



Figure 22 Upper Avoca Program Area

Table 53 Priority waterway reaches in the Upper Avoca Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Avoca River	5	57	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets
Avoca River	6	46	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets
Avoca River	7	34	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Avoca River	8	28	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets



The critical and high priority opportunities for actions are highlighted in Table 54. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Table 54 Key values and threats along priority reaches and the prioritised opportunities for management intervention

		Threats												
		Bank erosion	Bed erosion	Channel modification	Instream barriers	Water quality trend	Water quality attainment	Water quality SIGNAL	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation		
Values	Environmental	Statewide EVC										5	8	
												6		
												7		
												8		
		Significant fauna				5	5	5		5		5		6
						6	6	6	6	6	7	6		7
						7	7	7		7		7		8
		Wetland rarity			8		8	8				8	8	
		Heritage / Representative rivers						5						
		Invertebrates observed/expected		8			7	5	6					
						8	8							
	Width of riparian vegetation										5			
											7			
	Structural intactness of riparian vegetation										5			
											6			
											7			
											8			
	Longitudinal continuity of riparian vegetation										5			
											6			
										7				
Native fish observed/expected				7	7	8								
				8	8									
Native fish migration				5	7									
				7										
Social	Fishing				5	7	5			5				
					6		6							
					7	8	7			6				
					8		8			7				
	Camping						5							
							6							
Swimming					7	5								
					8	6								
Listed landscape										5				
										6				
										7				
Economic	Water supply – irrigation						5							
	Infrastructure	7	6	5										
			7	7		7	8							
			8	8										
	Land value										5			
										6				
										7				
Tourism						5								

Key

- x Critical priority
- x High priority

Note: See the supporting document for value and threat definitions.



Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 54) and the current understanding of threat/management interactions, Table 55 sets out actions for each priority reach and their targets, responsibilities and costs. Table 56 lists related actions that will occur as a result of the actions specified in Table 55.

This table integrates actions from key plans and strategies outlined in Section 3, developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for the community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.

Table 55 Upper Avoca Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
1. Hydrology (EWR)	5 6 7 8	ISC (hydrology) score 10.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> wetland rarity infrastructure <p><u>Threat:</u></p> <ul style="list-style-type: none"> channel modification 	1.1 Implement the North Central Regional Floodplain Management Strategy to reduce the threat of channel modification and enhance floodplain linkages, particularly to rare wetlands.	Reduce adverse effects of flooding through the implementation of proposed solutions identified in the Floodplain Management Strategy.	Improved floodplain linkages and functions.	ISC (hydrology)	North Central CMA	n/a	n/a
2. Riparian zone	5 6 7 8	ISC (streamside zone) score 7 for reach 5, score 6 for reach 6, score 5 for reach 7 and score 4 for reach 8.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> statewide EVC significant fauna wetland rarity width and longitudinal continuity of riparian vegetation listed landscape land value <p><u>Threats:</u></p> <ul style="list-style-type: none"> stock access degraded riparian vegetation 	2.1 To protect and enhance riparian vegetation values through fencing and enhancement plantings along priority reaches.	248ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 248ha of riparian land under management agreements.	124km of reach with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$745 over 5 years	\$248 over 5 years
				<p><u>Value:</u></p> <ul style="list-style-type: none"> significant fauna <p><u>Threat:</u></p> <ul style="list-style-type: none"> introduced fauna 	2.2 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a
3. Instream habitat	6 7 8	ISC (physical form) score 4 for reaches 6, 7 and 8.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> invertebrates infrastructure <p><u>Threats:</u></p> <ul style="list-style-type: none"> bed erosion bank erosion 	3.1 Minimise the risk of bed and bank erosion to values.	Assess, and if necessary, address the threat of erosion to values.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
				<p><u>Values:</u></p> <ul style="list-style-type: none"> wetland rarity infrastructure <p><u>Threat:</u></p> <ul style="list-style-type: none"> channel modification 	3.2 Minimise the risk of channel modification to values.	Assess, and if necessary, address the threat of channel modification to major highways and bridges.	Protection of all very high-value public assets (infrastructure).	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	7	ISC (physical form) score 4.	<p><u>Value:</u></p> <ul style="list-style-type: none"> significant fauna <p><u>Threat:</u></p> <ul style="list-style-type: none"> loss of instream habitat 	3.3 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 5km (total) of reach 7.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	North Central CMA, DSE, LG	\$11 over 5 years	\$4 over 5 years	
	5 6	ISC (physical form) score 4 for reach 6 and score 6 for reach 5.	<p><u>Value:</u></p> <ul style="list-style-type: none"> fishing <p><u>Threat:</u></p> <ul style="list-style-type: none"> loss of instream habitat 	3.4 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 10km (total) of reaches 5 and 6.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	North Central CMA, DSE, LG	\$22 over 5 years	\$7 over 5 years	
	5 6 7 8	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna native fish observed/expected native fish migration <p><u>Threat:</u></p> <ul style="list-style-type: none"> fishing instream barriers 	3.5 Assess man-made barriers to fish migration and prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	North Central CMA, DSE, DPI	n/a	n/a
4. Water quality	5 6 7 8	Avoca catchment generates 18 tonnes per year of phosphorus and 205 tonnes of nitrogen per year.	2003	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna wetland rarity representative river invertebrates native fish observed/expected native fish migration fishing 	4.1 Implement the following priority programs of the Avoca Nutrient Management Strategy ANMS: <ul style="list-style-type: none"> Stream and gully erosion Agricultural – nutrient awareness, buffer strips and best management practices Urban – nutrient awareness, urban stormwater, septic and waste-water treatment. 	Reduction in phosphorus and nitrogen loads contributing to the ANMS 2030 target.	Reduction in phosphorus loads by 7 tonnes and nitrogen loads by 72 tonnes at key monitoring sites within the Avoca catchment. This is a 2030 target from the ANMS.	VWQMN monitoring site 408200	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$1530 per year over 5 years ^o	\$0

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
	5 6 7 8	VWQMN site meets SEPP objective for total nitrogen concentration 4 years in 10. Site meets SEPP objective for total phosphorous concentration 4 years in 10.	1994 to 2003	<ul style="list-style-type: none"> camping swimming passive recreation water supply – irrigation infrastructure tourism <u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL 	4.2 Implement the action plans of the Avoca Nutrient Management Strategy (ANMS) identified in the nutrient-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 95% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 408200	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
	5 6 7 8	VWQMN site meets SEPP objective for turbidity 9 years in 10.	1994 to 2003		4.3 Implement the action plans of the Avoca Nutrient Management Strategy (ANMS) identified in the sediment-related actions (above).	Maintain compliance with SEPP (WoV) objectives (from North Central RCS).	Maintain compliance with SEPP (WoV) objectives (from North Central RCS).	VWQMN monitoring site 408200	North Central CMA, EPA Victoria, G-MW	n/a	n/a
	5 6 7 8	Salinity load of 100 tonnes per year measured along lower Avoca River at Quambatook (MDBC 1999).	1999		4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 5,000 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Reduce salt load by a further 259 tonnes per year (interim end-of-valley target) by 2022 (SKM 2002).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
		VWQMN site exceeds SEPP objective for turbidity in all years.	1994 to 2003			Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 95% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 408200	DPI, North Central CMA, EPA Victoria	n/a	n/a
5. Wetlands	8	No data – IWC and Regional Wetlands Strategy currently in development.	2005	<u>Value:</u> <ul style="list-style-type: none"> wetland rarity <u>Threats:</u> <ul style="list-style-type: none"> channel modification water quality trend and attainment stock access degraded riparian vegetation 	5.1 Undertake the IWC assessment of wetlands connected to reach 8. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Water Quality for reach 8 and actions will to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)
° This is an undiscounted figure

Table 55 presents actual actions to undertake along priority reaches for particular Resource Condition areas. The following Table 56 relies on the implementation of actions from Table 55 to meet the corresponding targets. Table 56 does not include costed actions as they relate to the costs detailed in Table 55.

Table 56 Upper Avoca Program Area – related actions and targets

■ Critical priority □ High priority

Resource Condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	
Aquatic life	5 7 8	1 of 9 sites meet all SEPP biological objectives.	1997 to 2001	Value: • invertebrates Threats: • water quality trend and attainment	Enhance invertebrate diversity by reducing the threat of poor water quality as per Riparian Zone and Water Quality actions 2.1, 2.2 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
	6		Value: • invertebrates Threat: • water quality SIGNAL	Enhance invertebrate diversity by reducing the threat of poor water quality as per Riparian Zone and Water Quality actions 2.1, 2.2 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	
	8		Value: • invertebrates Threat: • bed erosion	Enhance invertebrate diversity by reducing the threat of bed erosion as per Riparian Zone, Instream Habitat and Water Quality actions 2.1, 2.2, 3.1, 3.2, 3.5 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Condition.	Achieve 95% compliance with SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria	
	5 7 8	Golden perch, murray cod, mountain galaxias and freshwater catfish present in reaches 5, 7 and 8.	2000	Values: • native fish observed /expected • native fish migration Threats: • instream habitat • water quality trend and attainment	Protect and enhance threatened fish populations as per Instream Habitat, Riparian Zone and Water Quality actions 2.1, 2.2, 3.1 – 3.5 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA
River health	5 6 7 8	Moderate	1999	Refer to Table 54 for all values/threats for River health	Undertake integrated river management as per all Resource Condition actions 1.1, 2.1, 2.2, 3.1 – 3.5 and 4.1 – 4.4. Develop and implement a Catchment Action Plan.	Maintain ISC condition rating of 'Moderate'.	165km of river in 'Good' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
Representative river	5 6 7 8	Avoca River is considered to be representative of the Victorian Northwest uplands river region.	2002	Refer to Table 54 for all values/threats for a representative river.	Representative river reaches to be reviewed by the Victorian Environment Assessment Council (DNRE 2002a).	Riparian protection and enhancement as per actions in Riparian Zone for reaches 5, 6, 7 and 8.	One representative river in 'Good' condition.	ISC	DSE, North Central CMA



6.6.2 Lower Avoca (downstream of Charlton) Program Area

The Lower Avoca Program Area encompasses the northern portion of the Avoca River catchment downstream of Charlton to the Avoca Marshes. This area includes the townships of Charlton and Quambatook along the Avoca River as well as Wycheproof, Lalbert and Lake Meran. It includes the main stem of the Avoca River (reaches 1, 2, 3 and 4) and the Mosquito Creek anabranch (reach 9). The location and 1999 ISC condition of these waterways are shown in Figure 23.



Figure 23 Lower Avoca Program Area



According to the priority-setting process detailed in Section 5, Table 57 lists the priority reaches in the Lower Avoca Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 57 Priority waterway reaches in the Lower Avoca Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Avoca River	1	38	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches with high-environmental, social and economic value (environmental)
Avoca River	2	31	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches
Avoca River	3	10	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets
Avoca River	4	43	Principle 1: Protect and enhance ecologically healthy rivers and representative rivers Principle 2: Minimise risks to connected high-value assets Principle 3: Protect and enhance high-risk reaches Principle 4: Protect reaches with high-environmental, social and economic value (environmental)

The critical and high priority opportunities for actions are listed in Table 58. This table identifies the key value and threat relationships for each reach. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified by the priority-setting principles in Section 5, the prioritised opportunities for management intervention (Table 58) and the current understanding of threat/management interactions, Table 59 sets out the necessary actions for each priority reach and their targets, responsibilities and costs. Table 60 lists related actions that will occur as a result of the actions specified in Table 59.

This table integrates actions from key plans and strategies outlined in Section 3 and were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Photo: Stephen Malone Photography

Avoca River (reach 1) near Quambatook.



Table 58 Key values and threats along priority reaches and the opportunities for management intervention

		Threats														
		Channel modification	Instream barriers	Flow deviation	Wetland connectivity	Water quality trend	Water quality attainment	Water quality SIGNAL	Algal blooms	Exotic flora	Introduced fauna	Loss of instream habitat	Stock access	Degraded riparian vegetation		
Values	Environmental	Significant flora			1	1					2			1	2	
		Statewide EVC			1	1					2			2	1	
		Significant fauna		1		1	1	1	1			1		1	2	
		Wetland significance			1	1	1	1	1	1				1		
		Wetland rarity	3		1	1	1	1	1					1		
		Heritage / Representative rivers								1						
		Invertebrates observed/expected					1	4	1	1						
		Width of riparian vegetation												1		
		Structural intactness of riparian vegetation												1		
		Longitudinal continuity of riparian vegetation												2		
	Social	Native fish observed/expected		1			1		1	1						
		Native fish migration		1	1		1		1							
		Fishing		1	1		1	1	1			4				
		Non-motor sports		4						1						
		Motor sports		4						1						
		Camping					4		1	1						
		Passive recreation							2							
		Flagship species												3		
		Economic	Water supply – irrigation					1		1						
			Infrastructure	3				2								
Land value	4					3							1			
Tourism							4		1				2			
													3			

Key

x Critical priority
x High priority

Note: See the supporting document for value and threat definitions.

Table 59 Lower Avoca Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
1. Hydrology (EWR)	1 2 3 4	ISC (hydrology) score 4 for reach 1, score 6 for reach 2, score 7 for reach 3 and score 9 for reach 4.	1999 <u>Values:</u> • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • invertebrates • native fish migration • fishing • non-motor sports • motor sports <u>Threat:</u> • flow deviation	1.1 Finalise and implement the Upper Avoca Water Resource Management Plan.	Move toward the improvement of one in the measurement of hydrology for all priority reaches.	Improvement of one in the measurement of hydrology for all priority reaches.	ISC (hydrology)	DSE, North Central CMA, G-MW, Grampians Wimmera Mallee Water, LG, community	n/a	n/a
	1	ISC (hydrology) score 4.	1999 <u>Values:</u> • wetland rarity • infrastructure <u>Threat:</u> • channel modification	1.2 Implement the North Central Regional Floodplain Management Strategy and Lower Avoca Hydrologic Study to reduce the threat of channel modification and enhance floodplain linkages, particularly to rare wetlands.	Reduce adverse effects of flooding through the implementation of proposed solutions identified in the Floodplain Management Strategy.	Improved floodplain linkages and functions.	ISC (hydrology)	North Central CMA	n/a	n/a
2. Riparian zone	1 2 3 4	ISC (streamside zone) score 8 for reach 1, score 6 for reach 2 and score 7 for reaches 3 and 4.	1999 <u>Values:</u> • significant flora • statewide EVC • significant fauna • wetland significance • wetland rarity • width and longitudinal continuity of riparian vegetation • flagship species^ • land value • tourism <u>Threat:</u> • stock access	2.1 To protect and enhance multiple values associated with riparian vegetation through fencing and enhancement plantings along priority reaches.	183ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 183ha of riparian land under management agreements.	92km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, Landholders	\$550 over 5 years	\$183 over 5 years
	2 3 4	See scores above	<u>Values:</u> • significant flora • statewide EVC <u>Threat:</u> • exotic flora	2.2 Undertake exotic flora control to protect and enhance values.	37km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	111km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$370 over 5 years	\$123 over 5 years
	1 2 3 4	See scores above	<u>Value:</u> • significant fauna <u>Threat:</u> • introduced fauna	2.3 Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE threatened fauna databases	DPI, North Central CMA, Landholders	n/a	n/a
3. Instream habitat	3 4	ISC (physical form) score 5 for reach 3 and score 6 for reach 4.	1999 <u>Values:</u> • wetland rarity • infrastructure <u>Threat:</u> • channel modification	3.1 Reduce the threat of channel modification to protect and enhance values.	Assess, and if necessary, address the threat of channel modification to major highways and bridges.	Protection of all very high-value public assets (infrastructure) along reach.	ISC (physical form)	VicRoads, North Central CMA, DSE, LG	\$20 over 5 years	\$0
	1 2 3 4	ISC (physical form) score 5 for reaches 1, 2 and 3 and score 6 for reach 4.	1999 <u>Values:</u> • significant fauna • native fish observed /expected • native fish migration • fishing <u>Threat:</u> • loss of instream habitat	3.2 Assess man-made barriers to fish migration and prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys.	North Central CMA, DSE, DPI	n/a	n/a

Resource condition	Priority reaches	Current condition and year data collected		Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
										Gov't	Other
4. Water quality	1 2 3 4	Avoca catchment generates 18 tonnes per year of phosphorus and 205 tonnes of nitrogen per year.	2003	<u>Values:</u> <ul style="list-style-type: none"> significant fauna wetland significance wetland rarity representative river invertebrates native fish observed/expected native fish migration fishing non-motor sports motor sports camping passive recreation water supply – irrigation infrastructure tourism 	4.1 Implement the following priority programs of the Avoca Nutrient Management Strategy ANMS: <ul style="list-style-type: none"> Stream and gully erosion Agricultural – nutrient awareness, buffer strips and best management practices Urban – nutrient awareness, urban stormwater, septic and waste-water treatment. 	Reduction in phosphorus and nitrogen loads contributing to the ANMS 2030 target.	Reduction in phosphorus loads by 7 tonnes and nitrogen loads by 72 tonnes at key monitoring sites within the Avoca catchment. This is a 2030 target from the ANMS.	VWQMN monitoring site 408203	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$1530 per year over 5 years ^o	\$0
	1 2 3 4	VWQMN site exceeds SEPP objective for total nitrogen concentration in all years. Site exceeds SEPP objective for total phosphorous concentration in all years.	1994 to 2003	<u>Threats:</u> <ul style="list-style-type: none"> water quality trend, attainment and SIGNAL algal blooms 	4.2 Implement the action plans of the Avoca Nutrient Management Strategy (ANMS) identified in the nutrient-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 408203	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
	1 2 3 4	VWQMN site meets SEPP objective for turbidity 8 years in 10.	1994 to 2003		4.3 Implement the action plans of the Avoca Nutrient Management Strategy (ANMS) identified in the sediment-related actions (above).	Move toward the target of meeting the SEPP (WoV) objective in all years (from North Central RCS).	Meet the SEPP (WoV) objective in all years (from North Central RCS).	VWQMN monitoring site 408203	North Central CMA, EPA Victoria, G-MW	n/a	n/a
	1 2 3 4	Salinity load of 100 tonnes per year measured along lower Avoca River at Quambatook (MDBC 1999).	1999		4.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 5,000 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt load by 5,000 tonnes per year (interim end-of-valley target) by 2010 (SKM 2002).	Reduce salt load by a further 259 tonnes per year (interim end-of-valley target) by 2022 (SKM 2002).	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
			VWQMN site exceeds SEPP objective for salinity in all years.	1994 to 2003		Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 408203	DPI, North Central CMA, EPA Victoria	n/a	n/a
5. Wetlands	1	No data – IWC and Regional Wetlands Strategy currently in development.	2005	<u>Values:</u> <ul style="list-style-type: none"> wetland significance wetland rarity <u>Threats:</u> <ul style="list-style-type: none"> channel modification flow deviation wetland connectivity water quality trend, attainment and SIGNAL algal blooms stock access 	5.1 Undertake the IWC assessment of wetlands connected to reach 1. Implement specific wetland management actions as identified in the Regional Wetlands Strategy. Complete the Avoca Wetlands Salinity and Water Management Plan by 2005 and commence implementation. Implement the Kerang Wetlands Ramsar Site Strategic Management Plan.	As per Management Action Targets for Hydrology, Water Quality and Riparian Zone for reach 1 and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, DPI, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)
^oThis is an undiscounted figure

Table 60 presents actual actions to undertake along priority reaches for particular Resource Condition areas. The following Table 61 relies on the implementation of actions from Table 60 to meet the corresponding targets. Table 61 does not include costed actions as they relate to the costs detailed in Table 60.

Table 60 Lower Avoca Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	1 2 3 4	0 of 3 sites meet all SEPP biological objectives.	1997 to 2001 <u>Value:</u> • invertebrates <u>Threats:</u> • water quality trend and SIGNAL • algal blooms	Enhance invertebrate diversity as per Riparian Zone and Water Quality actions 2.1 – 2.3 and 4.1 – 4.4.	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach). As per Management Action Targets for corresponding Resource Conditions.	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	EPA monitoring sites	North Central CMA, EPA Victoria
	1 2 3 4	Golden perch and murray cod present in all priority reaches.	2000 <u>Values:</u> • native fish observed /expected • native fish migration <u>Threats:</u> • instream habitat • flow deviation • water quality trend and SIGNAL • algal blooms	Protect and enhance threatened fish populations as per Hydrology, Instream Habitat, Riparian Zone and Water Quality actions 1.1, 1.2, 2.1 – 2.3, 3.1, 3.2 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA
River health	2 3 4	Moderate	1999 Refer to Table 59 for all values / threats for river health	Undertake integrated river management as per all Resource Condition actions 1.1, 2.1 – 2.3, 3.1, 3.2 and 4.1 – 4.4. Develop and implement a Catchment Action Plan for Tyrell and Lalbert creeks with the Mallee CMA.	Maintain ISC condition rating of 'Moderate'.	84km of river in 'Good' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
	1	Poor	1999	Undertake integrated river management as per all Resource Condition actions 1.1, 1.2, 2.1, 2.3, 3.2 and 4.1 – 4.4.	Maintain ISC condition rating of 'Poor'.	38km of river in 'Moderate' condition (as measured by ISC).	ISC	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders
Representative river	1 2 3 4	Avoca River is considered to be representative of the Victorian Northwest floodplain river region.	2002 Refer to Table 59 for all values / threats for river health	Representative river reaches to be reviewed by the Victorian Environment Assessment Council (DNRE 2002a).	Riparian protection and enhancement as per actions in Riparian Zone for reaches 1, 2, 3 and 4.	One representative river in 'Good' condition.	ISC	DSE, North Central CMA
High environmental values/assets	1 4	Reach 1 is ranked 1 and reach 4 is ranked fifth in the North Central region according to environmental value.	2004 <u>Values:</u> • fishing • non-motor sports • motor sports <u>Threats:</u> • instream habitat • flow deviation • water quality trend, attainment and SIGNAL • algal blooms	Undertake integrated river management as per all Resource Condition actions 1.1, 1.2, 2.1 – 2.3, 3.1, 3.2 and 4.1 – 4.4.	As per Management Action Targets for corresponding Resource Conditions.	Two high-value-environmental reaches protected.	ISC (streamside zone) and VWQMN monitoring site 408203	North Central CMA, DSE, DPI, LG, EPA Victoria, G-MW, Landholders



6.7 Avon-Richardson catchment

The Avon-Richardson catchment lies in the west of the North Central region of Victoria and covers approximately 330,000 ha. The Avon and Richardson rivers join at Banyena and flow north to Lake Buloke. Major tributaries include Sandy, Wallaloo and Andersons creeks (see Section 4.2.4 Figure 10).

The overall objective for managing river health in the Avon-Richardson catchment is to minimise risks to the nationally significant Lake Buloke. In doing so, the riparian vegetation along Avon-Richardson catchment waterways will be protected and enhanced and may therefore create better habitat for both terrestrial and aquatic species. Improved water quality will benefit the health of the river and its variety of social and economic uses.

For the Index of Stream Condition (ISC) assessment, which forms the basis of the regional priority-setting process, six of the catchment's major waterways were divided into 10 reaches (see Section 4.2.4 Figure 10). These reaches are numbered 43 to 52 based on their location within the Wimmera Basin. Reaches 1 to 42 occur along the Wimmera River and its tributaries. In order to present the priority reaches, their actions, targets and costs, the Campaspe catchment was divided into three Program Areas.

Number of ISC reaches	10
Total length of ISC waterways	330km
Number of Program Areas	1

A number of waterway reaches were identified as priorities for river health management in the Avon-Richardson catchment. These reaches and their corresponding priority-setting principles are listed in Table 62. Refer to Section 5 for the objectives specific to each principle that guides the management actions for each priority reach.

Table 61 Priority waterway reaches in the Avon-Richardson catchment

Priority principle	Priority reach
Principle 2: Minimise risks to connected high-value assets	Avon River reaches 46, 47 and 48 Richardson River reaches 43, 44 and 45 Richardson Creek reach 52
Principles 5, 6 and 7	All waterways on a case by case basis

The desired long-term (50+ years) vision for all waterways across the Avon-Richardson catchment are defined in the following Aspirational Targets which are measurable and time bound. These reflect the vision and objectives for river health in the North Central region as outlined in Section 2.

- Waterways will achieve full attainment of SEPP (WoV) objectives by 2055.
- By 2030, average annual loads of phosphorous will be reduced by approximately 23% and nitrogen loads will be reduced by approximately 28% in the Avon-Richardson catchment.

In addition to these are the following long-term goals for the Avon-Richardson catchment:

- Water quality will match users' requirements and have no detrimental impact on aquatic life.
- Migratory fish will breed and move freely throughout the catchment.
- Erosion and sediment transport will be managed to reduce blue green algal blooms in waterways and wetlands.
- Minimise the impacts of the Avon and Richardson rivers to significant wetlands, e.g. Lake Buloke.
- Many areas will be targeted through the North Central Dryland Targeted Salinity Program, testing and applying emerging scientific developments to provide farmers in the North Central region with the best available technical options to improve their viability and environmental sustainability.
- Populations of threatened native plant and animal species will be restored to viable levels.
- Threatened vegetation communities will increase in extent and improve in quality to achieve a net gain.



- Urban development will be carefully planned and managed according to local government controls to minimise the impact on waterways, wetlands and floodplain areas.
- Long-term water security will be achieved through the implementation of the Sustainable Water Strategy for Northern Victoria.

Many of these long-term targets and goals apply across the entire Avon-Richardson catchment. Those particularly relating to the upper catchment, include the control of sediment and nutrient transport to reduce blue green algal blooms in waterways and wetlands. Those pertinent to the lower catchment include the protection of significant wetlands.

The Management Action and Resource Condition Targets aim to achieve these Aspirational Targets and long-term goals.

6.7.1 Avon-Richardson Program Area

The Avon-Richardson Program Area extends from the Pyrenees foothills southwest of St Arnaud to Lake Buloke, north of Donald. Other towns in the area include Marnoo and Watchem.

The major waterways of the area include the intermittently flowing Avon River (reaches 46, 47 and 48) and Richardson River (reaches 43, 44 and 45). These rivers meet at Banyena with the Richardson River continuing northward to Lake Buloke. Sandy Creek (reach 49) is the major tributary of the Avon River, while Wallaloo Creek (reach 50), Andersons Creek (reach 51) and Richardson (or Dog Trap) Creek (reach 52) feed into the Richardson River. The location and 1999 ISC condition of these waterways are shown in Figure 24.

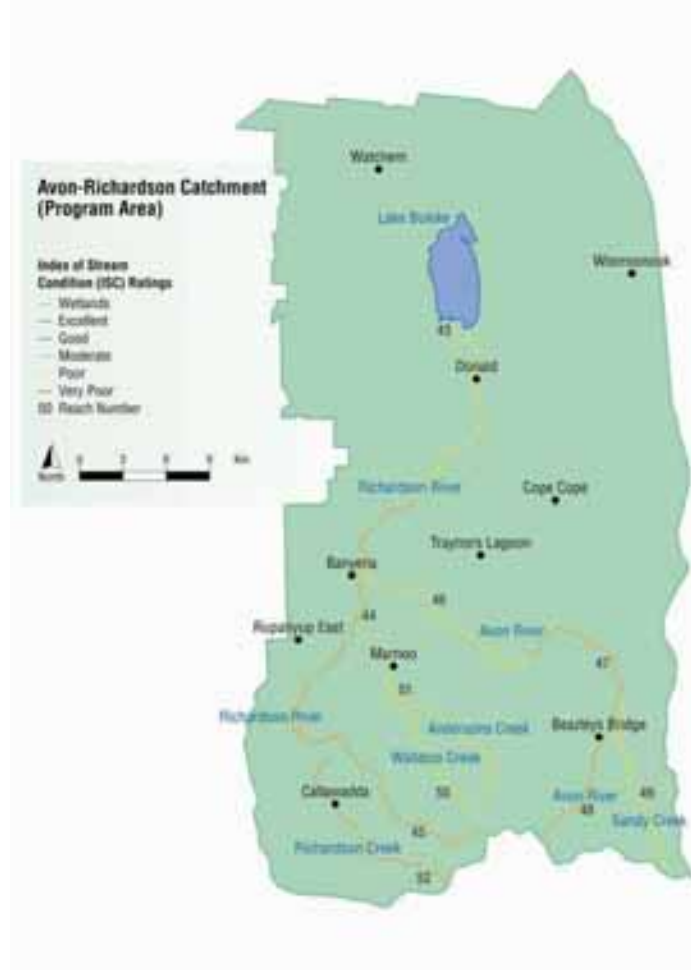


Figure 24 Avon-Richardson Program Area



According to the priority-setting process detailed in Section 5, Table 63 lists the priority reaches in the Avon-Richardson Program Area and their corresponding priority-setting principles. Refer to Section 5 for the principle objectives that guide management actions.

Table 62 Priority waterway reaches in the Avon-Richardson Program Area

Priority waterway	Priority reach	Length (km)	Priority-setting principle/s
Richardson River	43	38	Principle 2: Minimise risks to connected high-value assets
Richardson River	44	28	Principle 2: Minimise risks to connected high-value assets
Richardson River	45	60	Principle 2: Minimise risks to connected high-value assets
Avon River	46	43	Principle 2: Minimise risks to connected high-value assets
Avon River	47	25	Principle 2: Minimise risks to connected high-value assets
Avon River	48	24	Principle 2: Minimise risks to connected high-value assets
Richardson Creek	52	29	Principle 2: Minimise risks to connected high-value assets

Table 64 lists the critical and high priority opportunities for actions of each reach. This table identifies the key value and threat relationships. The complete value and threat dataset and risk-scores are available in the supporting document titled *North Central waterways – values, threats and risks* (North Central CMA 2005). This document is also available on the North Central CMA website at www.nccma.vic.gov.au.

Using the priority reaches identified in Section 5, the opportunities for management intervention (Table 64) and the current understanding of threat/management interactions, Table 65 sets out the prioritised actions for each priority reach and their corresponding targets, responsibilities and costs. Table 66 lists related actions that will occur as a result of the actions specified in Table 65.



Photo: Linton Argall

Andersons Creek (reach 51) near Marnoo.

This table integrates actions from key plans and strategies outlined in Section 3 and were developed in consultation with key stakeholder agencies. The specific location of prioritised actions will be identified through the development of Catchment Action Plans with the local community and relevant stakeholder groups and agencies. These plans are guided by the priorities contained in this Strategy and the extensive background information about every named waterway in the North Central region contained in the River Health Plans.

See Appendix 9 for cost- and target-setting assumptions and Appendix 10 for unit-cost assumptions.

Refer to Section 7 for community involvement actions and targets to achieve the high level of community participation required to implement the Strategy.



Table 63 Key values and threats along priority reaches and the prioritised opportunities for management intervention

		Threats										
		Bank erosion	Bed erosion	Channel modification	Instream barriers	Water quality trend	Water quality attainment	Exotic flora	Loss of instream habitat	Stock access	Degraded riparian vegetation	
Values	Environmental	Significant flora						43		43	43	
		Statewide EVC								43	43	
										44	43	
										45	44	
										46	46	
										47	46	
		Significant fauna				43	43	43		43	43	43
						44	44	44			44	
						46	46	46			46	
						52	52	52			52	
	Wetland rarity									43	43	
										46	46	
										52	52	
	Width of riparian vegetation									44		
										45		
										46		
										47		
	Structural intactness of riparian vegetation									44		
										45		
										46		
47												
Longitudinal continuity of riparian vegetation									48			
									47			
									48			
									48			
Proportion of fish introduced				44		44			45			
				45		45						
				46		46						
				47		47						
				48		48						
Native fish migration				43					43			
				44								
				45								
				52								
Social	Fishing								44			
Economic	Infrastructure	43	44	43								
			46									
	Land value										43	43
											44	
										45		
										46	46	
										47		

Key

- x Critical priority
- x High priority

Note: See the supporting document for value and threat definitions.

Table 64 Avon-Richardson Program Area – Actions and Targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)		
									Gov't	Other	
1. Riparian zone	43 44 45 46 47 48 52	ISC (streamside zone) score 4 for reaches 43, 46 and 52, score 5 for reach 44, score 6 for reaches 47 and 48, score 7 for reach 45.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna wetland rarity width and longitudinal continuity of riparian vegetation land value <p><u>Threats:</u></p> <ul style="list-style-type: none"> stock access degraded riparian vegetation 	1.1 To protect and enhance multiple values associated with riparian vegetation through fencing and enhancement plantings along priority reaches.	371ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total reach length). 371ha of riparian land under management agreements.	185km of reach with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$1037 over 5 years	\$346 over 5 years
	43 48	See scores above	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant flora statewide EVC significant fauna <p><u>Threat:</u></p> <ul style="list-style-type: none"> exotic flora 	1.2 Undertake exotic flora control to protect and enhance values.	16km of reach (or one quarter of total reach length) subject to riparian weed control at sites fenced and revegetated on both banks.	47km of reach (or three quarters of the total reach length) with improvement of one in the measurement of riparian condition*.	ISC (streamside zone)	North Central CMA, DSE, DPI, LG, Landholders	\$155 over 5 years	\$52 over 5 years
2. Instream habitat	43	ISC (physical form) score 3	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna native fish migration <p><u>Threat:</u></p> <ul style="list-style-type: none"> loss of instream habitat 	2.1 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 5km of reach 43.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	North Central CMA, DSE, LG	\$11 over 5 years	\$4 over 5 years
	44 45	ISC (physical form) score 5 for reach 44 and score 3 for reach 45.	1999	<p><u>Values:</u></p> <ul style="list-style-type: none"> proportion of fish introduced fishing <p><u>Threat:</u></p> <ul style="list-style-type: none"> loss of instream habitat 	2.2 Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat into 10km (total) of reaches 44 and 45.	Improvement of one in the measurement of ISC (physical form).	ISC (physical form)	North Central CMA, DSE, LG	\$22 over 5 years	\$7 over 5 years
3. Water quality		Avon-Richardson catchment generates 25 tonnes per year of phosphorus and 369 tonnes of nitrogen per year.	2003	<p><u>Values:</u></p> <ul style="list-style-type: none"> significant fauna wetland rarity invertebrates proportion of fish introduced fishing <p><u>Threats:</u></p> <ul style="list-style-type: none"> water quality trend and attainment 	3.1 Implement the following action plans of the Avon-Richardson Nutrient Management Strategy (ARNMS):	Reduction in phosphorus and nitrogen loads contributing to the ARNMS 2030 target.	Reduction in phosphorus loads by 8 tonnes and nitrogen loads by 106 tonnes at key monitoring sites within the Avon-Richardson catchment. This is a 2030 target from the ARNMS.	VWQMN monitoring site 415257	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	\$1592 per year over 5 years ⁹	\$0
	43 44 45 46 47 48 52	VWQMN site exceeds SEPP objective for total nitrogen concentration in all years. Site exceeds SEPP objective for total phosphorous concentration in all years.	1994 to 2003		3.2 Implement the action plans of the Avon-Richardson Nutrient Management Strategy (ARNMS) identified in the nutrient-related actions (above).	Establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve 60% compliance with SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.	VWQMN monitoring site 415257	North Central CMA, EPA Victoria, DPI, LG, G-MW, Landholders	n/a	n/a
		VWQMN site meets SEPP objective for turbidity 6 years in 10.	1994 to 2003		3.3 Implement the action plans of the Avon-Richardson Nutrient Management Strategy (ARNMS) identified in the sediment-related actions (above).	Maintain compliance with SEPP (WoV) objective (from North Central RCS).	Maintain compliance with SEPP (WoV) objective (from North Central RCS).	VWQMN monitoring site 415257	North Central CMA, EPA Victoria, G-MW	n/a	n/a
		No salinity load data available (MDBC 1999).	n/a		3.4 Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Reduce salt load by 612 tonnes per year (interim end-of-valley target) by 2022 (SKM 2002)	n/a	DPI, North Central CMA, EPA Victoria	n/a	n/a
3. Water quality		VWQMN site exceeds SEPP objective for salinity in all years.	1994 to 2003		Move toward achieving 60% compliance with SEPP (WoV) objective (from North Central RCS).	Move toward achieving 60% compliance with SEPP (WoV) objective (from North Central RCS).	VWQMN monitoring site 415257	DPI, North Central CMA, EPA Victoria	n/a	n/a	

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility	Cost ('000)	
									Gov't	Other
4. Wetlands	43	No data – IWC and Regional Wetlands Strategy currently in development.	2005 <u>Value:</u> • wetland rarity <u>Threats:</u> • water quality attainment • stock access • degraded riparian vegetation	4.1 Undertake the IWC assessment of wetlands connected to reach 43. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Water Quality for reach 43 and actions will be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a
	46 52		2005 <u>Value:</u> • wetland rarity <u>Threats:</u> • water quality attainment • stock access • degraded riparian vegetation	4.2 Undertake the IWC assessment of wetlands connected to reaches 46 and 52. Implement specific wetland management actions as identified in the Regional Wetlands Strategy.	As per Management Action Targets for Water Quality for reaches 46 and 52 and actions to be identified in the Regional Wetlands Strategy.	Improvement in condition of high-environmental-value wetlands and no further decline in the extent of wetlands (from North Central RCS).	Index of Wetland Condition (IWC)	North Central CMA, DSE, Landholders	n/a	n/a

Note: * Assumes one quarter of the total length is protected with existing fences in 2005 (see Appendices 9 and 10 for other target-setting and unit-cost assumptions)
° This is an undiscounted figure

Table 65 presents actual actions to undertake along priority reaches for particular Resource Condition areas. The following Table 66 relies on the implementation of actions from Table 65 to meet the corresponding targets. Table 66 does not include costed actions as they relate to the costs detailed in Table 65.

Table 65 Avon-Richardson Program Area – related actions and targets

■ Critical priority □ High priority

Resource condition	Priority reaches	Current condition and year data collected	Values / threats	Action	Management Action Target (5 years)	Resource Condition Target (10 years)	Monitoring requirements	Responsibility
Aquatic life	43 44 45 46 47 48 52	Golden perch present in reaches 46, 43 and 44. Reach 44 also contains river blackfish, silver perch, murray cod and freshwater catfish. freshwater catfish are also present in reach 43.	2000 <u>Values:</u> • proportion of fish introduced • native fish migration <u>Threats:</u> • water quality attainment • loss of instream habitat	Protect and enhance threatened fish populations as per Instream Habitat, Riparian Zone and Water Quality actions 1.1, 1.2, 2.1, 2.2 and 3.1 – 3.4.	As per Management Action Targets for corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	DSE database, fish surveys	DSE/DPI, North Central CMA
	43 44 45 46 47 48 52	Many natural and man-made instream barriers have been identified (DNRE 1999).	1999 <u>Values:</u> • significant fauna • proportion of fish introduced • native fish migration • fishing <u>Threat:</u> • instream habitat	Assess man-made barriers to fish migration and prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).	Number of man-made instream barriers present, fish surveys	DSE/DPI, North Central CMA



6.8 Regional targets summary

To provide an understanding of the overall actions required in the North Central region to meet the identified goals and targets, the following Table 67 condenses the information from the 11 Program Areas (Sections 6.4 – 6.7). Although Table 67 does not specify the target reaches, it provides a summary of the actions and targets to achieve. A summary of the costs are presented in Section 8.4 Table 67.

Table 66 North Central region targets summary

Resource Condition	Action	Management Action Target (5 years)	Resource Condition Target (10 years)
Hydrology (EWR)	Implement the North Central Regional Floodplain Management Strategy and other relevant plans.	Reduce adverse effects of flooding through the implementation of relevant strategies and plans.	Improved floodplain linkages and functions.
	To develop and implement the Sustainable Water Strategy for Northern Victoria.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in high value reaches.	Establishment of Environmental Water Reserve and improved flow regimes achieving environmental flow objectives in 14 high value reaches.
	Continue temperature monitoring at sites downstream of priority reservoirs to determine effects of cold water pollution.	Take appropriate actions to reduce the effects of cold water pollution.	Eliminate the threat of cold water pollution to priority reaches.
Riparian zone	To protect and enhance multiple values associated with riparian vegetation through fencing and enhancement plantings along priority reaches.	3,209ha of riparian land protected and enhanced (includes both banks and equates to one quarter of the total length of priority reaches). 3,209ha of riparian land under management agreements.	1580km (or three quarters of the total length of priority reaches) with improvement of one in the measurement of riparian condition.
	Undertake exotic flora control to protect and enhance values.	222km (or one quarter of total length of priority reaches) subject to riparian weed control at sites fenced and revegetated on both banks.	655km (or three quarters of the total length of priority reaches) with improvement of one in the measurement of riparian condition.
	Undertake exotic fauna control to protect and enhance values.	Support landholders to undertake rabbit-control programs (as per Rabbit Action Plan). Undertake integrated fox-control programs (from North Central RCS).	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).
Instream habitat	Reduce the threat of channel modification to protect and enhance values.	Assess, and if necessary, address the threat of channel modification to major highways and bridges.	Protection of all very high-value public assets (infrastructure) for 13 reaches.
	Minimise the risk of bed and bank erosion to values.	Assess, and if necessary, address the threat of erosion to values.	Improvement of one in the measurement of ISC (physical form) for 13 reaches.
	Assess man-made barriers to fish migration and prioritise their removal or modification.	Remove or modify the high-priority man-made fish barriers.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).
	Reinstate suitable instream habitat to protect and enhance values.	Reinstate suitable instream habitat.	Improvement of one in the measurement of ISC (physical form) for 14 reaches.
Water quality	Implement the priority programs of the relevant catchment Nutrient Management Strategies.	Reduction in phosphorus and nitrogen loads in each catchment.	Reduction in phosphorus loads by 724.6 tonnes and nitrogen loads by 123.3 tonnes at key monitoring sites within catchments by 2030 (key sites defined in Sections 6.4 – 6.7).



Resource Condition	Action	Management Action Target (5 years)	Resource Condition Target (10 years)
	Implement the action plans of the Nutrient Management Strategies that relate to total phosphorous and total nitrogen concentrations.	Maintain or move toward compliance (dependent upon current condition) with existing SEPP (WoV) objective or establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve compliance with existing SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.
	Implement the action plans of the Nutrient Management Strategies that relate to turbidity.	Maintain or move toward compliance (dependent upon current condition) with existing SEPP (WoV) objective or establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve compliance with existing SEPP (WoV) objectives (from North Central RCS) or other target to be determined using a risk-based approach.
Water quality	Implement priority actions recommended in the Draft North Central Dryland Management Plan (under review) (SKM 2002).	Support the implementation of priority actions in the Draft North Central Dryland Management Plan (under review) (SKM 2002). Reduce salt loads by interim end-of-valley targets for each catchment by 2010 (SKM 2002).	Reduce salt load by interim end-of-valley targets for each catchment by 2022 (SKM 2002).
		Maintain or move toward compliance (dependent upon current condition) with existing SEPP (WoV) salinity objective or establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve compliance with existing SEPP (WoV) salinity objectives (from North Central RCS) or other target to be determined using a risk-based approach.
Aquatic life	Enhance invertebrate diversity as per relevant Resource Condition actions, such as Riparian Zone, Instream Habitat and Water Quality.	Maintain or move toward compliance (dependent upon current condition) with existing biological and water quality SEPP (WoV) objective or establish an appropriate target based on the attainment of SEPP (WoV) environmental quality objectives (using a risk-based approach).	Achieve compliance with existing SEPP (WoV) biological and water quality objectives (from North Central RCS) or other target to be determined using a risk-based approach.
	Protect and enhance threatened fish populations as per relevant Resource Condition actions, such as Riparian Zone, Instream Habitat and Water Quality.	As per Management Action Targets for the corresponding Resource Conditions.	Maintain or improve existing viable populations of significant threatened species (from North Central RCS).
River health	Undertake integrated river management as per all relevant Resource Condition actions.	Maintain ISC condition rating of 'Poor'.	38km of river in 'Moderate' condition (as measured by ISC).
	Undertake integrated river management as per all relevant Resource Condition actions.	Maintain ISC condition rating of 'Moderate'.	364km of river in 'Good' condition (as measured by ISC).
	Undertake integrated river management as per all relevant Resource Condition actions.	Maintain ISC condition rating of 'Good'.	82km of river in 'Excellent' condition (as measured by ISC).



Resource Condition	Action	Management Action Target (5 years)	Resource Condition Target (10 years)
Wetlands	Undertake the IWC assessment of wetlands connected to high-value wetlands. Implement specific wetland management actions as identified in the Regional Wetlands Strategy and other relevant plans.	Protect and enhance values of reaches linked to high-value wetlands as per relevant Resource Condition actions. Implement actions to be identified in the Regional Wetlands Strategy and in existing plans.	Improvement in condition of high-value wetlands. No further decline in the extent of wetlands (from North Central RCS).
Representative river	Representative river reaches to be reviewed by the Victorian Environment Assessment Council (DNRE 2002a).	Representative river reaches protected and enhanced as per relevant Resource Condition actions.	Three representative rivers/reaches in 'Good' condition.
'Near' ecologically healthy reaches	Protect and enhance reaches which currently meet 'ecologically healthy' criteria as per the relevant Resource Condition actions. Fill information gaps for the criteria where there is currently insufficient data.	'Near' ecologically healthy reaches protected and enhanced. Information gaps filled.	Three ecologically healthy reaches in 'Good' condition. Two ecologically healthy reaches in 'Excellent' condition.
High environmental values/assets	Protect and enhance top five ranked reaches of environmental value in the North Central region.	Top five ranked reaches of environmental value protected and enhanced as per relevant Resource Condition actions.	Five high-value-economic reaches protected (see Section 5.4 for priority reaches).
High social values/assets	Protect and enhance top five ranked reaches of social value in the North Central region. Consider development of a recreational plan for areas of heavy recreational pressure.	Top five ranked reaches of social value protected and enhanced as per relevant Resource Condition actions.	Five high-value-economic reaches protected (see Section 5.4 for priority reaches).
High economic values/assets	Protect and enhance top five ranked reaches of economic value in the North Central region.	Top five ranked reaches of economic value protected and enhanced as per relevant Resource Condition actions.	Five high-value-economic reaches protected (see Section 5.4 for priority reaches).



SECTION SEVEN: COMMUNITY INVOLVEMENT

The population of the North Central region is in excess of 200,000, with a population growth of 2.5% since 1996 (North Central CMA 2003a). This growth will continue, with a 50% increase predicted for Bendigo over the next 30 years (DSE 2004a). Most of the population is concentrated in the southern region, and along the River Murray in the north, in urban areas. The population is ageing. The proportion of young people remaining in the region is declining.

These trends present a challenge to the social fabric, economic prosperity and natural-resource condition of the region. Along with drought years, the challenges for water resource management have been increasingly clear.

Communities of the North Central region place a high-value on their waterways, whether for cultural, recreation or aesthetic value or water usage. These values are summarised in Sections 1.2.8 and 1.2.9. Cultural heritage is important for both the Indigenous and non-Indigenous population to maintain spiritual, physical and emotional links to the environment.

From Section 2.3.1, a key objective of the North Central River Health Strategy (RHS) is to involve the community in the planning of and participating in actions to improve the health of waterways, floodplain and wetland systems. The community includes everyone who lives and works in the North Central region, visitors or those otherwise connected to it. The community is responsible for sustained management of its own natural resources.

Effective natural resource management involves creating and sustaining partnerships within and between the various levels of government, communities and community groups, Indigenous communities and private landholders. This ensures wide involvement from the early planning stages to implementation of river health programs.



Photo: Angela Gladman

Rivers are special places to enjoy.

7.1 Community engagement

Integral to the development of the North Central RHS was to consult effectively and involve the community and other key stakeholders. A communication plan for the North Central RHS (North Central CMA 2004c) was developed in consultation with the North Central RHS Consultative committee.

This plan outlined the key opportunities for community and agency to influence the content of the Strategy.

7.1.1 Communication objectives

Communication objectives included:

- to create awareness of the North Central RHS and its purpose
- to involve the community in the development of the North Central RHS
- to distribute effectively the draft North Central RHS to the key stakeholders
- to obtain feedback from the key stakeholders on the draft North Central RHS.

7.1.2 Phases of community engagement

There were four phases of community engagement outlined in the communication plan. These included:

Phase I - River Health Forums

Phase II - Formation of a consultative committee

Phase III - Receiving stakeholder and community feedback on the draft North Central RHS

Phase IV - Outlining the role of stakeholders and the community in the implementation of the North Central RHS.

Phase I - River Health Forums



To initially gather community feedback on the values and threats associated with their local rivers and creeks, the North Central CMA facilitated 19 community River Health Forums in towns throughout the North Central region in 2002. These community meetings also provided the North Central CMA with an indication of the types of management activities the regional community would like to see implemented.

These public meetings were widely advertised and open to all interested citizens, including landholders who have a key interest and direct bearing on waterway health. The forums attracted students, field naturalists, angling enthusiasts, local government councillors, landcare members, irrigators and dryland farmers.

Attendees completed surveys that were developed prior to the finalisation of the RiVERS model. Therefore, the value and threat categories were not identically aligned. However, the information was a useful cross-reference between the RiVERS database, statewide datasets and local staff knowledge.

There is a summary of the information for each catchment in Section 4.2.1 – 4.2.4. The North Central CMA is committed to community involvement for future revisions.

Two Indigenous River Health Forums were also held in 2002. The Indigenous forums aimed to:

- develop a general understanding of the cultural significance of waterways to Indigenous people
- gain an appreciation of how the Indigenous community view the current condition of the waterways in the North Central CMA region
- understand what the issues are for river health management from an Indigenous perspective, and what improvement works could be undertaken
- discuss options about how to collaborate on river health management issues
- discuss how to establish and maintain good connections with representatives of the Indigenous communities.

To establish a true working relationship with the Indigenous community, the forums made the following recommendations:

- the importance of adhering to the *Protocols, principles and strategies agreement for Indigenous involvement in land and water management in North Central Victoria* (Victorian Catchment Management Council 2003)
- the need for employment opportunities for the Indigenous community in land and water management agencies
- the need for the Indigenous community to participate in onground projects, consultative and facilitative processes, management, decision making and in all components of triple-bottom-line decisions
- significant opportunities for the North Central CMA to increase cultural awareness within the organisation
- improvement of the North Central CMAs engagement with the Indigenous community by demonstrating awareness and commitment to the issues surrounding cultural heritage sites
- consultation with the Indigenous community about land and water management issues should be ongoing.

The employment of an Indigenous facilitator at the North Central CMA in 2004, will concentrate efforts to ensure that these recommendations are achieved.

An agency River Health Forum was also held at the North Central CMA office in 2002. It involved representatives from regional councils, NRE (now DPI/DSE), EPA Victoria, Greening Australia, Land Victoria (now DSE Crown Land Management), Parks Victoria and G-MW. Apologies were received from Wimmera Mallee Water and Environment Victoria. This forum was held to gather agency input into:

- values of waterways
- threats to waterways (including a threat ranking of low, medium or high)
- solutions to address the identified threats from degrading the identified values
- limitations and barriers to achieving the solutions.

Participants were divided into four groups relevant to their field of expertise. These groups discussed the following river health management topics:

- water allocation and flow
- river channel
- water quality
- riparian land



A common theme was the development of working partnerships and better integration between agencies, and the need for a whole-of-catchment, strategic approach. The limitations and barriers were generally attributed to knowledge-gaps, funding and politics.

Phase II - Formation of a consultative committee

A consultative committee was formed in 2003. The goals of the consultative committee were to review the development and progress of the North Central RHS, and to invite stakeholder input.

The consultative committee comprised of representatives from the North Central community and the following organisations:

- South West and Wimmera Regional Cultural Heritage Program
- Victorian Farmers Federation
- Coliban Water
- Goulburn-Murray Water
- Wimmera Mallee Water
- EPA Victoria
- DSE
- North Central CMA
- Wotjobaluk Traditional Land Council
- Shire-based landcare coordinators
- North East Regional Cultural Heritage Program
- Parks Victoria
- Environment Victoria
- DPI
- North West Regional Cultural Heritage Program
- Victorian Recreational Fishing Peak Body (VR Fish)

The consultative committee was formed prior to the restructure of the Implementation Committee's (IC). Therefore it is acknowledged that there was no community representative from the Loddon Campaspe Irrigation IC area. However, all ICs were kept informed of the progress of the Strategy and had opportunity to provide input prior to and during the public comment period.

Although wider representation on the consultative committee could have been sought, the size of the committee was kept to a minimum for practical reasons. All organisations and groups had opportunities to provide input to the Strategy during the public comment period.

Phase III – Feedback on the draft North Central RHS

This phase involved the distribution of the draft North Central RHS to the community and partner agencies, and the collating of comments for final inclusion.

The draft Strategy, supporting document and fact sheet were publicly released for comment between 26 August and 29 October 2004.

A variety of communication methods were used. These included:

- Website (www.nccma.vic.gov.au) – highlighted the availability of the draft Strategy, relevant media releases and contained downloadable (pdf) versions of the draft Strategy, supporting document and fact sheet
- Media – provided media releases to regional newspapers, TV, radio and targeted publications, e.g. News and Views, DSE River Ramblings
- Presentations – to North Central Implementation Committee's and the North Central CMA staff group
- Direct mail – letters highlighting the release of the draft Strategy mailed to all North Central landcare groups and participants in the River Health Forums
- Email – contribution to the email-based newsletter for Landcare members, and shire-based landcare coordinators.

There is further detail in the *Communication Plan for the North Central RHS* (North Central CMA 2004c).



Following the conclusion of the public comment period, all submissions were collated and the appropriate courses of action were discussed with the consultative committee. Discussed changes were made to the document before it was open for a final three-week comment period to the consultative committee and key stakeholders during March 2005.

The finalised Strategy was presented for endorsement at the North Central CMA Board meeting on 15 April, after which it was sent for Ministerial endorsement. All individuals, groups and agencies that provided submission on the draft Strategy received information detailing how their comments were considered.

Phase IV – The role of stakeholders and the community in implementing the North Central RHS

Phase IV outlines ways that landholders, community groups and other agencies can help implement the Strategy.

The key element of Phase IV is the development of an additional community engagement plan to achieve future widespread involvement in the Strategy. This plan will outline:

- objectives
- strategy development
- target audience
- key messages
- communication tools
- communication program
- activity calendar
- evaluation
- budget

The opportunities for partner organisations to be involved will also be outlined in the community engagement plan. These partner organisations also invite community engagement and encourage awareness activities. This commitment also contributes to the outcomes of the Strategy (and other NRM projects). The key roles and responsibilities of partner organisations are detailed in Chapter 8.



Photo: Angela Gladman

Interpretive signage promotes river values at key recreational locations.

The community engagement plan will be developed within six months of Government endorsement of the Strategy and will have life span of five years (in line with the Strategy), after which time it will be evaluated.

7.2 Community involvement and capacity building

The future health of the environment is highly dependent on the people of the region – including those who farm, live in towns, work in agribusiness or public sector natural-resource agencies, school children, local government, members of the region's Indigenous community and Landcare volunteers.

Changing the way natural resources are managed requires leadership, knowledge, participation, resource wealth, grassroots action and accountability. Therefore, the North Central region needs people to be skilled, motivated and well-resourced. The region needs strong and effective networks and partnerships to engage the community in effective decision-making in response to natural-resource management issues.

Investing in people and building their capacity should strengthen a community's ability to commit, resource and problem-solve. This applies to the whole community, individual landholders, the North Central CMA and partner agency personnel.

Everyone has a role to play. Investing in people is as important as investing in technical solutions. Increasingly, natural-resource plans in the region reflect this need to build the capacity of the community to manage natural resources in a more sustainable manner.

A core role of the North Central CMA is the coordination and promotion of sustainable natural resource management. It must capture the imagination of the community and harness their energy. This can be achieved through creating and maintaining effective, flexible and responsive regional partnerships and structures. Foremost is the partnership that the North Central CMA has sought to establish with the regional community. The North Central CMA has also built



successful partnerships with government agencies (e.g. DSE, DPI, EPA Victoria), urban and rural water authorities (G-MW, Grampians Wimmera Mallee Water, Coliban Water, Central Highlands Water, Lower Murray Water, Western Water) and local government (including 15 local government areas).

Community involvement in the development of the Strategy was imperative to ensure a level of ownership and commitment to improve river health. The implementation of the Strategy will include community engagement actions with five- and ten-year targets. These are outlined in Section 7.3.

7.3 Community Involvement Targets

In order to achieve a high level of community participation, the following Community Involvement Targets have been set in consultation with local community facilitators, such as Waterwatch coordinators. They provide a realistic target while aiming for continual improvement in community involvement.

The Community Involvement Targets are:

- 1300 people, per year, involved in community monitoring. This includes existing and new monitors along all major waterways, with an emphasis on priority reaches.
- 120 additional people, per year, participating in river health management programs through onground incentive programs.
- 500 people, per year, participating in a range of river health awareness activities such as field days, bus tours, etc. This target aims to involve an expanding cross-section of age, cultural and interest groups.

To achieve these targets, the following costed actions and their five-year and ten-year targets have been developed in accordance with the North Central RCS (Table 68).

The key positions currently held at the North Central CMA that will lead the community involvement of the following actions (for which the North Central CMA is the lead agency) include the Indigenous Facilitator, River Health Awareness Officer, Regional Waterwatch Coordinator, Communications Coordinator and Regional Landcare Coordinator.

The communication tools to implement these actions will be detailed in the communication plan (to be developed).

The total cost of these actions is approximately \$2.85 million for the following five-year period.



Photo: Stephen Malone Photography

The Waterwatch program promotes awareness of river health.

Table 67 Community Involvement Actions and Targets

Action	Targeted Program areas/s	Target audience	Management Action Target (5 years)	Resource Condition Target (10 years)	Responsibility	Five-year cost ('000)	
						Gov't	Other
The North Central CMA Indigenous Facilitator to coordinate Indigenous community involvement.	All Program areas (region-wide)	Indigenous community	Implement the Protocols Agreement for Indigenous Involvement in Land and Water Management.	Active participation of the Indigenous community in the planning and implementing of river health projects and having Indigenous values, perspectives and approaches incorporated into projects.	North Central CMA, DSE, DPI, EPA Victoria, urban and rural water authorities, LG	\$90 per year	\$0
Align roles and responsibilities according to 'Our Water Our Future' and communicate them to the regional community.	All Program areas (region-wide)	All regional stakeholders	Promote a range of key messages outlining the NRM roles and responsibilities of regional stakeholders.	A clear understanding of NRM roles and the responsibilities of regional stakeholders.	North Central CMA, DSE, DPI, EPA Victoria, urban and rural water authorities, LG	\$10 per year	\$0
Assess alternative methods for delivery of NRM incentives through the <i>Partnerships in NRM</i> project.	All Program areas (region-wide)	All regional stakeholders, particularly delivery agencies	Implement an improved method of delivering NRM incentives to the regional community with regional stakeholders.	Improved partnerships with regional stakeholders in project planning, resourcing and delivery.	North Central CMA, DSE, DPI, Landholders	\$0 (already funded)	\$0
Employ a Regional Landcare Coordinator to promote the availability of high-quality support to Landcare groups to improve the effectiveness of NRM projects and group learnings.	All Program areas (region-wide)	Landcare groups and members of the wider community who may seek to join the Landcare network.	Implement the North Central Landcare Support Strategy.	A comprehensive network of self-directed Landcare and other community groups participating in NRM in rural, peri-urban and urban areas.	North Central CMA, DSE, DPI, urban and rural water authorities, LG, community	n/a	n/a
Develop strong community and agency leadership in natural resource management.	All Program areas (region-wide)	Local government, water authorities, government agencies and North Central CMA personnel	Implement a designed and professional development program for local government, water authorities, government agencies and North Central CMA personnel to improve retention rates and capacity.	High-calibre natural-resource professionals within both public and private sector organisations.	North Central CMA, DSE, DPI, EPA Victoria, urban and rural water authorities, LG	n/a	n/a
The North Central CMA River Health Awareness Officer to promote the North Central RHS to the regional and wider community.	All Program areas (region-wide)	North Central regional, Victorian, Australian and international community	Implement the communication plan to realise the North Central RHS.	A community informed and inspired by the region's efforts to improve the condition of river health.	North Central CMA, DSE, DPI, EPA Victoria, urban and rural water authorities, LG	\$90 per year	\$0
Help urban communities reduce their impacts on the security of water supply and river health.	All Program areas (region-wide)	Urban water users including the community, industry and developers	An engaged urban community by implementing of Government initiatives set out in 'Our Water Our Future'.	Sustainable management of urban water resources led by a well-informed community committed to efficient water use.	LG, DSE, rural water authorities, North Central CMA, community	n/a	n/a
Employ a Communication/Capacity Building Officer to enhance the community's ability to adopt and continue long-term sustainable farming practices in targeted dryland salinity areas.	Dryland Salinity Target Areas within Program areas: • Loddon (western tribs above Cairn Curran) • Lower Loddon • Upper Avoca • Lower Avoca • Avon-Richardson	Landholders within the ten Dryland Salinity Target Areas	Implement the North Central Dryland Targeted Salinity Program initiatives, e.g.: • Community capacity building • Environmental management systems (EMS) • Local Government planning	Completion of targeted salinity projects through the building of community capacity for NRM.	DPI, North Central CMA	n/a	n/a
Help the irrigation farming community improve water efficiencies for river health.	• Lower Campaspe • Lower Loddon • Mid-Loddon • Gunbower	Landholders (irrigated properties), community groups	An engaged irrigation community by implementing Government initiatives set out in 'Our Water Our Future'.	A confident, profitable and adaptable irrigation sector that generates wealth for the North Central community and Victoria.	DSE, DPI, North Central CMA	n/a	n/a
Help landholders manage the impacts of pest plant and animal populations, particularly in the riparian zone.	All Program areas (region-wide)	Regional landholders	An engaged community with knowledge of pest plant and animal management and which actively participates in control programs available.	Landholders with the capacity to fulfil their responsibilities regarding pest plant and animal management on their own properties.	DPI, North Central CMA	n/a	n/a
Raise awareness of the impacts of bed and bank erosion and its effect on river health, erosion control methods and the incentives available.	• Upper Campaspe • Coliban • Upper Loddon (above Cairn Curran) • Loddon (western tribs above Cairn Curran) • Lower Loddon • Upper Avoca • Avon-Richardson	Landholders, community groups, school children	An engaged community with knowledge of the impacts of bed and bank erosion on waterway health and which actively participates in erosion control programs.	An upper catchment community aware of the role they play in sediment management for the benefit of the whole catchment.	North Central CMA, DPI	\$17.5 per year	\$0
Employ a Wetlands Officer to raise community awareness of the importance of wetlands to catchment health.	All Program areas (region-wide)	Landholders, community groups, school children	An engaged community aware of the role and importance of wetlands to catchment health.	A regional community committed to the protection of wetlands for the benefit of catchment health.	North Central CMA, DSE, DPI	n/a	n/a
Educate the community about the importance of riparian vegetation to river health and raise awareness about the incentives available for its protection and enhancement.	All Program areas (region-wide)	Landholders, community groups, school children	An engaged community with knowledge of the importance of riparian vegetation and which actively participates in protection and enhancement programs.	A regional community aware of the role they play in maintaining healthy riparian vegetation for the benefit of the whole catchment.	North Central CMA, DSE, DPI	\$27.5 per year	\$0

Action	Targeted Program area/s	Target audience	Management Action Target (5 years)	Resource Condition Target (10 years)	Responsibility	Five-year cost ('000)	
						Gov't	Other
Educate the community about the importance of floodplain linkages to catchment health.	<ul style="list-style-type: none"> Lower Campaspe Lower Loddon Mid-Loddon Gunbower Lower Avoca Avon-Richardson 	Communities across the northern floodplain	An engaged floodplain community which receives accurate information about the importance of floodplain linkages to catchment health.	A floodplain community with the capacity to make informed decisions about land management across their unique landscape which have no adverse impacts on catchment health.	North Central CMA, DSE, DPI, G-MW	\$15 per year	\$0
Raise awareness of the role of nutrients in the catchment (dryland, irrigation and urban areas) as per Nutrient Management Strategies.	All Program areas (region-wide)	Communities, particularly landholders in dryland and irrigation farming properties and urban residents.	An active community with knowledge about the role of nutrients play in waterways and which actively participates in nutrient-management programs.	An upper catchment community aware of the role they play in nutrient management for the benefit of the whole catchment.	DPI, North Central CMA, DSE, EPA Victoria, LG, urban and rural water authorities	n/a	n/a
Raise the awareness of sustainable land management of landowners.	All Program areas (region-wide)	New and existing landowners on urban, peri-urban and rural private land.	Sustainable Land Management Guides available to all residents across the local government areas of the North Central region.	A regional community which can make decisions regarding sustainable land management on their own properties.	LG, North Central CMA, DSE, DPI, urban and rural water authorities	\$40 once off cost for four Guides	\$80
Engage the community to participate in river health awareness activities and onground works.	All Program areas (region-wide)	Urban, peri-urban and rural communities, Landcare and other community groups.	Implement a range of innovative tools to engage the diversity of people and groups across the region.	An inspired regional community which can influence improved river health.	North Central CMA, DSE, DPI, Parks Victoria, LG, urban and rural water authorities	\$10 per year	
Erect signage throughout the catchment to identify major waterways along key travel routes to improve awareness of local waterways.	All Program areas (region-wide)	Communities	Erect waterway signage on major road network.	Erect waterway signage on all road networks.	North Central CMA, VicRoads, LG	\$130 once off cost	
Implement consultation and decision-making that genuinely engage the community and other stakeholder organisations.	All Program areas (region-wide)	Communities and partner organisations	Development of Catchment Action Plans and other river-health-related plans that include extensive community input and review.	A regional community ready to improve river health, working with the relevant community and/or organisation/s.	North Central CMA, DSE, DPI, EPA Victoria, LG, urban and rural water authorities	n/a	n/a
Engage the community to participate in the monitoring of river health.	All Program areas (region-wide)	Landholders, school children	A comprehensive network of landholders and school children supported through the effective delivery of the Waterwatch program.	Landholders and school children who understand water quality issues and the indicators of a healthy waterway.	North Central CMA, urban water authorities	\$260 per year	\$40 per year (sponsored)
Raise awareness of the ecological objectives of the EWR for river and catchment health.	<ul style="list-style-type: none"> Lower Loddon Lower Campaspe 	Communities and partner organisations	An engaged community equipped with knowledge about the EWR and the benefits that can provide to river health.	A lower catchment community with the capacity to understand and provide informed comments regarding the EWR.	North Central CMA, DSE, DPI, urban and rural water authorities	\$5 per year	\$0
Educate the community about the interaction between groundwater and surface water systems.	<ul style="list-style-type: none"> Lower Campaspe Upper Loddon (above Cairn Curran) Loddon (western tribs above Cairn Curran) Mid-Loddon Lower Loddon 	Communities, particularly those within groundwater management areas.	A community which knows about the connection between groundwater and surface water systems and how their actions may affect river health.	A community within groundwater management areas which understands and makes decisions relating to use of groundwater, and its impacts on river health.	DSE, DPI, North Central CMA, rural water authorities	\$10 per year	\$0
Develop river health projects in close consultation with Implementation Committees through the Regional Catchment Investment Process (RCIP).	All Program areas (region-wide)	North Central CMA Implementation Committee members (who have their own community networks)	Receive funding for and complete five-year Management Action Targets identified in the North Central RHS.	Achieve Resource Condition Targets identified in the North Central RHS.	North Central CMA	n/a	n/a



SECTION EIGHT: IMPLEMENTATION

The North Central Regional Catchment Strategy (RCS) (North Central CMA 2003a) and Victorian River Health Strategy (RHS) (2002a) emphasise the importance of fully integrated natural resource management across the region. Integrated catchment management can only occur when all parties are involved in the planning and implementation process. The natural-resource-management capability of the North Central region is considerable, and is made up of individuals, community groups, urban and rural water authorities, local government as well as state agencies. The challenge is to establish and maintain effective relationships between the stakeholders in a way that grows partnerships, information exchange and support (North Central CMA 2003a).

8.1 Integrated Strategic Planning

A Regional Catchment Investment Plan (RCIP) is developed annually to complement the North Central RCS. The purpose of the RCIP is to facilitate coordinated investment targeted at achieving the agreed priorities of the North Central RCS through a suite of integrated natural-resource-management programs, of which river health is a key component (see Figure 2).

8.2 Implementation responsibilities and partnerships

The implementation of the North Central RHS is the primary responsibility of the North Central CMA in partnership with the community, state government agencies, urban and rural water authorities, local government and others. The following Sections 8.2.1 to 8.2.8 outline these key partnerships at the state and regional level. The partnerships with the Australian Government and the Murray-Darling Basin Commission are outlined in Section 3.1.1.

8.2.1 Community

Landholders are vital to successful implementation, as most works are on privately owned land or affect areas that require private co-operation. All landholders have a major stake in maintaining land, water and biodiversity assets and passing them on to the next generation. As such, the North Central CMA expects landholders (and all land managers) to comply with the *Catchment and Land Protection Act 1994* recommendations for pest plant and animal management.

There are approximately 170 Landcare and other community groups working in natural resource management in the North Central region. These groups have a diverse range of interests across the spectrum of natural resource issues and are strongly focussed on onground works. These groups are a key means by which the North Central CMA and its partners can deliver natural resource outcomes in the region. Their engagement and support will continue to be of high importance to the successful implementation of natural-resource-management programs.

Indigenous communities are valued contributors to the development of the North Central RHS and will have a key role in ensuring Indigenous values are recognised. Indigenous communities could further influence river health management (see Section 7.4). Indigenous communities have shown enthusiasm to be involved in river health projects, both on Indigenous-managed lands and public land.



Photo: Angela Gladman

Landholder support is vital to improving river health.

Regional industries have a significant stake in ensuring that natural resource assets are managed in accordance with the principles of Ecologically Sustainable Development (see definition and discussion in Section 3.1.1). Industry has a responsibility to ensure that its environmental impacts are minimised.

8.2.2 Roles and responsibilities in the water sector

As outlined in 'Our Water Our Future' (DSE 2004a), the Victorian Government has committed to delivering an innovative and accountable water sector by:

- improving clarity and allocation of roles and responsibilities



- improving capability and effectiveness
- creating greater integration and coordination
- providing incentives for innovation and improved performance.

The following framework guides the allocation of roles and responsibilities in the water sector.

- The Minister for Water, supported by the Department of Sustainability and Environment, is responsible for:
 - allocating water resources
 - collecting, analysing and publicising information on the status of water resources
 - statewide policy and strategic planning
 - overseeing the performance of the water sector and catchment management authorities (corporate planning, performance monitoring and board appointments).
- The Treasurer, supported by the Department of Treasury and Finance, is responsible for ensuring the financial success and viability of water authorities. With the Minister for Water, the Treasurer is responsible for corporate planning, performance monitoring and board appointments in the metropolitan water sector.
- Regulation is separate from operations and service delivery. This is the role of the Essential Services Commission, the Environment Protection Authority and some other specialised regulators.
- Catchment management authorities, the caretakers of river health, have strategic planning and priority-setting responsibilities for catchments, and deliver waterway, regional drainage and floodplain management services.
- Publicly owned water authorities are responsible for ensuring the delivery of water supply and waste-water disposal services.
- Private sector participation in infrastructure provision is supported in line with the Government's *Partnerships Victoria* principles.

8.2.3 Catchment management authorities

Catchment management authorities (CMAs) were established by the Government in 1997, as community-based organisations responsible for integrated planning and coordination of land and water management in each of the State's catchment-based regions and which, in regional Victoria, would provide integrated river and floodplain management.

The Victorian River Health Strategy (DNRE 2002a) extended their role from waterway and floodplain (including drainage) management to 'caretakers of river health' as the first step in establishing institutional arrangements to deliver integrated river protection and restoration. As outlined in 'Our Water Our Future' (DSE 2004a), CMAs have strategic planning and priority-setting responsibilities for catchments, and deliver waterway, regional drainage and floodplain management services. This is outlined in Action 3.1 of 'Our Water Our Future' (DSE 2004a) which states the Government will improve the health of Victoria's rivers, floodplains and estuaries through 'using regional river health strategies and catchment management authorities to establish regional priorities and integrated programs for river protection and restoration within a statewide policy context'. In addition, the Victorian Government considers that CMAs are best placed to manage the operational delivery of the Environmental Water Reserve in regional Victoria.

CMAs, in taking on this function, will have to ensure that the EWR are managed as part of an integrated river and wetland restoration program. The allocation of this role is consistent with the CMAs' existing roles in regional and catchment planning and coordination, and will benefit from their community consultation linkages.

CMAs will manage any new bulk entitlements for the environment but these entitlements will be formally held by the Minister for the Environment. Current arrangements for the existing environmental bulk entitlement will remain. As CMAs evolve as active managers of the Environmental Water Reserve, the Government may consider it appropriate for them to hold specific bulk entitlements for the environment. Consequently, in amending legislation, an enabling provision will be included to allow this to happen. However, this will not be brought into operation without a clear policy decision by the Minister and a formal process.

The functions associated with managing the Environmental Water Reserve will differ depending on how the Environmental Water Reserve is provided. This is outlined in detail in 'Our Water Our Future' (DSE 2004a).

At the time of Strategy production, Landholder Management Agreements between the North Central CMA and landholders participating in river health incentives are voluntary and have no legal status. However, DSE is investigating the development of legally binding Land Management Agreements under the *Conservation, Forests and Lands Act 1987*.



The North Central CMA also has statutory responsibilities under the *Water Act 1989* and North Central CMA By-law NC00/01. Under the *Water Act 1989*, the North Central CMA aims to reduce the flood damages for new buildings, help conserve and preserve flora, fauna and habitat in designated waterways, reduce water quality decline by appropriate siting of buildings, and providing effluent disposal sites away from the streams.

The functions include providing:

- permits to construct and operate works on a waterway, compliance and community education
- responses to planning permit referrals for developments within a flood prone area
- responses to applications for flood levels, flood risk reports and flood information prior to development
- flood planning information and advice to councils, SES, developers and others
- Flood Response Action Plan, including collection of flood information after a flood event and assistance with emergency planning and flood warning
- flood data management.

8.2.4 Rural water authorities

Goulburn-Murray Water (G-MW), Grampians Wimmera Mallee Water (GMMWater) (formerly Grampians Water and Wimmera Mallee Water) and Lower Murray Water (formerly Lower Murray Water and Sunraysia Water) are the rural water authorities operating in the North Central region. Rural water authorities deliver irrigation water, domestic and stock supplies, and drainage services to rural water entitlement holders. The authorities also supply bulk water to the urban water authorities in the region to supply towns. The rural water authorities operate on a cost-recovery basis and provide the ongoing refurbishment of infrastructure. The system includes an extensive series of water storages, weirs, pump stations, channels and drains to deliver water to customers. Natural waterways are also utilised in the water supply system. More than 40 different rural water services are provided to customers including gravity and pumped irrigation, surface and sub-surface drainage, surface and groundwater diversion, and flood protection. Emphasis is on customer service: licensing and compliance, corporate communications and community consultation to deliver price-efficient and sustainable water services.

Some of the major initiatives outlined in 'Our Water Our Future' (DSE 2004a) for rural water authorities include:

- The Government will develop five regional Sustainable Water Strategies to plan for secure and affordable water supplies, healthy rivers and aquifers across the State.
- Government will extend the current moratorium on the issuing of new water entitlements to all fully allocated river basins and aquifers across the State until legislation puts in place permanent arrangements through the creation of Environmental Water Reserves.
- The Government will allocate 20 per cent of the new lower reliability water entitlement in northern Victoria to the environment. This new environmental entitlement is expected to provide an average of 120,000 megalitres of water which will contribute to restoring flows to the River Murray and also:
 - provide additional water for important wetlands on the River Murray including Barmah and Gunbower wetlands
 - improve river flows, protecting aquatic habitat and improving water quality in the Goulburn, Loddon and Campaspe rivers.

Refer to 'Our Water Our Future' (DSE 2004a) for a full description of water initiatives for rural water authorities.

8.2.5 Urban water authorities

The urban water authorities with a presence in the North Central region are Coliban Water, Central Highlands Water, Lower Murray Water (formerly Lower Murray Water and Sunraysia Water) and Western Water.

Coliban Water is the major urban water authority the North Central region and manages, maintains and operates over 50 reservoirs and water storages. Coliban Water provides water and waste-water services to urban customers and to rural customers connected to the Coliban system of water works. These services encompass water harvesting and storage, urban water supply, waste-water collection, treatment, reuse, disposal, and rural water supply. Coliban Water also provides waste-water disposal services, including trade-waste treatment, to a number of large businesses including milk processors, abattoirs, a variety of food processors, major laundries, saleyards, tanneries, wineries, pet food manufacturers and health services.



Some of the major initiatives outlined in 'Our Water Our Future' (DSE 2004a) for urban water authorities include:

- The Government will require all urban water authorities to prepare Water Supply-Demand Strategies that identify the best mix of demand measures and supply options, including the introduction of permanent water savings measures and associated community education and information programs.
- The Government will require all urban water authorities to plan for new growth areas in the development of their Water Supply-Demand Strategies.
- The Government will require all urban water authorities to work with industry towards improved water management outcomes, including opportunities for water conservation, recycling and waste minimisation.
- Water authorities will implement leakage reduction programs and use cost-effective technology such as water pressure reduction to reduce distribution losses.
- The Government will contribute \$42 million over the next eight years in the new Country Towns Water Supply and Sewerage Program to assist in providing sewerage and water supply solutions to small country towns.
- The statutory planning and building approvals systems will be aligned to support water conservation and enable the use of recycled water and alternative supplies.

Refer to 'Our Water Our Future' (DSE 2004a) for a full description of water initiatives for urban water authorities.

8.2.6 Local government

Local government plays an important role in water management and many councils are leading the drive towards more sustainable water practices. Councils are not only role models and community educators, they also manage drainage and stormwater, regulate planning and building policies and are themselves significant water users (DSE 2004a). Local councils also manage planning permits for native vegetation removal. The North Central region includes 15 different local government areas that work closely with the community, North Central CMA, State government agencies, water authorities and other service providers for better NRM outcomes.

Some of the major initiatives outlined in 'Our Water Our Future' (DSE 2004a) for local government include:

- The Government will set an aspirational target for new development to achieve at least 25 per cent savings in water use.
- The Government will prepare Water Sensitive Urban Development guidelines to assist developers, industry and local government in achieving the target, further developing existing work by Councils, water authorities, developers and others.
- The Government will provide funding to support smart urban water-use initiatives, which encourage innovative approaches to demand management, recycling and stormwater management.
- Local government will be eligible for funding support for water conservation and recycling demonstration projects including use of recycled water on sporting grounds and in parks.
- As part of the Government's support for smart urban water initiatives, it will provide specific funding for projects to manage and harvest urban stormwater.

Refer to 'Our Water Our Future' (DSE 2004a) for a full description of water initiatives for local government.

8.2.7 EPA Victoria

EPA Victoria facilitates the protection of environmental quality objectives in State Environmental Protection Policies (SEPP). It controls discharges to the environment and encourages improved environmental performance through application of statutory tools. These include licensing, enforcement, development and promotion of best practice environmental-management guidelines, technical and scientific support, action partnerships, education and conflict resolution.

EPA Victoria are currently leading a Ecological Risk Assessment focussing on the Loddon River from Bridgewater to the River Murray. This is a collaborative project with the Water Studies Centre (Monash University), North Central CMA and G-MW. The project aims to provide information and tools that will assist the North Central CMA and G-MW to more clearly target onground management actions and monitoring programs for rehabilitation of the lower Loddon catchment.

The major initiatives outlined in 'Our Water Our Future' (DSE 2004a) for EPA Victoria include:

- EPA Victoria, in partnership with the Department of Human Services, will review the public health and environmental framework supporting alternative urban water supplies, including recycled water, grey water, stormwater and rain water.



- EPA Victoria will work in partnership with the Department of Human Services to build from the existing *Guideline for Environmental Management: Use of Reclaimed Water* (EPA, 2003) and establish a broad suite of guidance for alternative water supplies.

8.2.8 Other key regional partnerships

The North Central CMA is the key coordinating agency for natural resource planning and management in the North Central region, and one of ten such authorities in Victoria. As well as the partnerships with other organisations in the water sector, the North Central CMA performs its role in partnership with the community, State government agencies and other service providers on behalf of the Victorian Government.

While the North Central CMA and private landholders have the lead role in the protection and enhancement riparian areas for the benefit of river health on private land, riparian management on public land involves the cooperation and support of various government organisations. DSE and DPI are involved in vegetation management on public land and are in partnership with landholders on private land (e.g. within Salinity Target Areas). This includes ensuring compliance and enforcement of the *Catchment and Land Protection Act 1994*, *Flora and Fauna Guarantee Act 1988* and Crown land licensing.

Coordinated by the North Central CMA, DPI works with community groups and landholders to implement the North Central region's Rabbit Action Plan to reduce the impact of rabbits in priority areas and the Weed Action Plan to reduce the impact of priority weeds. DPI is also involved in reducing the economic and environmental impact of foxes in priority areas, and reducing the impact of priority weeds and pest animals on the boundary of public and private land, as well as roadsides.

The North Central CMA, DSE, DPI and EPA Victoria are the agencies responsible for the management of aquatic habitat and species. This includes the response to fish kills as outlined in the Interim Fish Protocols (EPA Victoria 2004) that outlines agency responsibilities in the event of a fish kill in the region's waterways. Other key stakeholders include the Field and Game Association, Victorian Recreational Fishing Peak Body (VRFish), Inland Fishery Committee, Fisheries Co-Management Council and regional angling associations.

The North Central CMA is responsible for coordinating water quality in the North Central region. This involves working with a wide range of stakeholders including DPI, DSE, EPA Victoria, local government, and rural and urban water authorities.

Wetland management in the irrigation area aims to generate multiple benefits based on strong local input, sound technical support and strategically scheduled works and services. Despite their recognised environmental, social and economic values, many wetlands are highly modified as a consequence of earlier management decisions and conjunctive use. They also suffer from unclear management objectives and poorly defined stakeholder roles and responsibilities. Working partnerships between the North Central CMA, DSE, DPI, Parks Victoria and landholders continue to improve our understanding of wetland processes in a saline environment and to establish priorities for developing management plans for key wetlands.

The North Central CMA integrates wetland objectives and outcomes into regional strategies, plans and investment plans in accordance with the North Central Wetlands Strategic Directions Paper (draft) (North Central CMA 2004d) and the Regional Wetland Strategy (in development). DSE provides the strategic coordination of wetlands policy for Victoria, undertakes projects on wetlands of state significance, and provides policy advice on wetlands and freshwater biodiversity. It also provides the strategic coordination of water allocation, water quality and salinity programs for riverine wetlands. DPI provides wetland advice and expertise. Parks Victoria manages all wildlife reserves within the catchment.

Catchment and Agriculture Services (CAS) is the service delivery arm of the division of Regional Services and Agriculture, which is a division of the DPI. CAS delivers services to private landowners. CAS is responsible for delivering cost-effective advisory and regulatory services in sustainable land and water management, management of pest animals and pest plants, agricultural industry development and biosecurity, and emergency management. It also includes a prosecutions unit which operates across several government agencies. Services are delivered statewide through well-defined projects which include evaluation, community engagement and communications plans. CAS works closely with PIRVic (the DPIs Research and Development division) in multidisciplinary project teams, and where appropriate, will deliver project outcomes.



Control of salinity in the Murray-Darling Basin depends on joint State action. Salinity management requires a total-catchment approach - rarely can one land manager solve a salinity problem.

The North Central Dryland Targeted Salinity Program demonstrates that farmer-Government partnerships are the key to achieving broadscale sustainable farming systems. The program is funded by the National Action Plan for Salinity and Water Quality, a joint Commonwealth and State Government initiative, through the North Central CMA. It involves a close working partnership between DPI, North Central CMA, local government and research bodies (e.g. PIRVic). The North Central Dryland Management Plan (SKM 2002) is currently under review.

The Draft Loddon-Murray Land and Water Management Strategy (LMLWMS) (Loddon-Murray Forum 2002) provides the strategic direction for land, water and biodiversity management in the Loddon-Murray irrigation region. The implementation of the Strategy is led by the Loddon-Campaspe Irrigation Implementation Committee. It has identified the regional asset values and challenges from an environmental, social and economic viewpoint. It is focussed on achieving outcomes in land and water management, biodiversity enhancement, social capacity and planning and development and includes the Kerang-Swan Hill Future Land Use Priority Project. The development of the Loddon Campaspe Land and Water Management Plan will encompass a wider geographical area and new and emerging issues.

The North Central CMA prioritises and funds works that deliver the direction provided in the North Central RCS. These projects are delivered by a range of departments, agencies and community groups across the region, primarily through incentives programs. The *ad hoc* delivery of onground works in the region has created 13 different incentive programs, causing much confusion for landholders.

A 'Partnerships in Natural Resource Management' project is underway. It aims to achieve better outcomes from current partnerships and build upon initiatives already being promoted by agencies. The project is led by a steering committee and driven by project working groups, which comprise of agency representatives from across the region.

8.3 Cost-sharing principles

While the North Central RHS recommends that resources be directed to the areas of highest priority, it is clear that the task is a major one requiring significant resources and long-term commitment by the government, partner organisations, industry community groups and individuals. It is important that long-term funding reflects the general cost-sharing principles for natural resource management as set out in the Victorian RHS (DNRE 2002a) and truly represent, in a fair and equitable way, the groups and beneficiaries most affected by river health.

Beneficiaries that need to be considered include:

- water authorities, given their dependence on a healthy resource base and their potential impacts on healthy rivers
- direct beneficiaries (e.g. recreational groups)
- local government representing regional economic benefits (e.g. increased tourism)
- industry
- the broader Victorian community
- individuals.

The following cost-sharing principles will be applied to the development and implementation of river protection and enhancement programs.

8.3.1 Duty of care

All natural resource users and managers have a duty of care to ensure that they do not damage the natural resource base. They are responsible for making good any damage incurred as a result of their actions.

8.3.2 Beneficiary pays

When it is not possible to attribute damage, then primary beneficiaries should pay. Users, both existing and future, are expected to pay for activities which provide private benefits. Contributions from secondary beneficiaries will, where appropriate, be negotiated with the primary beneficiaries.



8.3.3 Government contributions for public benefit

Government contributes primarily, for activities which produce public benefits. Government may agree to contribute to land and water management activities that provide private benefits, where the cumulative uptake of these activities provides significant public benefit and government support needed.

8.3.4 Positive benefit-cost

Before Government will contribute to any land or water management activity, the activity must be technically sound, the benefits must justify the costs and it must be considered a priority activity.

8.3.5 Statewide policy and monitoring

Government will contribute to the cost of statewide planning, statewide resource monitoring and assessment, and research and investigations where they are crucial to sustainable land and water management.

Regional and landholder contributions for actions which are part of the implementation of this Strategy or the component strategies and plans will be negotiated during the planning process using these cost-sharing principles as a basis.

8.4 Investment requirements

This section summarises the detailed costs for priority reaches within Program Areas in the North Central region. The cost of implementing the Strategy over the following five years is indicative and will be reviewed at the time of implementation.

It is anticipated that the implementation of the five-year Strategy will total approximately \$28,400,000, at an approximate cost of \$5,700,000 per year. This figure has been calculated using the costs to address the critical and high priority actions in each of the Program Areas that contain priority reaches, detailed in Section 6 of this document. The cost of implementing only critical priority actions requires approximately \$26,400,000. The contribution from landholders totals approximately \$4,000,000 over five years.

Table 54 summarises North Central CMA costs for onground works (including management costs) at the Program Area scale. The detailed costs for priority reaches are in Section 6 and costs have been set for the next five years for priority reaches. Note that costs from the Nutrient Management Strategies have been included but costs from other plans and strategies have not been repeated (to avoid potential duplicate costs with other programs). All costs are indicative and are dependant on a number of factors, as identified in the target- and cost-setting assumptions (Appendix 9) and unit-cost assumptions (Appendix 10).

In addition to onground works, the total cost of implementing the Strategy also includes strategic planning, community engagement, monitoring, evaluation and reporting, and research and development. Table 69 outlines the indicative total cost of these aspects. Implementation of the Strategy will rely on continuing learning, data collection and investigations into the health of the region's rivers and the strong support of the community and land managers. Monitoring and evaluation programs are required to enable a true adaptive management approach.

The Catchment Management Authorities, who are the statutory waterway managers and caretakers of river health, are responsible for implementing the bulk of the river health activities. River health related activities undertaken by other agencies such as water authorities, DPI, local government and DSE and associated costs have been identified and documented wherever possible. It is important to recognise that implementation of other action plans and sub-strategies under the Regional Catchment Strategies contribute to river health outcomes, and are not directly costed or implemented under this strategy.

It is important to note that the estimated funding requirements and proposed cost shares are indicative. Catchment Management Authorities coordinate and implement river health related activities on behalf of Government, in accordance with Government policies. Government's investment in this region's strategy is contingent on Government budgets and priorities. The timelines for implementing a strategy's targets may need to be amended in line with the funding provided.

Table 68 Indicative costs for implementation of river health onground works and preliminary assessments over the next five years in priority reaches

Resource condition	Key threat	North Central region \$	Upper Campaspe \$	Coliban \$	Lower Campaspe \$	Upper Loddon \$	Loddon (western tribs) \$	Lower Loddon \$	Mid-Loddon \$	Gunbower \$	Upper Avoca \$	Lower Avoca \$	Avon-Richardson \$	TOTAL \$
Environmental Water Reserve	Flow deviation	The development and implementation of the EWR will occur in line with policy established in Our Water Our Future, 2004. The costs associated with the delivery of Environmental Water Reserves will be determined by a range of stakeholders.												
Riparian zone	Degraded riparian vegetation		\$209,000	\$436,000	\$620,000	\$495,000	\$626,000	\$2,008,000	\$1,588,000	\$668,000	\$745,000	\$550,000	\$1,037,000	\$8,915,000
	Exotic flora		\$300,000	\$30,000	\$173,000	\$280,000	\$216,000	\$315,000	\$188,000	\$370,000		\$370,000	\$155,000	\$2,322,000
Instream habitat	Bed/bank erosion*			\$20,000			\$20,000	\$40,000	\$84,000	\$20,000	\$40,000	\$20,000		\$224,000
	Instream barriers*			\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000			\$60,000
	Loss of instream habitat*					\$11,000		\$33,000		\$11,000	\$33,000		\$33,000	\$121,000
Water quality	Poor water quality^	\$7,500,000												\$7,500,000
TOTAL		\$7,500,000	\$509,000	\$501,000	\$808,000	\$801,000	\$877,000	\$2,411,000	\$1,875,000	\$1,084,000	\$833,000	\$940,000	\$1,225,000	\$20,023,000

Note: * indicates the cost of preliminary assessments and investigations

^ This figure is the approximate summation of the total five-year cost of implementing the four Nutrient Management Strategies. This cost will be reviewed through the development of the Catchment Water Quality Action Plans.

Table 69 Indicative costs for region-wide actions

Region-wide actions	Cost \$
Regional Frontage Management Plan	\$100,000
Regional Fisheries Management Plan	\$100,000
Nine Catchment Action Plans	\$450,000
Installation of four fishways	\$1,000,000
Erosion control (pending assessments)	\$1,000,000
Instream habitat enhancement	\$500,000
Community engagement	\$2,845,000
Monitoring, evaluation and reporting	\$1,000,000
Research and development	\$1,400,000
TOTAL	\$8,395,000

The costs associated with the delivery of Environmental Water Reserves will be determined by a range of stakeholders and will include:

- monitoring of ecological responses
- development of Environmental Operating Strategies
- investigations into options for improving environmental flows
- managing physical constants to delivering environmental flows
- costs associated with headwaters and delivery of the Environmental Water Reserve.

It is important to note that these costs are indicative and will be refined through the development of the Catchment Action Plans. The following table outlines the region-wide actions to be undertaken in addition to and based on the preliminary assessments costed in the above table.

The total indicative cost to implement the Strategy is approximately \$28,400,000 (sum of Table 69 and Table 70 totals). Although the contribution of other agencies to meet the river health targets is acknowledged, these costs are not detailed in the Strategy but will be considered in future revisions.



SECTION NINE: MONITORING AND EVALUATION

9.1 River Health Strategy review

The North Central River Health Strategy (RHS) and the Communication Plan for community engagement will be reviewed and updated every five years, based on changes in resource condition and the level of inputs and outputs over that time. Changes in the nature of community attitudes will be taken into account in refining recommendations for key river health objectives.

This review will both reflect on achievements made and whether progress is adequate, and consider new science or information.

DSE will lead an evaluation of the RiVERS decision support tool. This will include a review of the risk-assessment approach and will consider a review of the current asset and threat database.

9.2 Monitoring and evaluation

An effective monitoring program is essential to ensure that the actions outlined in the North Central RHS achieve the five- and ten-year targets for priority reaches that contribute to the long-term Aspirational Targets for each catchment.

The precise design of the monitoring program is beyond the scope of this Strategy. A number of actions need to be refined before a detailed monitoring program can be designed. Therefore, a flexible monitoring program will be implemented as an integral part of onground works planning.

9.2.1 Ongoing activities

The monitoring and evaluation component for onground activities outlined in the North Central RHS will largely draw from the *Monitoring Framework for Waterways Ongoing Works* (North Central CMA 2003g). The purpose of the framework is to:

- develop a monitoring program framework for waterways activities (adapted from Rutherford *et al.* 2000)
- provide a core group of monitoring tools for the range of projects undertaken along waterways
- provide a secondary (add-on) group of monitoring tools for complex/enhanced projects.

These activities have the common purpose of improving stream health through mitigating, altering and/or restoring any one of a number of stream processes. An individual project may implement several of the aforementioned activities at a site to try to improve river health.

Management Action Targets of the North Central RHS reflect the activities required in the short term to reach the Resource Condition Targets is outlined in Section 6. Management Action Targets relate to the effective implementation of actions including onground works that focus on the critical threats in 'at risk' reaches. They generally have one - five year timeframes so that progress can be reported in the short term, despite changes in natural resource condition occurring over longer periods.

9.2.2 Reporting

The reporting of project outputs is required to assess performance in terms of target achievements. The North Central CMA is required to report project details, budgets/expenditure and outputs to relevant Implementation Committees on a quarterly basis. These reports are then presented to the North Central CMA Board. Reporting is also a requirement of agreements entered into with federal and state funding sources.

9.2.3 Adaptive management

Monitoring and evaluation of both onground projects and the implementation of the overall North Central RHS allow for the refinement of targets and objectives through the feedback of outcome information (Figure 23). This may include increased/updated knowledge of stream restoration techniques and stream condition. In this light, current natural-resource management directions emphasise the importance of monitoring and evaluation as a process that forms the basis of, and directs, adaptive management (i.e. learning by doing). As such, it may be used to revise goals, objective and targets, and add to existing knowledge.

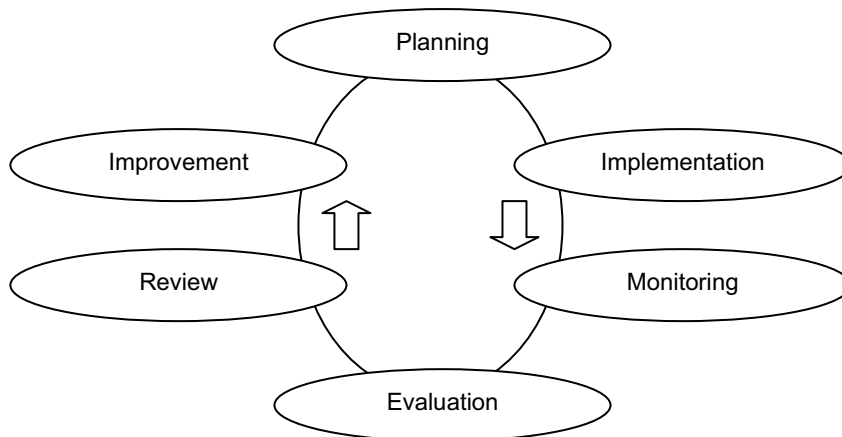


Figure 23 Adaptive management cycle

9.3 Monitoring framework development

The monitoring program framework for onground projects developed by the North Central CMA is based on the outline for evaluation of projects included in the Evaluation Tools section of *A Rehabilitation Manual for Australian Streams* (Rutherford *et al.* 2000). This outline provides a sequential series of steps that should be followed to develop an appropriate and informative monitoring and evaluation program.

The steps include:

- What are the objectives of the project?
- What style of evaluation do you need?
- How confident do you need to be?
- What level of evaluation do you need (for outcome styles of evaluation only)?
- What should you measure?
- How frequently should you measure?
- How long do you need to monitor?
- Who is responsible for the evaluation?
- What recording technique will you use?
- Project monitoring design.

9.3.1 Monitoring and evaluation tools

Monitoring tools for use by the North Central CMA need to be accessible, easy to use, and be time- and cost-efficient. Therefore, monitoring tools should also include key indicators. These indicators (outlined in the target tables in Section 6) are a means of assessing completion and survival outputs, as well as basic physical, chemical and ecological outcomes.

The North Central CMA has a range of monitoring tools that have been, are, or could potentially be, used to determine the outputs and outcomes of projects. Each of these monitoring tools are accompanied by application protocols in the monitoring framework (North Central CMA 2003g). These tools include:

General:

- documentation of works – timelines and implementation
- GPS/GIS mapping of works
- photo points
- repeat site visits (survival)
- aerial photography
- water quality parameter measurement
- Waterwatch.



Instream habitat enhancement actions:

- instream fauna survey
- habitat assessment.

Riparian vegetation and enhancement actions:

- monitoring of revegetation projects (survival)
- monitoring of direct-seeding projects (survival)
- terrestrial fauna survey.

Structural/engineering actions:

- cross-section profiles (bank migration/bed form or shape/sediment capture)
- long profiles (gradient change/head position change/sediment capture).

Water quality improvement actions:

- water quality monitoring
- measurements of indicators against SEPP (WoV).

9.3.2 Identified monitoring tool gaps

The *Monitoring Framework for Waterways Onground Works* (North Central CMA 2003g) identified a number of 'gaps' in our monitoring tools, which require attention. These include:

- GPS feature marking protocol
- GIS mapping protocol
- repeat visit protocol
- method to assess success of direct seeding
- method to assess natural regeneration
- cross-section and long-profile protocol
- instream and terrestrial fauna survey methods
- chemical analysis of water quality (developed on a per project basis)
- method for biological assessment (developed on a per project basis), e.g. the Rapid Bioassessment tool using SEPP (WoV).

9.3.3 Monitoring and evaluation limitations

Effective monitoring and evaluation of waterway projects are potentially confounded by a number of limitations. In part, these explain the general lack of monitoring programs aimed at evaluating the outputs of waterway rehabilitation projects. These include:

- Natural variability – reduces certainty due to an inability to establish trends in the resource
- Budget restraints – monitoring-cost typically exceeds project-cost for detailed monitoring programs
- Resource restraints – lack of time/experience to carry out the required monitoring
- Baseline information – typically lacking or sparse, resulting in an uncertain initial condition of the resource against which to compare.

To allow effective evaluation, output targets should be:

Specific – include sufficient detail to document explicitly what the target is addressing.

Measurable – quantifiable, describing the range between what you would consider to be a great success and a disappointing result.

Achievable – socially, biophysically and economically achievable.

Relevant – relevant to the specific output.

Time bound – include year by which target is to be achieved.

9.4 Research and development

The Victorian Government's 'Our Water Our Future' (DSE 2004a) highlighted that knowledge is a crucial resource in the management of water, for assisting agencies to regularly adopt more efficient, effective and environmentally sensitive processes.



Investing in research and capability building is the responsibility of all players in the water sector: urban water authorities, rural water authorities, CMAs and the Government. Water authorities and CMAs need to invest in research, innovation and capability building in areas where it affects the success and future directions of their businesses. The Government's task is to support broader specific research that may detail sustainable water management options.

The North Central CMA is currently developing a Research and Development Strategy to direct the focus and priorities of research agencies, rather than being a passive recipient of research findings. The North Central CMA is also creating protocols which will facilitate improved application of future research and development across all assets of the North Central RCS (North Central CMA 2003a).

A parallel process is the development of a *Monitoring, Evaluating, Reporting and Learning Plan for the implementation of the North Central RCS*. This information will feed into the Research and Development Strategy. A workshop will be conducted in 2005 with key implementation agencies for the waterways and wetlands, and water resources asset classes of the North Central RCS. The outcomes of this workshop will include:

- a list of existing monitoring for each MAT and RCT (i.e. responsible agency for monitoring, spatial extent, timing, frequency, status, data custodian, storage, access, accuracy, reporting audience, frequency and mechanism)
- identification of information users, managers, analysts and collectors
- identification of core indicators for RCTs and outputs for MATs
- new data required to populate core indicators/outputs identified through a gap analysis
- consideration of design, sampling, frequency, analysis and ethics of proposed monitoring.

In order to meet the regional goals and targets of the North Central RHS, the North Central CMA is committed to fostering opportunities for collaborative projects that build partnerships with a wide range of regional stakeholders. This includes strengthening the linkages of river-health-management projects with state and national research agendas and communicating the relevance of projects to key, natural-resource-management stakeholders across the region.

One such example is a Murray-Darling Basin Commission project, designed to evaluate the effectiveness of riparian restoration in improving stream health. Currently, this project is being run by a research team from Monash University and the University of Melbourne and is supported by the North Central CMA. The project sets up a controlled experiment to test the assumption that the condition of riparian vegetation plays a large role in determining the overall health of our streams. This will allow a better understanding of how the large investment in fencing and revegetation is improving stream health.

9.4.1 Information gaps

The North Central RHS has identified information gaps. Additional information gaps are expected to be identified through the *Monitoring, Evaluating, Reporting and Learning Plan*. Several assumptions have been made as part of the target-setting process (see Appendix 2).

Some of the key information gaps currently identified include:

- an inventory of wetlands, including their management and condition
- an inventory of exotic willow distribution, including prioritisation for control
- the significance of saline groundwater intrusions on stream salinities
- the status of existing fish stocking programs
- current grazing regimes of Crown land frontages
- an understanding of the key drivers behind landholder/stakeholder participation and their understanding of natural resource management
- an understanding of the full suite of water quality parameters and their impacts on river health, e.g. pH, water temperature, toxic substances
- a better understanding between the current conditions of invertebrate populations and the identification of actions to improve condition for appropriate targets to be set, i.e. the use of ecological risk-assessments
- the long-term impacts or changes of current river-health-management actions
- the development of a comprehensive water quality monitoring network in line with the Victorian Government 'Our Water Our Future' initiatives regarding monitoring water resources, e.g. surface water, groundwater and status of fish communities



- an understanding of the economic benefits of environmental assets, and incorporation of cost-benefit analysis in future priority-setting processes
- an understanding of the risk of climate change on river health (in line with the Victorian Government 'Our Water Our Future' initiatives regarding climate change research)
- a regional study of geomorphological processes.

Many of these information gaps are being addressed by the North Central CMA and partner organisations.

As outlined in 'Our Water Our Future' (DSE 2004a), the Government has committed to working with water authorities and CMAs to develop a long-term research, innovation and capability program for the water and catchment industry. It will enter into partnerships with leading knowledge providers to pursue areas of priority research as well as invest in education, capability building and fundamental knowledge-generation by funding postgraduate scholarships in water resource management.



References

- CMPS&F Environmental 1994, Campaspe River Health Management Study: Final Report Volume 1, Campaspe River Health Management Group.
- Department of Natural Resources and Environment (DNRE) 1997, Scientific Panel Environmental Flow Assessment of the Coliban River below Malmsbury and the Campaspe River below Redesdale, DNRE, Melbourne.
- Department of Natural Resources and Environment (DNRE) 2000, Rabbit Management Action Plan 2000 – 2005 North Central Region, East Melbourne, Victoria.
- Department of Natural Resources and Environment (DNRE) 2001, Status of Cold Water Releases from Victorian Dams, Heidelberg, Victoria.
- Department of Natural Resources and Environment (DNRE) 2001a, North Central Region Weed Action Plan 2001 – 2005, East Melbourne, Victoria.
- Department of Natural Resources and Environment (DNRE) 2002a, Healthy Rivers, Healthy Communities & Regional Growth – Victorian River Health Strategy (RHS), East Melbourne, Victoria.
- Department of Natural Resources and Environment (DNRE) 2002b, Bendigo Region Fisheries Management Plan, East Melbourne, Victoria.
- Department of Sustainability and Environment (DSE) 2000, Threatened Vertebrate Fauna of Victoria.
- Department of Sustainability and Environment (Catchment and Water Services) (DSE) 2003a, Guidelines for Preparation of a Regional River Health Strategy, East Melbourne, Victoria.
- Department of Sustainability and Environment (DSE) 2003b, Gunbower Forest Ramsar Site Strategic Management Plan, East Melbourne, Victoria.
- Department of Sustainability and Environment (DSE) 2003c, Advisory List of Rare or Threatened Plants In Victoria.
- Department of Sustainability and Environment (DSE) 2003d, Threatened Vertebrate Fauna in Victoria.
- Department of Sustainability and Environment (DSE) 2004a, Victorian Government White Paper 'Securing our Water Future Together'. East Melbourne, Victoria.
- Department of Sustainability and Environment (DSE) 2004b, Kerang Wetlands Ramsar Site Strategic Management Plan, East Melbourne, Victoria.
- Department of Sustainability and Environment (DSE) website (accessed 13/07/04) at <http://www.dse.vic.gov.au/dse/nrenpa.nsf/FID/-2947421F94BC2D724A25684A0004FC7B0OpenDocument>
- Egis Consulting Australia 2000, North Central Regional Floodplain Management Strategy.
- Environment Australia 2001, A Directory of Important Wetlands in Australia, Third Edition. Canberra, Australia.
- EPA Victoria (2004) Interim Fish Protocols, EPA Victoria.
- Heron Environmental Consulting & As One Consulting 2004, River Values and Environmental Risk System (RIVERS) - A Priority-Setting Tool for Victorian Waterways - Background & Basic User Guide.
- Hobbs, R. and Kristjanson, L. 2003, Triage: How Do We Prioritize Health Care for Landscapes? Ecological Management and Restoration, Volume 4 supplement, February 2003.
- ID & A 1998, Avoca Catchment River Health Strategy, Wangaratta, Victoria.
- Loddon-Murray Forum 2002, Loddon-Murray Land and Water Management Strategy.
- Loddon River Environmental Flows Scientific Panel (LREFSP) 2002a, Environmental Flow Determination of the Loddon River Catchment: Final Report. Unpublished Report to the North Central Catchment Management Authority and Department of Natural Resources and Environment.
- Loddon River Environmental Flows Scientific Panel (LREFSP) 2002b, Environmental Flow Determination of the Loddon River Catchment: Issues Paper. Unpublished Report to the North Central Catchment Management Authority and Department of Natural Resources and Environment.
- McGuckin, J. and Doeg, T. 2000, Investigation of Aquatic Ecosystems of the Loddon Catchment. Prepared for the North Central CMA as part of the Loddon River Health Plan.
- McGuckin, J. and Doeg, T. 2001, Investigation of Aquatic Ecosystems of the Campaspe Catchment. Prepared for the North Central CMA as part of the Campaspe River Health Plan.
- Murray-Darling Basin Commission (MDBC) 2001, National Land and Water Resources Audit, Murray-Darling Basin Commission, Canberra.
- Murray-Darling Basin Commission (MDBC) 2003, Native Fish Strategy for the Murray-Darling Basin 2003-2013, Murray-Darling Basin Commission, Canberra.
- Natural Resource Management Ministerial Council 2002, National Framework for Natural Resource Management Standards and Targets, Canberra.



- North Central Catchment Management Authority (North Central CMA) 2000a, Avoca Whole-of-Catchment Plan 2000/2002, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2000b, Campaspe Whole-of-Catchment Plan 2000/2002, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2000c, Loddon Whole-of-Catchment Plan 1999/2004, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2000d, Avon-Richardson Whole-of-Catchment Plan 2000/2002, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2001a, Marmal Floodplain Strategy, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2001b, Campaspe Catchment Riparian Vegetation Investigation, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2002a, Redundant Weir Review, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2002b, Avon-Richardson Nutrient Management Strategy, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2002c, Bendigo Creek Catchment Waterway Action Plan.
- North Central Catchment Management Authority (North Central CMA) 2003a, North Central Regional Catchment Management Strategy 2003–2007, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003b, North Central Native Vegetation Plan (draft), North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003c, Draft Campaspe River Health Plan, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003d, Draft Loddon River Health Plan, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003e, Draft Avoca River Health Plan, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003f, Draft Avon-Richardson River Health Plan, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003g, Monitoring Framework for Waterways Onground Works, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003h, Loddon Nutrient Management Strategy, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003i, Avoca Nutrient Management Strategy, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003j, Avon-Richardson Catchment Riparian Vegetation Investigation, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2003k, Avoca Catchment Riparian Vegetation Investigation, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) (draft) 2004a, Wetlands Strategic Directions Paper.
- North Central Catchment Management Authority (North Central CMA) 2004b, North Central Waterways – Values, Threats and Risks, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2004c, North Central River Health Strategy (RHS) – Communication Strategy, North Central CMA, Huntly.
- North Central Catchment Management Authority (North Central CMA) 2004d, Campaspe Nutrient Management Strategy (in development), North Central CMA, Huntly.
- Pipe It – Saving Water for Western Victoria (accessed 30/6/2004) at <http://www.pipeit.com.au/>
- Riparian Australia 2000. Loddon Catchment Riparian Vegetation Investigation, Bundoora, Victoria.
- Rutherford *et al.* 2000, A Rehabilitation Manual for Australian Streams.
- SAMLIV Project Team 2003, Strategy for Aboriginal-Managed Lands in Victoria, SAMLIV Steering Committee, Melbourne.
- Sinclair Knight Merz 1999a, Environmental Action Plan for Tang Tang Swamp, Armadale, Victoria.



- Sinclair Knight Merz 1999b, Management Options to Improve the Ecological Health of Kow Swamp
- Sinclair Knight Merz (SKM) 2002a, Stressed Rivers Project - Environmental Flow Study, Avoca River System, Armadale, Victoria.
- Sinclair Knight Merz 2002b, Second Generation Dryland Salinity Management Plan for the North Central Region, Armadale, Victoria.
- Singleton Bahen Stansfield 2001, Bendigo Creek, Bagshot Flood Study.
- The Living Murray (accessed 30/06/04) at <http://www.thelivingmurray.mdbc.gov.au/content/index.phtml/itemId/3288>
- Victorian Waterway Managers Forum (September 2003), River Values and Environmental Risk System (RiVERS), North Central CMA version, North Central CMA, Huntly.
- VRFish 2004, Access for Recreational Fishing - Policy Paper.



Appendix 1 Glossary

Anabranch – a secondary channel or river that leaves the main channel and re-joins it further downstream.

Barriers – artificial instream structures, such as dams, weirs, causeways and culverts that restrict the migration and movement of fish or other biota, and can interrupt transport of organic matter and sediment.

Bulk Entitlement – the property right to water held by water and other authorities defined in the *Water Act 1989*. The BE defines the amount of water that an authority is entitled to from a river or storage, and may include the rate at which it may be taken and the reliability of the entitlement.

Catchment – the region which drains all the rainfall, other than that which is removed by evaporation, into a stream which then carries the water to the sea or a lake.

Catchment Management Authorities (CMAs) - Catchment management authorities are the caretakers of river health, responsible for regional and catchment planning and coordination, as well as waterway, floodplain, salinity and water quality management.

COAG – The Council of Australian Governments is the peak inter-governmental forum in Australia, comprising the Prime Minister, State Premiers, Territory Chief Ministers and the President of the Australian Local Government Association (ALGA).

Ecologically Sustainable Development – using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be enhanced.

Effluent stream – a creek that leaves a watercourse and does not return to it (the opposite of tributary).

Environmental flow – The streamflow required downstream of a water storage 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.

Exotics – species that are non-indigenous or outside their natural range.

Fish passage – provision for the movement or migration of fish past barriers.

Fishway – a structure that facilitates fish passage.

Flagship species – a well-known species the community are enthused to protect, e.g. murray cod, platypus.

Floodplain – relatively flat land beside a river that is inundated when the river overflows its banks during a flood.

Flow regime – the pattern of flow in a river which can be described in terms of the quantity and variability of water flows.

Groundwater – All sub-surface water, generally occupying the pores and crevices of rock and soil.

Hydrology – The science dealing with surface and groundwaters of the earth; their occurrence, circulation and distribution; their chemical and physical properties; and their reaction with the environment.

Large woody debris – large branches (> 10cm diameter) within the stream channel.

Invertebrates – animals without backbones, including zooplankton, shellfish, worms, shrimps and snails, that can be seen with the naked eye.

Management unit – an area defined at the sub-catchment planning level based upon physical feature similarities and stream management issues.

Nutrients – substances, such as phosphorous and nitrogen, that are necessary for plants (including algae) to grow.

Potable – suitable for drinking.

Program area – an area defined at the broader regional planning level based on geography, water regulation, river classes, size and relationship to key supporting strategies.

Protection – ensuring that there is no further decline in the environmental condition of a river.

Reach – a section of stream typically 10km–30km long which is relatively homogeneous with regard to its physical, biological and chemical features.



Regulated systems – those where the flow of the river is regulated through the operation of large dams or weirs.

Restoration – improvement or enhancement of the environmental condition of the river toward 'ecologically healthy'.

Reticulation – The network of pipelines used to take water into areas of consumption. Includes residential districts and individual households.

Riparian zone – the area along the bank of a river or a stream that often has water-dependent vegetation.

River basin – the land into which a river and its tributaries drain.

Salinity – the total amount of water-soluble salts present in the soil or stream.

Stormwater – untreated rainfall run-off from urban areas.

Terminal lake – receives inflows from streams or rivers draining its catchment, but has no streams draining from it. It is the endpoint of a river system.

Threat – an action or process likely to cause cause harm, i.e. degrade a value.

Tributary – a river or creek that flows into a larger river or creek.

Triple-bottom-line (TBL) – Integrated approach to the achievement of environmental, social and economic outcomes.

Unregulated system – a system where no major dams or weir structures have been built to supply or extract water.

Value – something considered to be important or beneficial.

Water authorities – authorities charged with supplying water to towns and cities, for urban, industrial and commercial use. They administer the diversion of water from waterways and the extraction of groundwater.

Waterway – *The Water Act 1989* defines a waterway as: a river, creek, stream, watercourse and a natural channel where water regularly flows, whether or not the flow is continuous.

Wetlands – inland, standing, shallow bodies of water, which may be permanent or temporary, fresh or saline.



Appendix 2 Regional plans, strategies and investigations

Fisheries management plans

Bendigo Region Fisheries Management Plan (DNRE 2002b) – nine specific objectives were identified with associated performance measures and targets to achieve the best possible match between fisheries management arrangements and the recreational fisher's aspirations for fisheries in the Campaspe River and upper Loddon River catchments.

Investigation of Aquatic Ecosystems of the Loddon Catchment (McGuckin and Doeg 2000) – priority areas and actions to preserve and restore aquatic ecosystems were identified, based on literature reviews of fish and invertebrate communities throughout the Loddon catchment.

Investigation of Aquatic Ecosystems of the Campaspe Catchment (McGuckin and Doeg 2001) – priority areas and actions to preserve and restore aquatic ecosystems were identified throughout the Campaspe catchment, based on written reviews of fish and invertebrate communities, wildlife, water quality and stream health records.

North Central CMA Redundant Weir Review (North Central CMA 2002a) – an inventory and priority listing of potentially redundant structures within the North Central region that restrict the movement of migratory fish.

Other relevant plans include:

- Native Fish Strategy for the Murray-Darling Basin 2003-2013 (MDBC 2003)
- VRFish Access for Recreational Fishing Policy 2004
- VRFish Inland Fishery Policy
- VRFish Boat Launching Facilities Review Document
- Recreational Fishing Code of Conduct.

Flow plans

Scientific Panel Environmental Flow Assessment of the Coliban River below Malmsbury and the Campaspe River below Redesdale (DNRE 1997) – the environmental values and threats affecting the Campaspe River Basin were identified, and preferred environmental flows recommended.

Environmental Flow Determination of the Loddon River Catchment: Issues Paper (LREFSP 2002a) – this paper details the available information of ecology and hydrology of the Loddon River study area that is required to formulate environmental flow recommendations. This paper provides a set of environmental flow objectives for key environmental assets to guide the development of recommendations.

Environmental Flow Determination of the Loddon River Catchment (LREFSP 2002b) – this report details the final deliberations of the Loddon River Environmental Flows Scientific Panel and presents environmental flow recommendations for reaches of the Loddon River. The recommendations are to be used in the development of Bulk Water Entitlement conversions in the Loddon River.

Stressed Rivers Project – Environmental Flow Study. Avoca River System (SKM 2002a) – this report examines the environmental water requirements of the surface water systems of the Avoca River catchment. It provides a scientific basis for the recommendation of environmental water requirements. These recommendations are based on the FLOWS method and the development of an Issues Paper.

Nutrient management strategies

Draft Loddon Nutrient Management Strategy (North Central CMA 2003g) – a framework of six action plans to reduce nutrient exports to Loddon waterways and the River Murray, and to reduce the incidence of algal blooms over 30 years. Implementation of the Strategy will achieve a reduction in the average annual phosphorous and nitrogen loads to Loddon waterways by approximately 50% and 40%, compared to a 'without strategy' scenario. This Strategy updates the Draft Loddon Catchment Water Quality Strategy (1996). The strategy is supported by the Loddon Catchment Nutrient Action Plan (2001), which prioritises the recommended actions on a sub-catchment basis.



Draft Campaspe Nutrient Management Strategy (in development) (North Central CMA 2004d) – a framework of six action plans to reduce nutrient exports to Campaspe waterways and the River Murray, and to reduce the incidence of algal blooms over 30 years. Implementation of the Strategy will achieve a reduction in the average annual phosphorous and nitrogen loads to Campaspe waterways by approximately 35% and 25%, compared to a ‘without strategy’ scenario. This Strategy updates the Draft Campaspe Water Quality Strategy (1997). The Strategy is supported by the Campaspe Nutrient Action Plan (2001), which prioritises the recommended actions on a sub-catchment basis.

Avoca Nutrient Management Strategy (North Central CMA 2003h) – a framework of eight action plans to reduce nutrient exports to Avoca waterways, the Avoca Marshes and the River Murray, and to reduce the incidence of algal blooms over 30 years. Implementation of the Strategy will achieve a reduction in the average annual phosphorous and nitrogen loads to Avoca waterways by approximately 25% and 32%, compared to a ‘without strategy’ scenario. The Strategy is supported by the Avoca Nutrient Action Plan (2003), which prioritises the recommended actions on a sub-catchment basis.

Avon-Richardson Nutrient Management Strategy (North Central CMA 2002b) – a framework of nine action plans to reduce nutrient exports both to Avon-Richardson waterways and Lake Buloke, and to reduce the incidence of algal blooms over 30 years. Implementation of the Strategy will achieve a reduction in the average annual phosphorous and nitrogen loads by approximately 23% and 28%, compared to a ‘without strategy’ scenario. The Strategy is supported by the Avon-Richardson Nutrient Action Plan (2003), which prioritises the recommended actions on a sub-catchment basis.

Second Generation Dryland Salinity Management Plan (SKM 2002) – the Second Generation Dryland Salinity Management Plan for the North Central region has been based upon the organisation’s vision and objectives. The vision emphasises themes that are reinforced within five strategies (or program elements), including: 1) effective management arrangements; 2) adaptive management; 3) targeted responses; 4) enabling communities; and 5) improved farming and land use systems. Programs have been developed to ensure a lasting change in the capacity of landholders and communities to tackle salinity and related natural-resource issues.

The urban and rural water authorities within the North Central region are also developing management plans for the water storages they manage, such as the draft Lake Eppalock Water Quality and Biodiversity Storage Management Plan (G-MW 2003).

Waterway and wetland management plans

Avoca Catchment River Health Strategy (ID& A 1998) – identifies programs and actions necessary to restore and maintain waterways and their environments in healthy condition. Provides the methodology for determining future works programs. Strategies are identified for each Management Unit with qualitative outcomes.

Bendigo Creek Catchment Waterway Action Plan (North Central CMA 2002c) – a five-year works program based on existing information, community views and previous studies. This plan specifically aims to protect and improve the health of the Bendigo Creek catchment.

River Health Plans – the North Central CMA has developed a catchment scale planning document for each of the Campaspe, Loddon, Avoca and Avon-Richardson catchments. These River Health Plans sit directly beneath the North Central RHS, providing an even greater level of detail at the individual stream level.

The development of the plans has involved over 1,600 rapid-assessment field surveys of 306 major waterways across the North Central region. These surveys provide a more detailed account of the current condition of many more waterways than the 57 representative waterways surveyed using the ISC method.

In conjunction with the field surveys, aerial photo and map interpretation, a review of statewide flora and fauna databases, literature reviews (including historical literature) and input from the community via the community River Health Forums helped to accurately describe the current condition of the region’s major waterways.

Each River Health Plan provides an overview of the catchment, summaries of the current condition and recommended actions for each major waterway and the major contributing investigations.



Lower Avoca Wetland Management Study: Wetland Management Plan (in development) - identifies threats and risks to the wetland system, provides clear management objectives and actions to protect and enhance the ecological values, and reduces the impacts of threats.

Flooding Enhancement of Gunbower Forest Project: Water Management and Operational Plan for Gunbower Forest (in development) – a project designed to protect and enhance the ecological communities within the forest by providing a flooding regime based on pre- and post-river regulation flooding patterns.

Wetlands Program: Wetlands Strategic Directions Paper (North Central CMA 2004a) – aims to ensure that wetlands within the region are given high priority for conservation and rehabilitation under the North Central CMA's natural-resource-management functions. As part of the Wetlands Program, a Wetlands Strategic Directions Paper for the North Central catchment is being developed. This Paper will set strategic direction for wetland management within the North Central region.

Gunbower Forest Ramsar Site Strategic Management Plan (DSE 2003a) – provides management agencies and stakeholders with an appropriate management framework and the necessary information to ensure that decisions regarding land use, development and ongoing management, are made with full regard for wetland values environmentally, socially and economically.

Kerang Wetlands Ramsar Site Strategic Management Plan (DSE 2004b) – provides management agencies and stakeholders with an appropriate management framework and the necessary information to ensure that decisions regarding land use, development and ongoing management, are made with full regard for wetland values in environmental, social and economic terms.

Environmental Action Plan for Tang Tang Swamp (SKM 1999a) – a description of the conservation significance of Tang Tang Swamp, major threatening issues, management aims and high-priority actions.

Management options to improve the ecological health of Kow Swamp (SKM 1999b) – a description of the current status of the flora and fauna of Kow Swamp, an outline of the current management regime and its effects on environmental values and the development, assessment and cost of alternative management regimes to improve the environmental condition of the wetlands.

Wetland operational and management plans continue to be developed by partner agencies, such as DPI and Parks Victoria and the North Central CMA. For example, many of the wetlands that make up the Kerang Lakes Ramsar site have watering and operational plans, such as McDonald Swamp, Richardson's Lagoon and Murphys Swamp.

Floodplain management strategies

North Central Regional Floodplain Management Strategy (Egis Consulting Australia 2000) – nine programs for proactive coordination and implementation of flood management measures.

Marmal Floodplain Strategy (North Central CMA 2001a) – mechanisms and strategies for the control and removal of works for floodplain storage, natural flows and management of Lake Marmal. The impacts of existing and proposed drainage schemes are identified and actions to enhance the adoption of water retention practices, education and protective measures of environmental assets are outlined.

Other strategies

A number of other strategies have been developed that contribute to the North Central RHS (see Figure 3). These include:

Native vegetation plans

Riparian Vegetation Investigations – four separate documents produced by the North Central CMA for each of the Campaspe, Loddon, Avoca and Avon-Richardson catchments. Priority areas are identified to protect and enhance native riparian vegetation communities throughout the catchment based on their current condition, values and threats.



Draft North Central Vegetation Plan (North Central CMA 2003b) – provides direction for the coordination of vegetation management in the North Central region. This Plan aims to protect and enhance the native vegetation communities of the North Central region by achieving 20% native vegetation cover by 2020.

Pest plants and animals

Rabbit Management Action Plan 2000 – 2005 North Central Region (DNRE 2000) – aims to provide clear direction for rabbit management over the next five years. Actions are initiated in five strategic areas: building a rabbit-free culture, priority-setting and resource allocation, regional leadership and resource coordination, technical excellence and effective community support.

North Central Region Weed Action Plan 2001 – 2005 (DNRE 2001) – refers to weed species that affect the environmental, agricultural and social values of the North Central region. Provides direction for community and government investment in weed management to reduce the environmental, economic and social impact of weeds.

Instream habitat

River health will be managed according to the threatening processes identified in action statements under the *Flora and Fauna Guarantee Act 1988*, including:

- degradation of native riparian vegetation along Victorian rivers and streams
- increase in sediment input into Victorian rivers and streams due to human activities
- removal of woody debris from Victorian streams
- alteration to the natural temperature regimes of rivers and streams
- input of toxic substances into Victorian rivers and streams
- prevention of passage of aquatic biota as a result of the presence of instream structures.

Bio-regional strategies

Campaspe Whole-of-Catchment Plan 2000 – 2002 (North Central CMA 2000a) – the integration of all major strategies relevant to the catchment to produce a framework for developing future options in line with identified priorities.

Loddon Whole-of-Catchment Plan 1999 – 2004 (North Central CMA 2000b) – the integration of all major strategies relevant to the catchment to produce a framework for developing future options in line with identified priorities.

Avoca Whole-of-Catchment Plan 2000 – 2002 (North Central CMA 2000c) – the integration of all major strategies relevant to the catchment to produce a prioritised works plan.

Avon-Richardson Whole-of-Catchment Plan 2000 – 2002 (North Central CMA 2000d) – the integration of all major strategies relevant to the catchment to produce a prioritised works plan with specific objectives and targets.

Other land plans

North Central Dryland Management Plan for the North Central Region (SKM 2002b) – a review of the four First Generation Dryland Salinity Management Plans (Campaspe, Loddon, Avoca and Avon-Richardson catchments) with the themes such as protecting assets, targeted responses, lasting landscape scale change in farming and land use systems, and enabling communities.

Loddon-Murray Land and Water Management Strategy (Loddon-Murray Forum 2002) – The Draft Loddon-Murray Land and Water Management Strategy (LMLWMS) is an action plan under the North Central RCS which deals with the Loddon-Murray irrigation region. It provides the strategic direction for land, water and biodiversity management in the irrigation region and has identified the regional asset values and challenges from an environmental, social and economic viewpoint. The LMLWMS builds on and consolidates earlier land and water management plans. It is focussed on achieving outcomes in land and water management, biodiversity enhancement, social capacity and planning and development. It includes an implementation program that identifies the activities and actions to be taken over five-, ten- and 30-year timescales.



Appendix 3 Threatened riparian-dependent flora species

Species Name	Common Name	EPBC	VROTS	FFG
<i>Amphibromus fluitans</i>	River Swamp Wallaby-Grass	Vul	K	I
<i>Austrostipa breviglumis</i>	Cane Spear-Grass		R	
<i>Bolboschoenus fluviatilis</i>	Tall Club-Sedge		K	
<i>Bossiaea riparia</i>	River Leafless Bossiaea		r	
<i>Callitriche cyclocarpa</i>	Western Water Starwort	Vul	v	L
<i>Callitriche sonderi</i>	Matted Water-Starwort		k	
<i>Callitriche umbonata</i>	Winged Water-Starwort		v	N
<i>Cardamine tenuifolia</i>	Slender Bitter-Cress		k	
<i>Carex chlorantha</i>	Green-Top Sedge		k	
<i>Craspedia paludicola</i>	Swamp Billy-Buttons		v	
<i>Cyperus bifax</i>	Downs Flat-Sedge		v	
<i>Cyperus concinnus</i>	Trim Flat-Sedge		v	
<i>Cyperus victoriensis</i>	Flat-Sedge		k	
<i>Dianella porracea</i>	Riverina Flax-Lily		v	
<i>Diuris palustris</i>	Swamp Diuris		v	L
<i>Eleocharis pallens</i>	Pale Spike-Sedge		v	
<i>Eragrostis australasica</i>	Cane Grass		v	
<i>Eucalyptus aggregata</i>	Black Gum		e	L
<i>Fimbristylis dichotoma</i>	Common Fringe-Sedge		v	
<i>Gahnia microstachya</i>	Slender Saw-Sedge		r	
<i>Glossostigma cleistanthum</i>	Spoon Mud-Mat		r	
<i>Helichrysum aff. rutidolepis (Lowland Swamps)</i>	Pale Swamp Everlasting		v	
<i>Isolepis congrua</i>	Slender Club-Sedge		v	L
<i>Isolepis victoriensis</i>	Victorian Club-Sedge		k	
<i>Juncus psammophilus</i>	Sand Rush		r	
<i>Lepidium fasciculatum</i>	Bundled Pepper-Cress		k	
<i>Lepidium hyssopifolium</i>	Basalt Pepper-Cress	End	e	L
<i>Lepidium monoplacoides</i>	Winged Pepper-Cress	End	e	L
<i>Lepidium phlebopetalum</i>	Veined Pepper-Cress		e	
<i>Lepidium pseudohyssopifolium</i>	Native Pepper-Cress		k	
<i>Lepidium pseudopapillosum</i>	Erect Pepper-Cress	Vul	e	L
<i>Marsilea mutica</i>	Smooth Nardoo		k	
<i>Melaleuca halmaturorum ssp. halmaturorum</i>	Salt Paperbark		v	L
<i>Muehlenbeckia horrida</i>	Spiny Lignum		k	
<i>Myriophyllum porcatum</i>	Ridged Water-Milfoil	Vul	v	L
<i>Pultenaea weindorferi</i>	Swamp Bush-Pea		r	
<i>Ranunculus sessiliflorus var. pilulifer</i>	Annual Buttercup		k	
<i>Ranunculus undosus</i>	Swamp Buttercup		v	
<i>Schoenus nanus</i>	Tiny Bog-Sedge		k	

Source: Advisory List of Rare Or Threatened Plants In Victoria 2003 (DSE 2003c)

Key to Conservation Status:

EPBC (*Environment Protection and Biodiversity Conservation Act 1999*): X = extinct; End = endangered; Vul = vulnerable; R = rare; K = poorly known.

VROTS (*Victorian Rare or Threatened Species*): x = extinct; e = endangered; v = vulnerable; r = rare; k = poorly known.

FFG (*Flora and Fauna Guarantee Act 1988*): L = listed under Schedule 2, N = nominated for listing, I = rejected for listing



Appendix 4 Threatened riparian-dependent fauna species

Common Name	Scientific Name	EPBC	VROTS	FFG
Australasian Shoveler	<i>Anas rhynchos</i>		v	
Baillon's Crane	<i>Porzana pusilla</i>		v	
Blue-Billed Duck	<i>Oxyura australis</i>		v	L
Brolga	<i>Grus rubicunda</i>		v	L
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>		v	
Caspian Tern	<i>Sterna caspia</i>			L
Eastern Curlew	<i>Numenius madagascariensis</i>		lr	
Flat-Headed Galaxias	<i>Galaxias rostratus</i>		dd	
Freckled Duck	<i>Stictonetta naevosa</i>		e	L
Freshwater Catfish	<i>Tandanus tandanus</i>		v	L
Glossy Ibis	<i>Plegadis falcinellus</i>		v	
Golden Perch	<i>Macquaria ambigua</i>		v	
Great Egret	<i>Ardea alba</i>		e	L
Growling Grass Frog	<i>Litoria raniformis</i>	Vul	v	L
Gull-Billed Tern	<i>Sterna nilotica</i>		e	L
Hardhead	<i>Aythya australis</i>		v	
Intermediate Egret	<i>Ardea intermedia</i>		ce	L
Lewin's Rail	<i>Rallus pectoralis</i>		e	
Little Egret	<i>Egretta garzetta</i>		ce	L
Macquarie Perch	<i>Macquaria australasica</i>	End	e	L
Magpie Goose	<i>Anseranas semipalmata</i>		e	N
Murray Cod	<i>Maccullochella peelii</i>	Vul	v	L
Murray Cray	<i>Euastacus armatus</i>			L
Murray Hardyhead	<i>Craterocephalus fluviatilis</i>	Vul	e	L
Murray River Crayfish	<i>Euastacus armatus</i>		ins	
Musk Duck	<i>Biziura lobata</i>		v	
Nankeen Night Heron	<i>Nycticorax caledonicus</i>		v	
Painted Snipe	<i>Rostratula benghalensis</i>	Vul	e	L
Pied Cormorant	<i>Phalacrocorax varius</i>		lr	
Red-backed Kingfisher	<i>Todiramphus pyrrophygia</i>		v	
Royal Spoonbill	<i>Platalea regia</i>		v	
Silver Perch	<i>Bidyanus bidyanus</i>		ce	L
Southern Purple-Spotted Gudgeon	<i>Mogurnda adspersa</i>		ce	L
Trout Cod	<i>Maccullochella macquariensis</i>	End	ce	L
Whiskered Tern	<i>Chlidonias hybridus</i>		lr	
White-Bellied Sea Eagle	<i>Haliaeetus leucogaster</i>		e	L

Source: Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2003d) & Threatened Vertebrate Fauna of Victoria (DSE 2000)

Key to Conservation Status:

EPBC (*Environment Protection and Biodiversity Conservation Act 1999*): X = Extinct; End = Endangered; Vul = Vulnerable; R = Rare; K = poorly known.

VROTS (Victorian Rare or Threatened Species): x = extinct; ce = critically endangered; e = endangered; v = vulnerable; lr = lower risk, near threatened; dd = data deficient.

FFG (*Flora and Fauna Guarantee Act 1988*): L = Listed under Schedule 2, N = Nominated for listing.

The lowland riverine fish community of the southern Murray-Darling Basin is also listed on the *Flora and Fauna Guarantee Act 1988* (DSE website)



Appendix 5 Supporting document sample

Reach 4		Campaspe River			22km
Principles under which the reach is a priority		2, 3, 5, 6, 7			
Value ranking (compared to other 100 ISC reaches)		Environmental	Social	Economic	
		13	12	35	
Total risk ranking		14			

Value/threat combinations of high risk (risk score > 20) shaded in grey

		Threats																TOTAL					
		Bank Erosion	Bed Erosion	Channel Modification	Barriers	Flow Deviation	Wetland Connectivity	WQ Trend	WQ Attainment	Temperature	WQ Signal	Algal Blooms	Exotic Flora	Introduced Fauna	Loss Instream Habitat	Stock Access	Degraded Riparian Veg.						
Values	Environmental	Significant Flora	1	3	2	1	5	4	2	4	4	5	5	1	5	1	2	5	1	1	10	5	58
		Statewide EVC	5	6	8	4	5	20	12	10	15	2	10	2	15	3	3	25	16	156			
		Significant Fauna	5	12	16	4	20	20	12	25	20	8	20	8	12	15	12	20	20	244			
		Wetland Significance	1	3	3	3	6	4	5	8	8	2	8	5	4	2	3	8	4	76			
		Wetland Rarity	5	12	8	8	15	20	12	20	20	2	20	10	12	6	6	20	16	207			
		Sites Significance	1	3	3	3	2	3	4	4	4	1	4	2	3	1	3	6	3	49			
		Heritage/Rep. Rivers	1	5	4	4	2	4	3	8	10	3	8	5	5	3	3	6	5	78			
		Invertebrates Obs. Exp.	5	15	20	6	10	20	12	25	25	10	25	10	9	15	12	15	12	241			
		Width Vegetation	3	6	4	3	8	9	4	4	8	1	4	1	8	2	2	20	6	90			
		Struct Intactness Veg.	3	10	2	2	4	6	6	4	12	1	4	1	8	2	2	20	10	94			
	Longitudinal Continuity	5	15	4	6	5	10	6	5	10	2	5	2	12	3	3	25	16	129				
	Fish Obs. Exp.	2	3	6	3	15	10	4	15	15	5	15	5	3	5	5	9	8	126				
	Fish Proportion	1	3	3	3	10	5	5	10	10	5	10	5	3	5	5	6	4	92				
	Fish Migrations	4	2	9	4	25	20	8	25	15	4	20	2	4	2	8	15	3	166				
	Eco. Healthy River	1	2	2	2	10	4	3	6	6	4	6	3	5	1	5	8	5	72				
	Social	Fishing	4	6	9	4	20	20	4	20	25	2	25	5	8	8	10	10	12	188			
		Non-Motor Sports	3	4	2	1	16	15	2	8	12	1	12	5	8	8	2	4	6	106			
		Motor Sports	1	2	1	1	8	5	1	4	6	1	6	5	3	1	1	2	2	49			
		Camping	3	4	2	1	4	12	2	16	20	1	20	5	8	2	4	12	8	121			
		Swimming	5	12	16	2	15	25	3	25	25	2	25	10	12	6	6	15	12	211			
Passive Recreation		3	6	6	4	8	15	2	8	16	1	12	5	10	4	8	16	10	131				
European Heritage		5	12	12	6	5	10	3	5	15	2	10	6	9	6	3	15	12	131				
Economic	Flagship Species	4	8	9	3	5	4	2	5	5	1	5	1	8	4	2	20	9	91				
	Listed Landscape	1	4	3	3	2	1	1	2	2	1	2	1	4	2	1	8	3	40				
	Water Supply IRR	4	6	9	1	10	20	2	25	25	1	20	5	4	4	2	20	9	163				
	Water Supply PC	1	4	4	1	4	5	1	10	10	1	8	5	2	2	1	8	3	69				
	Infrastructure	5	15	20	10	5	10	3	20	5	2	5	2	6	6	3	10	12	134				
	Land Value	4	10	9	4	5	16	2	15	10	1	10	2	10	4	2	25	15	140				
	Tourism	2	2	6	1	3	8	1	9	15	1	12	5	4	2	3	12	8	92				
Power Generation	1	1	1	1	2	1	1	2	2	1	2	1	1	1	1	2	1	21					
TOTAL		196	203	100	251	326	130	349	377	70	337	126	205	126	122	392	255	3565					



Appendix 6 Reaches ranked according to environmental value

Waterway	Reach	RiVERS score	Rank	Waterway	Reach	RiVERS score	Rank
Avoca River	1	53	1	Burnt Creek	17	35	52
Campaspe River	6	53	2	Bullock/Pyramid Creek	33	35	53
Gunbower Creek	38	49	3	Bendigo Creek	42	35	54
Loddon River	2	49	4	Barr Creek	31	35	55
Avoca River	4	48	5	Andersons Creek	51	35	56
Loddon River	10	48	6	Cherry Tree Creek	15	34	57
Avoca River	2	47	7	Glenlogie Creek	20	34	58
Avoca River	3	46	8	Rutherford Creek	19	34	59
Tullaroop Creek	18	46	9	Mount Pleasant Creek	8	34	60
Gunbower Creek	39	46	10	Mount Pleasant Creek	9	34	61
Loddon River	7	45	11	Little Coliban River	20	34	62
Coliban River	18	44	12	Middle Creek	24	34	63
Mosquito Creek	9	43	13	Bullock Creek	36	34	64
Campaspe River	3	43	14	Avoca River	6	33	65
Campaspe River	4	43	15	Number Two Creek	18	33	66
Creswick Creek	20	43	16	Mclvor Creek	14	33	67
Bendigo Creek	40	43	17	Loddon River	3	33	68
Richardson Creek	52	43	18	Mountain Creek	17	32	69
Campaspe River	5	42	19	Pipers Creek	23	32	70
Bet Bet Creek	14	42	20	Bet Bet Creek	15	32	71
Campaspe River	2	41	21	Bendigo Creek	41	32	72
Avoca River	8	40	22	Serpentine Creek	11	32	73
Avoca River	5	40	23	Loddon River	4	32	74
Campaspe River	7	40	24	Avon River	47	32	75
Birches Creek	21	40	25	Wild Duck Creek	16	31	76
Loddon River	8	40	26	Kangaroo Creek	21	31	77
Back Creek	47	40	27	Loddon River	9	31	78
Loddon River	6	40	28	Bradford Creek	13	31	79
Avoca River	7	39	29	Bullock Creek	35	31	80
Coliban River	19	39	30	Avon River	48	31	81
Bendigo Creek	44	39	31	Myrtle Creek	17	30	82
Loddon River	1	39	32	Jim Crow Creek	27	30	83
Avon River	46	39	33	Bullabul Creek	12	30	84
Richardson River	43	39	34	Bendigo Creek	43	30	85
Joyces Creek	25	38	35	Fentons Creek	14	29	86
Tullaroop Creek	19	38	36	Forest Creek	11	29	87
Loddon River	5	38	37	Bet Bet Creek	16	29	88
Richardson River	44	38	38	Bullock Creek	34	29	89
Campaspe River	1	37	39	Myers Creek	45	29	90
Axe Creek	12	37	40	Myers Creek	46	28	91
Five Mile Creek	24	37	41	Box Creek	32	28	92
Coliban River	22	37	42	Strathfillan Creek	11	27	93
Sailors Creek	28	37	43	Fentons Creek	13	27	94
Middle Creek	12	36	44	Mclvor Creek	15	27	95
Barkers Creek	30	36	45	Campbells Creek	29	27	96
McCallum Creek	22	36	46	Beckworth Creek	23	27	97
Spring Creek	37	36	47	Sandy Creek	49	27	98
Richardson River	45	36	48	Homebush Creek	16	26	99
Campbells Creek	10	35	49	Forest Creek	10	26	100
Sheepwash Creek	13	35	50	Wallaloo Creek	50	25	101
Muckleford Creek	26	35	51				



Appendix 7 Reaches ranked according to social value

Waterway	Reach	RiVERS score	Rank	Waterway	Reach	RiVERS score	Rank
Loddon River	7	42	1	Middle Creek	24	17	52
Gunbower Creek	38	37	2	Avoca River	3	16	53
Loddon River	10	35	3	Tullaroop Creek	18	16	54
Campaspe River	5	32	4	Richardson River	45	16	55
Loddon River	8	32	5	Number Two Creek	18	16	56
Avoca River	7	32	6	Mclvor Creek	14	16	57
Campaspe River	3	31	7	Mountain Creek	17	16	58
Loddon River	6	31	8	Pipers Creek	23	16	59
Loddon River	2	30	9	Richardson River	43	15	60
Gunbower Creek	39	30	10	Little Coliban River	20	15	61
Campaspe River	1	30	11	Coliban River	22	14	62
Campaspe River	6	29	12	Muckleford Creek	26	14	63
Campaspe River	4	29	13	Barr Creek	31	14	64
Creswick Creek	20	29	14	Avon River	48	14	65
Avoca River	5	29	15	Forest Creek	10	14	66
Avoca River	6	29	16	Campbell Creek	10	13	67
Avoca River	4	28	17	Forest Creek	11	13	68
Campaspe River	2	28	18	Sheepwash Creek	13	12	69
Coliban River	19	28	19	Cherry Tree Creek	15	12	70
Coliban River	18	27	20	Glenlogie Creek	20	12	71
Campaspe River	7	27	21	Mount Pleasant Creek	8	12	72
Sailors Creek	28	27	22	Avon River	47	12	73
Jim Crow Creek	27	27	23	Wild Duck Creek	16	12	74
Loddon River	1	25	24	Bradford Creek	13	12	75
Five Mile Creek	24	25	25	Bullabul Creek	12	12	76
Serpentine Creek	11	25	26	Strathfillan Creek	11	12	77
Bet Bet Creek	14	24	27	Bendigo Creek	40	11	78
Birches Creek	21	24	28	Richardson Creek	52	11	79
Richardson River	44	24	29	Myrtle Creek	17	11	80
Middle Creek	12	24	30	Fentons Creek	14	11	81
Barkers Creek	30	24	31	Myers Creek	45	11	82
Loddon River	9	24	32	Fentons Creek	13	11	83
Axe Creek	12	23	33	Sandy Creek	49	11	84
Avoca River	1	22	34	Wallaloo Creek	50	11	85
Tullaroop Creek	19	22	35	Back Creek	47	10	86
Avoca River	2	21	36	Spring Creek	37	10	87
Mosquito Creek	9	21	37	Bullock/Pyramid Creek	33	10	88
McCallum Creek	22	21	38	Bendigo Creek	42	10	89
Loddon River	3	21	39	Andersons Creek	51	10	90
Joyces Creek	25	20	40	Rutherford Creek	19	10	91
Kangaroo Creek	21	20	41	Mount Pleasant Creek	9	10	92
Avoca River	8	19	42	Bendigo Creek	41	10	93
Avon River	46	19	43	Bullock Creek	35	10	94
Bet Bet Creek	15	19	44	Bendigo Creek	43	10	95
Loddon River	5	18	45	Bet Bet Creek	16	10	96
Bullock Creek	36	18	46	Bullock Creek	34	10	97
Loddon River	4	18	47	Myers Creek	46	10	98
Box Creek	32	18	48	Mclvor Creek	15	10	99
Campbells Creek	29	18	49	Beckworth Creek	23	10	100
Bendigo Creek	44	17	50	Homebush Creek	16	10	101
Burnt Creek	17	17	51				



Appendix 8 Reaches ranked according to economic value

Waterway	Reach	RIVERS score	Rank	Waterway	Reach	RIVERS score	Rank
Loddon River	8	23	1	Strathfillan Creek	11	16	52
Five Mile Creek	24	23	2	Myers Creek	45	16	53
Creswick Creek	20	22	3	Avoca River	7	15	54
Coliban River	19	22	4	Avoca River	6	15	55
Campaspe River	7	22	5	Richardson River	44	15	56
Barkers Creek	30	22	6	Axe Creek	12	15	57
Tullaroop Creek	18	22	7	Mosquito Creek	9	15	58
Mclvor Creek	14	22	8	Loddon River	5	15	59
Coliban River	22	22	9	Loddon River	4	15	60
Loddon River	7	21	10	Burnt Creek	17	15	61
Loddon River	10	21	11	Bullabul Creek	12	15	62
Campaspe River	6	21	12	Bendigo Creek	40	15	63
Coliban River	18	21	13	Bendigo Creek	42	15	64
Birches Creek	21	21	14	Bendigo Creek	43	15	65
Campaspe River	3	20	15	Bet Bet Creek	16	15	66
Loddon River	6	20	16	Bullock Creek	34	15	67
Bendigo Creek	44	20	17	Myers Creek	46	15	68
Gunbower Creek	38	19	18	Loddon River	1	14	69
Campaspe River	5	19	19	Middle Creek	12	14	70
Gunbower Creek	39	19	20	Loddon River	3	14	71
Avoca River	4	19	21	Avon River	46	14	72
Sailors Creek	28	19	22	Bullock Creek	36	14	73
Bet Bet Creek	14	19	23	Avoca River	3	14	74
Mclvor Creek	15	19	24	Mountain Creek	17	14	75
Loddon River	2	18	25	Spring Creek	37	14	76
Campaspe River	1	18	26	Bendigo Creek	41	14	77
Jim Crow Creek	27	18	27	Beckworth Creek	23	14	78
Loddon River	9	18	28	Avoca River	8	13	79
Box Creek	32	18	29	Forest Creek	10	13	80
Campbells Creek	29	18	30	Mount Pleasant Creek	8	13	81
Little Coliban River	20	18	31	Avon River	47	13	82
Muckleford Creek	26	18	32	Rutherford Creek	19	13	83
Wild Duck Creek	16	18	33	Bullock Creek	35	13	84
Myrtle Creek	17	18	34	Avoca River	2	12	85
Campaspe River	4	17	35	Sheepwash Creek	13	12	86
Avoca River	5	17	36	Back Creek	47	12	87
Tullaroop Creek	19	17	37	Andersons Creek	51	12	88
McCallum Creek	22	17	38	Homebush Creek	16	12	89
Kangaroo Creek	21	17	39	Avon River	48	11	90
Bet Bet Creek	15	17	40	Forest Creek	11	11	91
Number Two Creek	18	17	41	Cherry Tree Creek	15	11	92
Pipers Creek	23	17	42	Glenlogie Creek	20	11	93
Barr Creek	31	17	43	Bradford Creek	13	11	94
Bullock/Pyramid Creek	33	17	44	Wallaloo Creek	50	11	95
Campaspe River	2	16	45	Mount Pleasant Creek	9	11	96
Serpentine Creek	11	16	46	Richardson Creek	52	10	97
Avoca River	1	16	47	Fentons Creek	14	10	98
Joyces Creek	25	16	48	Sandy Creek	49	10	99
Middle Creek	24	16	49	Fentons Creek	13	9	100
Richardson River	45	16	50	Campbell Creek	10	8	101
Richardson River	43	16	51				



Appendix 9 Target- and cost-setting assumptions

In summary, the key assumptions used to develop the Management Action and Resource Condition Targets and costs for each action across all Program Areas. Costs are calculated at 2004 rates and no provision has been made for Consumer Price Index (CPI) increases.

Hydrology (EWR)

- The actions of the North Central RHS will contribute to the maintenance or improvement in the Hydrology ISC sub-index.
- The implementation of relevant floodplain plans and strategies will contribute to the improvement of floodplain linkages and functions.
- The completion and implementation of hydrology plans and strategies (e.g. bulk entitlement, environmental flow and floodplain management) are at various stages of completion and cannot be accurately estimated.

Riparian zone

- One-quarter of the total length of priority waterways are already fenced along both banks (i.e. existing fences).
- Through the implementation of the North Central RHS, the North Central CMA in partnership with the community and other agencies, will protect and enhance a further distance equating to half of the total length of the priority reach in 10 years (cost includes fencing materials and revegetation of left and right stream banks).
- By 2015, only one-quarter of the total length of priority reaches will remain unfenced.
- In five years, one-quarter of the total length of priority waterways will be fenced (i.e. Management Action Target).
 - For example, if the total length of the priority reach is 100km, we can assume that 25km is already fenced along both banks. To fence an additional one-quarter of the reach in the next five years, 25km multiplied by two banks (50km) equates to the five-year Management Action Target for length reach protected. Therefore, if the 10-year target is to have protected three-quarters of the total reach length, the remaining quarter (25km multiplied by two banks) would need to be protected.
- The areas for protection and enhancement will target the riparian areas currently in good and moderate condition (identified in existing riparian investigations) and priority buffer strip areas (identified in catchment Nutrient Action Plans).
- The calculation of area protected is based on an average riparian width of 30m (top of bank to fence line).
- 'Riparian land enhanced' may include activities such as fencing, off-stream watering sites and revegetation of indigenous vegetation.
- Offstream watering is required for one-quarter of the total length of permanently flowing priority reaches protected and enhanced according to the North Central CMA Offstream Watering Guidelines.
- The number of plants required for revegetation is calculated at 3,000 plants per kilometre of fencing.
- At every site revegetated using tubestock along the sloping river bank, direct seeding will also occur on the flatter areas (evaluated on a site by site basis).
- The amount of direct seeding required is calculated at 2km per kilometre of fencing.
- Landholders contribute towards one-third of the cost of riparian protection and enhancement activities for maintenance of weeds, fencing and offstream watering equipment (if eligible).
- Exotic flora control costs \$5,000 per kilometre for woody weed management (heavy) and landholders are estimated to contribute an additional one-third of this cost for ongoing weed maintenance. This is additional to the weed control involved in riparian revegetation.
- All riparian vegetation in the North Central region is considered threatened (i.e. endangered, vulnerable or depleted).
- The protection and enhancement of riparian zones will contribute to enhanced biodiversity.

Instream habitat

- The reduction in stock access to the bed and banks, and vegetation enhancement of the riparian zone, will reduce the amount of sediment entering the waterways. It will contribute to an improvement in the Physical Form ISC sub-index.
- The reinstatement of suitable instream habitat (generally aquatic vegetation) will also contribute to an improvement in the Physical Form ISC sub-index through bed scouring and protection of the toe from erosion.
- The number of aquatic plants for enhancement of instream habitat is calculated at 1,000 per kilometre of stream.
- Landholders contribute one-third of the cost of instream habitat enhancement.



- According to the Victorian RHS, large woody debris shall not be removed from rivers unless it is demonstrated to be a serious threat to a high-value asset or to human lives. Where this has been demonstrated, the option of realigning the snag will be investigated to retain as many of the ecological benefits as possible.
- The cost of addressing instream barriers is associated with initial assessment of the threat. The implementation of assessment recommendations are not costed in the Strategy.

Aquatic life

- Current condition of threatened fish species is based on state databases. All records are post-1990.
- Current condition of invertebrates is based on limited data (1997 – 2001).
- Protection and enhancement of the riparian zone, the reinstatement of suitable instream habitat (e.g. large woody debris and aquatic vegetation), the removal or modification of migratory fish barriers and the improvement in the flow regime will better the Aquatic Life ISC sub-index and reduce the number of threatened native fish species.
- The cost of addressing bed and bank erosion is associated with initial assessment of the threat. The implementation of assessment recommendations are not costed in the Strategy.

Water quality

- Current condition of total nitrogen, total phosphorous, turbidity and salinity are based on limited data at selected sites over a 10-year period (1994 to 2003).
- The implementation of the Draft North Central Dryland Management Plan (SKM 2002) will lead to a reduction in stream salinity.
- The implementation of the relevant Nutrient Management Strategies will lead to a reduction in total nitrogen and total phosphorous in regional waterways.
- The cost of addressing the nutrient threat is based on the costs outlined in the relevant catchment Nutrient Management Strategies.

River health

- Overall change in ISC condition is based the incremental targets for priority waterways within each Program Area.
- Where no data exists (e.g. limited data for aquatic life or water quality sub-indices) a score is assigned based on a similar reach.

Wetlands

- The implementation of the North Central CMA Wetlands Strategic Directions Paper will lead to no further decline in the type and extent of wetlands.
- The implementation of the relevant plans and strategies will contribute to the overall improvement in condition of high-environmental-value wetlands.

Representative rivers

- The implementation of all river restoration actions and targets will contribute to an improvement in the overall ISC score in the next five years (Management Action Target).
- The Resource Condition Target aims to achieve an ecologically healthy condition of the representative rivers by 2021, as outlined in the VRHS.

Ecologically healthy rivers

- The implementation of all river restoration actions and targets will contribute to an improvement in the overall ISC score over the next five years (Management Action Target).
- The Resource Condition Target aims to achieve an ecologically healthy condition.

General assumptions:

- Targets aim to demonstrate progress in river health over time.
- There is a level of uncertainty in estimating long-term targets.
- The targets have been based on the best available information at the time of writing the Strategy.
- Achievement of targets is highly dependent upon the available funding.
- Achievement of targets is highly dependent upon the level of landholder or stakeholder contribution.
- Achievement of set targets requires significant monitoring, which may be limited by available resources.
- The cost of developing various regional plans and strategies are estimates based on similar existing documents.



Appendix 10 Unit-cost assumptions

	\$/UNIT	UNIT
INSTREAM AQUATIC RESTORATION		
Construction of fish ladder	100,000	vertical metre of barrier
Fish survey	6,500	km
Invertebrate survey	1,200	project area/site
Reinstatement of large woody debris	70,000	km
RIPARIAN MANAGEMENT		
Fencing (materials only)	2,250	km
Fencing (construction)	2,250	km
Riparian weed management for site preparation (ground cover e.g. bathurst burr, phalaris)	900	km
Riparian weed management for site preparation (woody weeds e.g. gorse, blackberry)	1,000	km
Woody weed management (heavy)	5,000	km
Willow management (light)	2,300	km
Willow management (heavy)	18,000	km
Offstream watering	2,500	km
Riparian revegetation (plants, stakes and guards only)	650	1,000 plants
Riparian revegetation (plants, stakes, guards and planting crew – labour)	1,650	1,000 plants
Direct seeding	350	km
Aquatic revegetation (plants and planting crew - labour)	2,200	km
URBAN ENHANCEMENT		
Weed management (light)	12,000	km
Weed management (heavy)	21,000	km
EROSION CONTROL		
Gully stabilisation – rock chute (minor)	5,000	site
Gully stabilisation – rock chute (major)	12,000	site
Stream stabilisation – rock chute (minor)	8,000	site
Stream stabilisation – rock chute (major)	18,000	site
Stream stabilisation – rock beaching (minor)	4,000	km
Stream stabilisation – rock beaching (major)	7,000	site
STRATEGIES AND PLANS		
Development of Catchment Action Plans	50,000	each
EDUCATION		
Half-day workshop (Expert led e.g. riparian vegetation, ecology, erosion)	2,500	each
Media Release	200	each
Forum (e.g. River Health Forum)	2,000	each
Educational material	1,000	1,000 units
Curriculum aids for schools – water quality, waterway-related topics	10,000	topic
Special event (e.g. World Environment Day)	30,000	each

Note: A 30% project management cost is incorporated into the calculated costings in Table 69, which includes employment, corporate and associated on costs.