



STRATEGY DEVELOPMENT:

Upper Avoca River – Catchment Action Plan

November 2007



NORTH CENTRAL
Catchment Management Authority

Document history

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Forward

Rivers and waterways make up only a small portion of the Victorian landscape and yet their overall significance for the economy, the ecology and the social fabric of Victoria is immense. Nearly every town in Victoria was situated on or near a river to provide a source of water and transport. Consequently rivers have become entwined in the lives and histories of people.

Rivers have been the focus for recreation, and have provided community meeting places and an attraction for people outside their region. They support a large array of native flora and fauna (many of which are threatened or endangered) and are highly important in the movement and cycling of sediment and nutrients through the landscape.

Virtually all of these values are reliant to some extent on (good) river condition. Waterway health is affected by many factors including clearing of native bush, declining water quality, salinity, modified flow regimes, loss of riparian vegetation, poor land management practices, climate change and fragmentation of floodplains and wetlands. Currently, only 22% of Victoria's major rivers and streams could be classified as either in good or excellent condition and unfortunately many are continuing to decline.

In response to this challenge, the Victorian Government released the Victorian River Health Strategy (VRHS) which was followed by the more specific North Central River Health Strategy (NCRHS) prepared by the North Central Catchment Management Authority. The NCRHS provides the framework for communities to work in partnership with Government to manage and restore our rivers and waterways over the long term. It endeavours to ensure the most effective river health benefits for the effort and resources invested.

This Action Plan is informed by the VRHS and NCRHS and focuses on the upper part of the Avoca River catchment. This catchment covers approximately 1.2 million hectares and extends about 340 kilometres from the Great Dividing Range near Amphitheatre, to the Avoca Marshes and into the River Murray. In the Avoca catchment, similar to the rest of Victoria, the impact from land clearing, grazing and cropping enterprises, and urban development has caused a decline in catchment and waterway values

This Catchment Action Plan (CAP) has been designed to provide the finer level of planning and development of actions within priority reaches of the Upper Avoca catchment. Its purpose is to provide realistic targets and guide effort for the next 5 years into activities that will bring about the greatest improvement in river health.

It is expected that through these actions and over time that the high priority reaches will improve in quality and environmental value. It is anticipated that both the riparian zone and instream environment will be reinstated as close to possible its natural pre European condition.

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Acronyms and Abbreviations

ANMS	Avoca Nutrient Management Strategy
ANZECC	Australian and New Zealand Environment and Conservation Council
AUSRIVAS	Australian River Assessment System
CMA	Catchment Management Authority
CAP	Catchment Action Plan
DNRE	Department of Natural Resources and Environment
DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment (formerly DNRE)
EC	Electrical Conductivity
EPA	Environment Protection Agency
EWR	Environmental Water Reserve
EVC	Ecological Vegetation Class
FSR	Flow Stressed Ranking
FFG Act	<i>Flora and Fauna Guarantee Act 1988</i>
ISC	Index of Stream Condition
ML	Megalitre
NAP	National Action Plan for Salinity and Water Quality
NCCMA	North Central Catchment Management Authority
NHT	Natural Heritage Trust
NWQMS	Australian National Water Quality Management Strategy
RCS	Regional Catchment Strategy
RiVERS	River Values & Environmental Risk System
RHS	River Health Strategy
SDL	Sustainable Diversion Limit
SEPP	State Environmental Protection Policy
SIGNAL	Stream Invertebrate Grade Number
VWQMN	Victorian Water Quality Monitoring Network

Executive Summary

Waterways are a highly important feature to the natural environment, local communities and economic prosperity of farming enterprises and towns. These valuable assets are however vulnerable to a number of risks such as, vegetation clearance, salinity, pest plants and feral animals that provide an ongoing management challenge to the government and local community.

In response to this challenge the Victorian Government released the Victorian River Health Strategy (VRHS) and the North Central Catchment Management Authority (CMA) subsequently prepared the North Central River Health Strategy (NCRHS) that provides the framework for communities to work in partnership with Government to manage and restore our rivers and waterways over the long term.

This Catchment Action Plan (CAP) was developed as an action from the NCRHS and is designed to provide the finer level of planning and management actions within priority river reaches of the Upper Avoca catchment. This document has been produced to enable the CMA and landholders to focus effort on the most important actions to improve waterway health.

The process undertaken to produce this CAP involved the review of a large number of reports that were identified as having actions and targets that pertain to the Upper Avoca Catchment. In reality however, most were either out dated, non specific and provided little useful information. Reviewing these reports did however help to develop an understanding of how this plan should be presented. This should ensure that it does not become idle and is actually used to guide effort and funding for the next 5 years in the Upper Avoca.

The report is structured to provide adequate information on the background to the region, and importantly, the priority setting process undertaken by the CMA. The report is formatted to provide a number of stand alone action plans and maps for each river reach of interest.

Within the floodplain area of the Avoca River the principal focus of effort and investment is to improve and enhance biodiversity values. It is in these areas that the remnant riparian corridor is most intact and improvement of river health is closely linked to improvement in the adjacent vegetation. To protect the internationally important Avoca Marshes and Kerang wetlands, the reaches 5, 6, 7 & 8 of the Upper Avoca River have been identified as priority river reaches and are specifically addressed in this report.

Within the tributary areas, actions that relate to the improvement of water quality and sediment generation have been targeted to protect the instream values of the high priority floodplain river reaches of the Avoca River (Reaches 5, 6, 7 & 8). Reaches 10 (Campbell Creek), 13 (Fentons Creek), 16 (Homebush Creek) and 17 (Mountain Creek) are key tributary reaches that have been identified as priority river reaches and are also specifically addressed in this report.

This report is designed to be brief but to clearly articulate the most important actions for the next five years which will have the greatest impact on improving river health.

1 Purpose

This Upper Avoca Catchment Action Plan (CAP) provides one to five year detailed on-ground actions in priority river reaches, which when implemented will lead to measurable improvements in river and catchment health.

The need to prepare CAPs is outlined in the North Central River Health Strategy (NCRHS), which forms a key sub-component of the North Central Regional Catchment Strategy (NCRCS) and the Victoria River Health Strategy. The CAP's function is to provide a level of detail to allow the identification of specific actions. The relationship between the NCRCS, NCRHS and CAPs is depicted in **Appendix A**.

“Catchment Management 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.”

North Central River Health Strategy (page 53)

2 Objectives

The CAP has the following three main objectives:

Capitalise and build on previous experience, knowledge and reports:

- Review the strategic direction and extensive work in the North Central Regional Catchment Strategy (NCRCS), North Central River Health Strategy (NCRHS) and other previous reports.
- Consolidate and prioritise the strategies and actions in the previous reports.
- Seek input from stakeholders.

Make the best use of limited resources:

- Select areas with the highest values and highest threats and propose management intervention actions which remove threats and/or to maintain/enhance values.
- Select practical actions which yield the best long term result.
- Target specific waterways, landholdings and threats.

Deliver a well regarded CAP:

- Prepare a CAP which is landowner friendly, practical and brief.
- Reflect stakeholder input where appropriate.
- Produce a practical planning tool for Project Managers to direct the delivery of management actions.

3 Development process

The NCCMA has undertaken many investigations and prepared numerous reports and plans in relation natural resource management in the catchment. These documents range in age, relevance, scope, detail and level of planning. Broadly the preparation of the CAP has been based on the following process:

- 1 A review and consolidation of these existing reports.
- 2 Input from the community and other stakeholders.
- 3 Identification of priority reaches and actions.

3.1 Review of existing reports

A large number of documents were reviewed and are included in the references. For the most part, only a few of these documents provided useful recommendations for reach and sub-reach actions to the extent they would provide meaningful input into the CAP.

Of all documents reviewed, the key strategic documents were the:

- Victorian River Health Strategy (VRHS)
- North Central Regional Catchment Strategy (NCRCS)
- North Central Native Vegetation Strategy (NCNVS)

Other documents which provided useful reach and sub-reach action information include the:

- North Central River Health Strategy (NCRHS)
- Avoca Nutrient Management Strategy
- Avoca Nutrient Action Plan
- Avoca Catchment Riparian Vegetation Investigation
- North Central Native Vegetation Plan

3.2 Community and stakeholder engagement

Engaging with the community is critical to establish ownership, awareness, to gather local knowledge and help refine priorities. Ultimately success of this plan will be measured by the knowledge, desire, skill and action of all stakeholders in the catchment.

Two half day community workshops were held at St Arnaud and Avoca on 26 June 2007 and a stakeholder and steering group workshop was held on 27 June 2006. The intended objectives of these workshops included:

- 1 Explanation of Catchment Action Plans
- 2 Outline the background, purpose and content of the CAP

- 3 Capture community and stakeholder comment and views on:
 - a. What issues are important and what actions should be pursued
 - b. Where these issues are located
- 4 Test the North Central River Health Strategy (i.e. test if the NCRHS priorities align with the community)
- 5 Build Community Ownership, Awareness and Joint Action

Effort was made to build on (rather than revisit) previous work (particularly the NCRHS) and engagement initiatives.

3.3 Principles underpinning actions

Through discussion with the Project Steering Committee and landholders during the engagement process, a number of principles were developed. These principles underpin the actions presented in this action plan and are described below.

- Actions on Upper Avoca River priority reaches (5, 6, 7 and 8) and some tributaries will provide the most cost effective mechanism to protect the internationally important Avoca Marshes which are located downstream (Section 6.2.13).
- Generally river health is best achieved when the waterway is stable, has a good native vegetation cover, low occurrence of weeds and is protected from stock.
- Mechanical sediment removal is only appropriate to protect assets or where resource extraction is appropriate and approved.
- Investigations and recommendations from previous reports have been based on high value, high threats and high likelihood of threat occurring.
- There are positive and willing landowners.
- Actions are proven to be practical and cost effective.

3.4 Development of monitoring and evaluation program

Many of the documents reviewed have developed a range of targets, monitoring and evaluation procedures which have been subject to considerable discussion and community consultation.

It is important to consider that actions undertaken today may take many years until they achieve the outcomes that may be expected. For instance, a revegetation program may take 10 years until the trees are mature enough to produce seed and another 80 years until they provide hollows for habitat. The monitoring program needs to be realistic and measure issues that are appropriate for the time scale of the works.

4 Background

4.1 North Central region overview

The region of the North Central Catchment Management Authority (CMA) covers approximately three million hectares or 13% of the State of Victoria. The region extends 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 (Figure 1). The North Central region contains four river catchments (Campaspe, Loddon, Avoca and Wimmera).

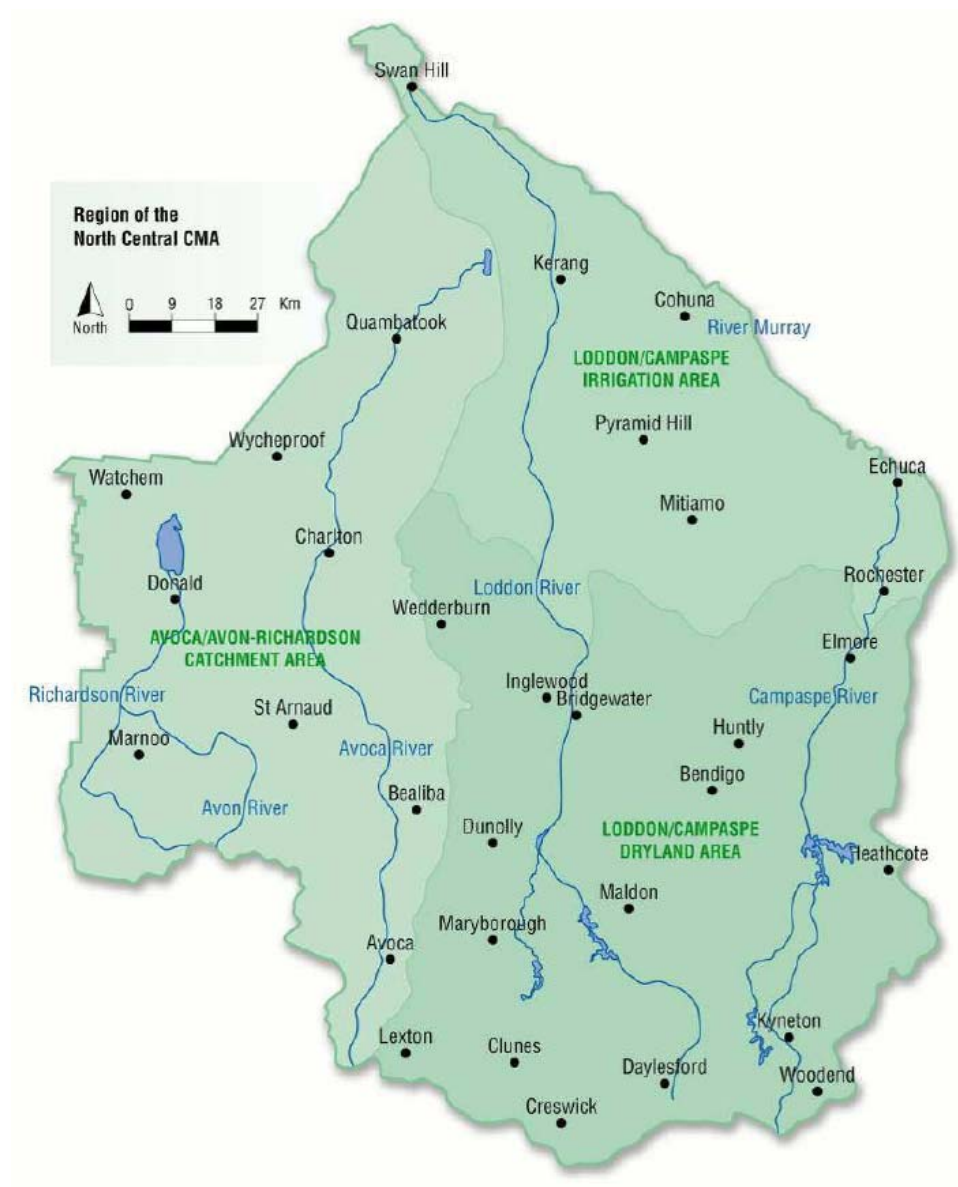


Figure 1. Region of the North Central Catchment Management Authority

Community

The North Central region's population now exceeds 200,000 people, most of who live in the larger urban centres including Swan Hill, Echuca, Donald, St Arnaud, Bendigo, Castlemaine, Maryborough and Creswick.

European exploration and settlement of the North Central region was closely linked to waterways and people of the North Central region today retain a strong connection to waterways. Waterways are widely used for recreational pursuits such as boating, swimming and fishing. The broad community places a high value on water and waterways, from which it derives many benefits, including irrigation, stock watering, domestic and industrial supply, tourism, habitat for native flora and fauna, recreational and visual amenity values, regional identity and nature conservation.

An intrinsic relationship between Indigenous culture and land has been maintained 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 these provided a vital source of food, water and camping sites.

Biophysical

The Avoca River flows into a series of lakes and wetlands (the Avoca Marshes). During flood events, the Avoca River may flow to the River Murray and to a further series of lakes via stream channels. Although not part of the North Central region, the River Murray between Echuca and Swan Hill lies on the border of the region. 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 water, salt and nutrients to the Murray.

The region's waterways play a crucial role in supplying water. 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.

Groundwater is a significant and valuable component of the region's water resources and is used extensively for stock and irrigation purposes and increasingly for town water supplies.

Land

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 central and upper areas.

The catchments of the various rivers and streams within the region include areas of flood-prone land, where flooding has historically caused substantial damage. More than 5,000 square kilometres of land across the region is subject to inundation by a 1 in 100 year flood.

River health

Within the region many natural waterways (particularly ephemeral systems) and floodplains have been cleared for agriculture. However, despite these losses, the Kerang Wetlands and Gunbower Forest have been protected and recognised as wetlands of international importance.

Unfortunately, in the North Central region almost no waterway is classified as being in excellent or good condition (Table 1). More specifically for the Avoca Catchment, 75% and 24% of stream length is in moderate and poor condition respectively (Figure 2).

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

Table 1. Summary of North Central waterway condition according to the 1999 Index of Stream Condition (ISC) results

4.2 Avoca River overview

Community

The Avoca River catchment (Figure 2) covers approximately 1.2 million hectares. It extends about 340 kilometres from the Great Dividing Range near Amphitheatre, to the Avoca Marshes and into the River Murray.

Today 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. When flowing, the waterways of the Avoca catchment are popular for recreational fishing, swimming, canoeing and camping.

Biophysical

The Avoca River is an anabranching river system and has a highly variable flow. The river ceases to flow for many months during dry years. Twelve weirs influence flow, but no major storages regulate flow. 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. Moving downstream, the channel capacity decreases into a wider floodplain.

One of the most significant and obvious issues is the occurrence of gully erosion in the upper reaches of the catchment and the subsequent transport of sediment downstream. The major source of sediment in the Avoca catchment over the last century has been gully erosion in the headwaters of first order streams. It has been estimated that there are about 150 km of gullies in the catchment with an additional 200 km of deepened and widened streams. Most of the gullies would have reached their current state before the 1940s and it is thought that gully erosion in the catchment has reached its topographic threshold.

Despite a theoretical reduction in gully erosion and consequent reduction of sedimentation in the lower reaches, anecdotal evidence suggests that accumulated sediment in the waterways is still a highly significant issue. Landowners at the community workshops advised that sedimentation has eliminated deep water holes and fish, covered springs, exacerbated weed issues and caused channel modification.

There are many wetland areas in the Avoca catchment, the majority of which are located in the northern part of the catchment; including the Avoca Marshes, part of the Ramsar listed Kerang Lakes.

Native vegetation has been significantly modified in the catchment and the larger stands of remaining native vegetation are located on the mountainous regions and along some of the larger waterway systems. Many native vegetation communities within the Avoca catchment are considered endangered or vulnerable because of the extent of land clearing. There are also many threatened flora and fauna species that are dependent upon the aquatic and terrestrial riparian environment.

In summary, key issues in the Avoca catchment include sedimentation, weeds, biodiversity decline, degrading water resources and loss of soil health.

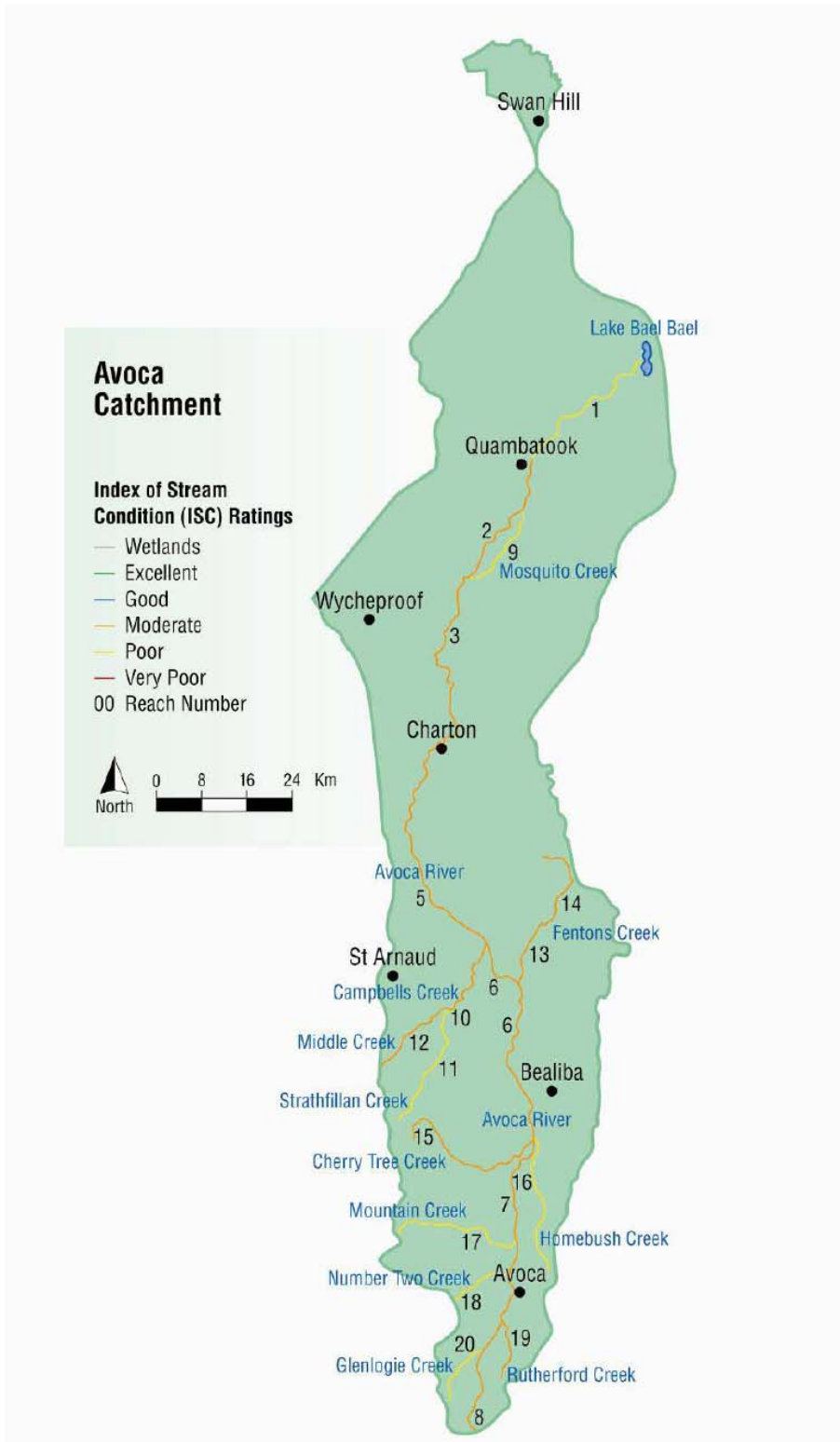


Figure 2. Avoca River catchment waterway condition, according to the 1999 Index of Stream Condition (ISC) results.

4.3 Upper Avoca – the project area

The target area for the development of the CAP is the Upper Avoca area, which includes the southern portion of the Avoca River catchment, extending about 250km north from the Great Dividing Range near Amphitheatre to Charlton (Figure 3). 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 (reach 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. 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.

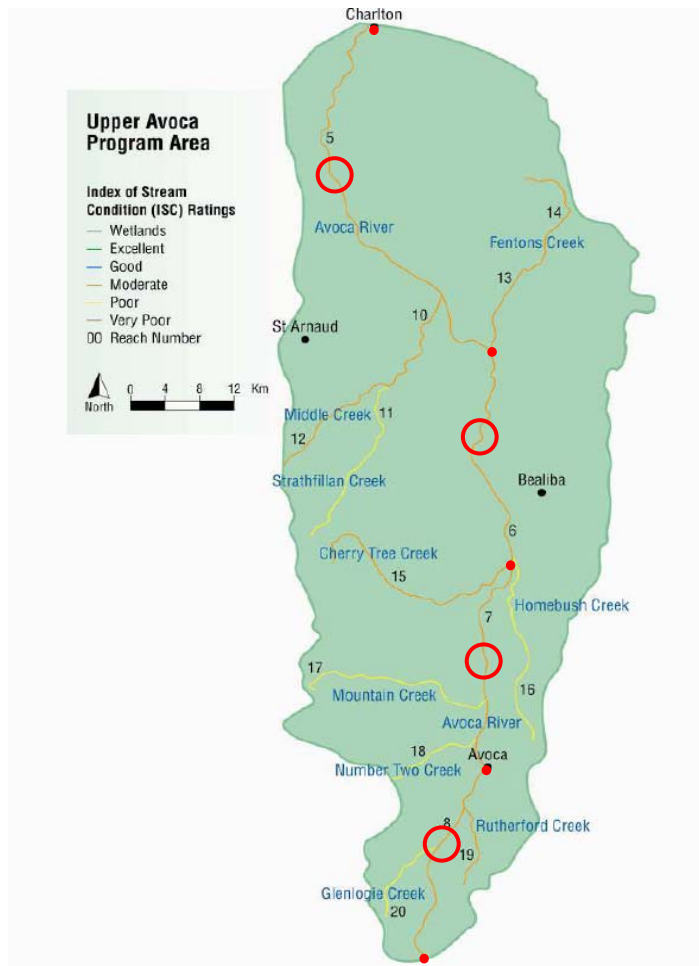


Figure 3. Upper Avoca Program Area, showing catchment waterway condition according to the 1999 Index of Stream Condition (ISC) results.

5 Selecting priority river reaches

There are many waterways across the state needing government investment to improve their health. However given that there is only a limited amount of funding available, the State Government has decided to identify and focus only on priority areas. This approach focuses on protecting remaining high value areas (with high threats) and therefore accepts that some lower priority reaches may continue to decline. This ensures we are investing time and effort into the areas that currently have the greatest community benefit.

The process to identify priority river reaches is a substantial task. It is however important for the community to understand the thinking that sits behind the CMA's decisions and the following describes the process of how priority reaches were identified.

5.1 Determining waterway condition

The NCRHS sets priorities and targets for river health management at the river reach scale (a section of stream normally around 10–30 kilometres long) based on the Index of Stream Condition (ISC). The ISC method is a state wide approach that is based on five sub-indices that measure the extent of change from natural or ideal conditions. An overall condition rating is assigned to a reach i.e. excellent, good, moderate, poor or very poor. Table 1 and Figure 3 show the outcome of the ISC assessment for the Upper Avoca catchment.

The 1999 ISC data indicate that 76% (400 km) of the length of waterways in the Avoca catchment were in moderate condition and 24% (135 km) in poor condition (Table 1; NCCMA, 2005a). Based on 2004 ISC scores and estimated 1999 scores (where available), changes in resource condition can be gauged. The results indicate that reaches 10, 11, 12, 14 and 19 all showed declines of two or more ISC points for one or more subindices. For example, at reach 19 the instream habitat sub-index score declined from 5 in 1999 to 1 in 2004. Reaches 6, 13, 17, 18 and 20 showed declines of two ISC points. Of these, four reaches were on waterways draining into the Avoca River, namely Fentons, Mountain, Number Two and Glenlogie Creeks, and only one was on the main stem of the Avoca River, reach 6 (just north of the Cheery Tree Creek/Avoca River confluence). The combined results indicate deterioration has occurred in most of the major waterways draining into the Avoca River, and the deterioration was mostly associated with the streamside zone, hydrology and physical form sub-indices.

5.2 Waterway values, threats and risks

The River Values and Environmental Risk System, known as RiVERS, is a framework for the prioritisation of river health management programs based on values and threats. 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 harm. The Victorian Waterway Managers Forum and Department of Sustainability and Environment (DSE) have agreed on a state-wide list of values and threats which are presented in Table 2.

Table 2. Value and threat categories assigned to the RiVERS database

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

5.3 Principles

To provide a method to sort the data captured from ISC and AusRivers inputs a number of principles were proposed in the NCRHS. Using these principles and the data allowed the identification of priority river reaches and hence identified where the investment of funding should be targeted.

These principles are underpinned by the notion that it is more cost effective and more likely to lead to better environmental outcomes if the focus is on protecting and enhancing remaining high value natural areas (called 'high value assets'), rather than restoring highly degraded areas. The principles are:

- 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

5.4 Selection criteria

Setting priorities for waterway management considers both the values and threats to ensure resources are allocated to the most important areas and issues. On this basis, the overall objective of the NCRHS for managing river health in the Avoca catchment is to minimise risk to the Ramsar listed Kerang Lakes/Avoca Marshes and to protect river values that contribute to its status as a 'Representative' river. This is particularly relevant when assessing Principle 1 and 2.

Of the 101 reaches in the North Central region the NCRHS identified 56 priority reaches according to these principles. Within these 56 reaches, reaches 5 to 8 (on the main stem of the Upper Avoca River) are considered to be priority reaches. An extract from the NCRHS is provided below which articulates the priorities for these reaches.

Table 3 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

5.5 Priority river reaches

The priority river reaches have been identified in this report and hence the focus for this CAP is to 'Protect and enhance' reaches 5, 6, 7 & 8 of the Avoca River. For a detailed understanding of the values and threats to each of these priority reaches, please refer to Appendix B.

The water quality of these priority river reaches is impacted by upstream generation of sediment and nutrients. This CAP has therefore also identified the most likely sources of sediment generation and also listed these tributaries as priority areas to protect reaches 5, 6, 7 & 8 of the Avoca River.

6 Community engagement outcomes

As part of the CAP process the community was engaged to help set priorities and actions. The following points represent consistent messages raised at the community and stakeholder meetings. Where appropriate and consistent with regional objectives, these points have been incorporated into the CAP and actions taking into account the criteria and principles used to select priority reaches and actions.

Loss of overall habitat, economic and social values:

- Large water holes
- Fish/fishing
- Wildlife (e.g. snakes and birds)
- Low/no flows
- Springs dried up
- Litter in town sites

Sediment accumulation in waterway (more of an issue in reaches 5 & 6)

- Impact on deep pools
- Impact on instream channel
- Impact on change in watercourse
- Allows weed / vegetation intrusion (more frequent flooding)
- Large timber and asset risk in flood
- Flood risk at Avoca and Charlton

Salinity levels in waterway:

- Impact on all aspects of river health
- Unable to water stock

Weeds:

- Chilean Needle Grass
- Gorse
- Castor Oil Plant
- Spiny Rush
- Ash (urban)

Native Plants which may require human management:

- River Red Gum (especially regeneration after flood)
- Cumbungi

Land management of stock exclusion fencing:

- Department of Primary Industries (DPI) can't provide money for fencing Crown land boundaries because Crown land doesn't fence their land
- Conditions of Crown Land leases (i.e. 99 year)

7 Upper Avoca Catchment Action Plan

With direction from the Steering Committee it was agreed that this CAP needed to be concise and easy to understand by the agencies and farming community. As discussed, part of the process undertaken involved reviewing a large number of previous reports (refer to references). These were reviewed in an attempt to extract all of the actions that applied to the Upper Avoca Catchment. A key finding was that many of these reports were either out-dated, not used, or contained a vast amount of actions, thereby requiring unrealistic funding.

In the filtering exercise undertaken it is important to note that the multitude of actions have not been disregarded altogether but marked for review in the next five year plan. These actions have been captured and presented in Appendix C for future reference.

7.1 Focus of effort

Consistent with the NCRHS, this plan is strongly driven by the philosophy that effort needs to be focused into key tasks that result in the best value for money and greatest impact in improving river health of priority reaches. The focus of effort for this CAP can broadly be broken into two principal areas which include the floodplain and tributary areas.

Within the floodplain area of the Avoca River (reaches, 5, 6, 7 & 8) the principal focus of effort and investment is to improve and enhance biodiversity values, with the intention of protecting the internationally important Kerang Wetlands and Avoca Marshes. It is in these areas that the remnant riparian corridor is most intact and improvement of river health is closely linked to improvement in the adjacent vegetation.

Within the tributary areas, actions that relate to the improvement of water quality and sediment generation should be undertaken to protect the instream values of the high priority floodplain reaches of the Avoca River downstream. Table 4 captures where effort should be focused.

Table 4. Catchment areas and focus of effort

Catchment area	Focus of effort	Likely actions
Floodplain area (reaches 5,6,7 & 8)	Biodiversity improvement	Stock exclusion fencing Off stream watering Weed control Rabbit control Revegetation
Upper Tributary area	Sediment generation and water quality	Stock exclusion fencing Off stream watering Rabbit control Gully stabilization and revegetation Recharge exclusion fencing Planting of buffer strips

7.2 What has been excluded from this plan

Almost as important as what has been included in this report, is what has been excluded. These actions have deemed not to be included in this 5 year plan as they are either not appropriate or considered a second priority and should be reconsidered in the next 5 year plan.

Instream habitat works

Large wood naturally recruits into a waterway either through tree death or undermining of the bank. Where the riparian vegetation is sparse and may lack large hard wood species, there may not be sufficient timber falling into the waterway to create the ideal habitat for fish and invertebrates.

The instream habitat works identified in a number of the reviewed plans actually sourcing large logs and physically placing them into the waterway. Such actions were identified as actions in reaches 6, 7 and 8.

Recent instream habitat works within the GHCMa region cost around \$400 per log installed, meaning this is a very expensive task and the costs proposed in the reports reviewed were substantially undercosted. The installation of large timber in engineered log structures may provide benefit in some scouring and improve the habitat value of the waterway bed, but given the large volume of sand in the system, they would likely need to be significantly engineered to avoid being smothered, further adding to the cost.

It is proposed that limited funding is better spent on actions that provide better value for money. In reality, the best way to create a self sustaining system of large wood in waterways is to ensure the timber is growing on the banks. Therefore the focus in the next five years has been on the protection and enhancement of the riparian vegetation and not instream habitat works.

Stormwater Management Plan actions

There are a number of actions that relate to the implementation of stormwater management plan actions. As a general rule, urban stormwater has elevated levels of nitrogen, phosphorus and suspended solids and has the potential to transport litter.

Nitrogen is predominantly from atmospheric sources and not a direct result of urbanisation. Phosphorus is normally attached to sediment, and it is proposed that the level of sediment and suspended solids generated in urban areas is effectively negligible when compared to agricultural runoff and bed and bank erosion of gullies and waterways.

Litter is the other area of concern but engagement with the community and stakeholders did not consider litter to be a major issue.

It is proposed that pursuing Stormwater Management Plan actions does not present the best value for money if the focus of effort is to improve the health of the waterway in the next five years. Given the impact of stormwater is relatively minor, it is suggested that these actions are placed on hold until a time that all other higher priority actions have been completed.

Septic tank management

Septic tank management was raised in a number of reports as an issue that needs to be addressed. It was difficult to determine the extent of the issue from the literature but generally nutrients levels were not identified as a key issue in the priority reaches nor did the community

identify any issues regarding high nutrients. This does not mean that high nutrients are not an issue, but does suggest that that are not on top of the priority list. Septic tank issues have not been included in this 5 year plan but may be considered in later plans.

Intensive industry effluent management

Piggeries were raised as a topic for discussion during the community forums and actions were identified in some of the reviewed reports to “implement best practice in the intensive animal industry associated with effluent management”.

There was no tangible evidence that effluent from any intensive animal industries was impacting on the waterways in the catchment and discussion with the Environmental Protection Authority (EPA) suggests the issue is well managed through the provision of the Environment Protection Act 1970.

It is proposed that any actions associated with effluent management should not be part of this CAP. Any actions should be undertaken by the EPA and are excluded from the scope of catchment planning.

Flood plain management

There were a number of actions that pertained to flood plain management within the reports reviewed. Although it was generally agreed that flooding is an issue of concern especially on the lower reaches, discussion with CMA staff revealed that the lack of data across the entire region made it difficult to progress local flooding issues. Local governments are also concerned with flooding, current sediment/timber accumulation and how this may impact private and public assets in a flood event. It is recommended that this concern is communicated to the NCCMA Floodplain Manager to consider actions along with other flood mapping priorities across the region.

Environmental flow recommendations

Actions associated with environmental flow recommendations are basically aligned with checking if extraction currently exceeds flow recommendations. This issue was not raised as being significant to the community nor the stakeholder group; however, given the issues of ongoing low rainfall, it is appropriate that it should maintain the interest of the CMA.

Actions associated with this issue have not been included in the action tables, but should be considered further if there is more detailed feedback received during the public exhibition process.

8 Action Plans

The following tables present the actions and maps for the nominated reaches. This information has been presented so that it is relatively simple to extract an A3 plan and map to provide to a landholder / landcare group to illustrate where the focus of effort should be over the next 5 years.

The Action Plans provide a basic vision of the system at 5 years and prioritises actions in case funding is limited. Where possible the extent of the action has been quantified and an indicative cost provided.

Although the action plans appear to provide a range of simplistic actions, they have been developed with consideration to community input and a focus on how to direct effort for the greatest impact on river health. Table 5 helps to communicate that the implementation of actions identified in the action plans will address the majority of community concerns raised in section 6.

Table 5. Community issues and incorporation into CAP

Concern raised	Action to address issues	Incorporated into action plans
Loss of large water holes	Reduce sediment input through control of erosion	Yes
Loss of fish/fishing	Reduce sediment input through control of erosion and fence and revegetate waterway. Protection of refuge areas (water holes) through fencing, revegetation and maintenance of water levels in holes during dry conditions where possible.	Yes
Wildlife (e.g. snakes and birds)	Improve habitat values by excluding stock and revegetation activities	Yes
Low/no flows	Issue principally climate driven and cannot be addressed through management actions	No
Springs dried up	Issue principally climate driven and cannot be addressed through management actions	No
Impact on instream channel	Reduce sediment input through control of erosion	Yes
Impact on change in watercourse	Reduce sediment input through control of erosion	Yes
More frequent flooding through weed / vegetation intrusion	Reduce sediment input through control of erosion	Yes
Large timber and asset risk in flood	Large timber plays a vital role in river ecology and is not targeted as a general action. Areas of threat to high value assets may require intervention, but such sites have not been identified in this process	No
Flood risk at Avoca and Charlton	There is a substantial amount of work required to understand flood risk, however, a reduction of sediment input through control of erosion will maintain greater cross sectional capacity and can therefore convey greater amounts of water within the channel	Yes
Weeds (various species)	Control weeds in priority areas to protect high value vegetation	Yes
Salinity levels in waterway	Implement recharge revegetation as directed by the Dryland Salinity Management Plan	No

Action Plan - REACH 5

Current Condition:

The indigenous vegetation of Reach 5 is a fragmented subset of the larger agriculturally dominated vegetation community. This means the existing remnants have a high edge to volume ratio allowing greater light and wind penetration creating conditions that favour exotic grasses and a poor environment for the establishment of seed from indigenous species. Along this reach the riparian buffer ranges from good condition with a diversity of cover and understorey species to degraded which is significantly compromised by weeds and stock access. The areas of 'good' vegetation condition are the target for works in this 5 year plan and generally these areas have a reasonably intact over and understorey community but are in slow decline due to grazing pressure and ongoing weed invasion. These areas of 'good' condition are scattered along the length of Reach 5 and not well connected.



Proposed Condition:

The proposed condition of Reach 5 involves the exclusion of all stock through repair of existing fencing, and construction of new fences. This will create a buffer strip of a minimum of 25 m along the length of the waterway that is identified as having 'good' vegetation condition and will provide the greatest value for NRM outcomes. Areas of 'good' vegetation will be joined through linking plantations where appropriate to improve longitudinal connectivity. Weeds and vermin will be well controlled to allow the regeneration of robust over, middle and understorey species. Ground storey species may or may not establish depending on the extent of invasive grasses. With the exclusion of stock the in-stream and ephemeral environment should improve in species diversity and density.

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Survey existing fences along all priority areas of high value vegetation and where necessary repair fences and gates to exclude stock.	N/A	X	X				Fences adequately exclude stock.	Fences adequately exclude stock.	Minimal	Landholder with support from NCCMA/DPI.
Where no fencing exists, construct fences to exclude stock in nominated priority areas of high value vegetation.	18km [#]	X	X	X			Fences adequately exclude stock 1 year after construction.	Improvement of one in the measurement of riparian condition within area of works.	\$92,000 ¹	Landholder with support from NCCMA/DPI.
Undertake weed and vermin control in all areas that are fenced off.	7ha*	X	X	X			All significant weed species have been eradicated after three years.	Improvement of one in the measurement of riparian condition within area of works.	\$7,000 ²	Landholder with support from NCCMA/DPI.
Install off stream watering where required at areas that are fenced off and if located in priority areas.	20 sites	X	X	X			Off stream watering installed and operational.	Improvement of one in the measurement of riparian condition within area of works.	\$20,000 ³	Landholder with support from NCCMA/DPI.
Fence and revegetate priority areas to link areas of high value vegetation (aim 25m buffer and 4 rows of vegetation) along waterway. Works include 8km fencing and 10,400 plants.	8km [#] 10,400plants [^]			X	X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$65,000 ⁴	Landholder with support from NCCMA/DPI.
Undertake maintenance on all new plantings to control weeds.	8km			X	X	X	Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$2000	Landholder with support from NCCMA/DPI.
Undertake an assessment to determine if a fish ladder is required at Yawong weir. Consideration should be given to the value of the actual barrier and current and future habitat values of upstream.		X					Undertake assessment using qualified consultant.	N/A	\$10,000	NCCMA
Undertake inspection of the fish refuge areas from Gower East Bridge and immediately downstream, Yawong Weir (500m upstream + 1km downstream) and Charlton weir pool with local angling clubs. Discuss the need for any fencing and revegetation activities, and to ensure no inappropriate amounts of water is being extracted from these specific deep pool locations.		X					An understanding of the site and improved protection and enhancement if required.	As per output.	Minimal	NCCMA/DPI in conjunction with local angling club.

length includes both sides of waterway. i.e a 1km reach will have a fencing requirement of 2km. Also assumes no fencing present and therefore figures and costs presented provide the worse possible scenario.

* assumes an average buffer width of 25 meters.

[^] plants include a mix of 1/3 overstorey and 2/3 understorey.

Priority Actions

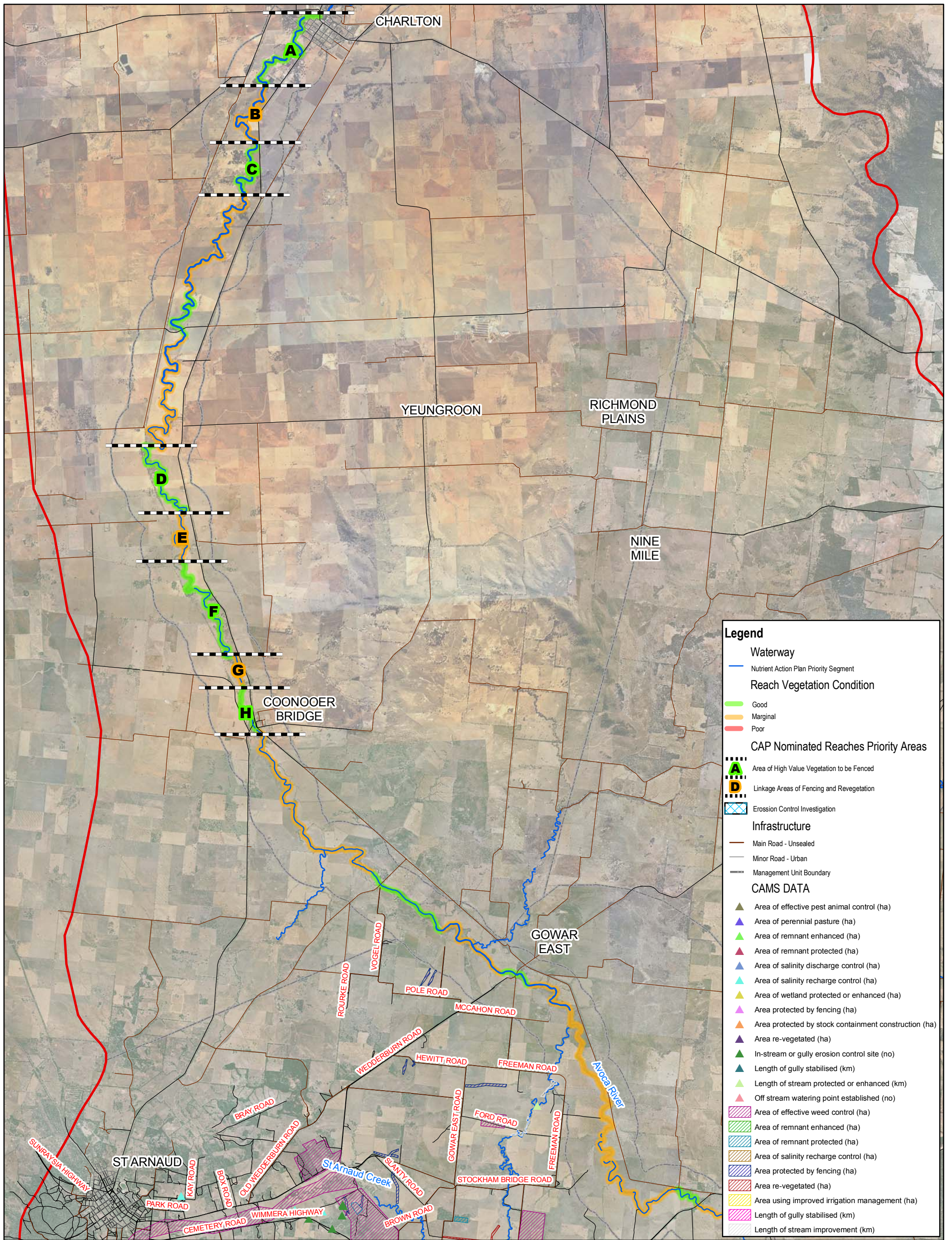
Action	Very High	High	Med	Low
Exclude stock from all nominated areas of high priority remnant vegetation.	X			
Eradicate weeds and vermin for all nominated areas of high priority remnant vegetation.	X			
Install off stream watering for all nominated areas of high priority remnant vegetation.		X		
Revegetate priority areas to link nominated areas of high value vegetation.		X		
Assess need for fish ladder at Yawong weir.			X	
Ensure protection of fish refuge area (water hole) in nominated areas within this reach			X	

1 assumes \$5/m for materials and labour provided by landholder as part of a devolved grant process.

2 assumes \$1000/ha and is an annual cost.

3 assumes 1000/site.

4 planting assumes \$2.50/plant for materials and labour provided by landholder as part of a devolved grant process. also assumes \$5/m for fencing materials and labour provided by landholder as part of a devolved grant process.



HLA
REACH 5 - AVOCA RIVER
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria

alluvium



DATUM GDA 1994, PROJECTION MGA ZONE 55
 0 5501,100 2,200 3,300 4,400
 Metres

FIGURE

1

Action Plan - REACH 6

Current Condition:

The indigenous vegetation of Reach 6 is a fragmented subset of the larger agriculturally dominated vegetation community. This means the existing remnants have a high edge to volume ratio allowing greater light and wind penetration creating conditions that favour exotic grasses and a poor environment for the establishment of seed from indigenous species. Along this reach the riparian buffer ranges from good condition with a diversity of over and understorey species to degraded and is significantly compromised by weeds and stock access. The areas of 'good' vegetation condition are the target for works in this 5 year plan and generally these areas have reasonably intact over and under storey communities but are in slow decline due to grazing pressure and ongoing weed invasion. These areas of 'good' condition are scattered along the length of Reach 6 and not well connected.



Proposed Condition:

The proposed condition of Reach 6 involves the exclusion of all stock through repair of existing fencing, and construction of new fences. A buffer strip will be created of a minimum of 25 m along the length of the waterway that is identified as having good vegetation condition and will provide the greatest value for money for NRM outcomes. Areas of 'good' vegetation will be joined through linking plantations where appropriate to improve longitudinal connectivity. Weeds and vermin will be well controlled to allow the regeneration of robust over, middle and understorey species. Ground storey species may or may not establish depending on the extent of invasive grasses. With the exclusion of stock the instream and ephemeral environment should improve in species diversity and density.

Priority Actions

Action	Very High	High	Med	Low
Exclude stock for all areas of nominated high priority remnant vegetation.	X			
Eradicate weeds and vermin for all areas of nominated high priority remnant vegetation.	X			
Install off stream watering for all areas of nominated high priority remnant vegetation.		X		
Revegetate priority areas to link areas of high value vegetation.		X		

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Survey existing fences along all priority areas of high value vegetation and where necessary repair fences and gates to exclude stock.	N/A	X	X				Fences adequately exclude stock.	Fences adequately exclude stock.	Minimal	Landholder with support from NCCMA/DPI.
Where no fencing exists, construct fences to exclude stock in nominated priority areas of high value vegetation.	5km [#]	X	X	X			Fences adequately exclude stock 1 year after construction.	Improvement of one in the measurement of riparian condition within area of works.	\$25,000 ¹	Landholder with support from NCCMA/DPI.
Undertake weed and vermin control in all areas fenced off.	3ha*	X	X	X			All significant weed species have been eradicated after three years.	Improvement of one in the measurement of riparian condition within area of works.	\$3,000 ²	Landholder with support from NCCMA/DPI.
Install off stream watering where required at areas fenced off and if located in nominated priority areas.	10 sites	X	X	X			Off stream watering installed and operational.	Improvement of one in the measurement of riparian condition within area of works.	\$10,000 ³	Landholder with support from NCCMA/DPI.
Fence and revegetate priority areas to link areas of high value vegetation (aim 25m buffer and 4 rows of vegetation) along waterway. Works include 6km fencing and 8,000 plants.	6km [#] 8,000 plants [^]			X	X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$50,000 ⁴	Landholder with support from NCCMA/DPI.
Fence and revegetate priority areas to link areas of nominated high value vegetation off waterway. i.e connection of waterway environment to large stands of terrestrial vegetation (aim 25m corridor and 4 rows of vegetation).	0.6km [#] 800 plants [^]			X	X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Movement of fauna species between the riparian corridor and large stands of remnant vegetation.	\$5,000 ⁴	Landholder with support from NCCMA/DPI. (Biodiversity program)
Undertake maintenance on all new plantings to control weeds.	6.6km			X	X	X	Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$10,000	Landholder with support from NCCMA/DPI.

length includes both sides of waterway. i.e a 1km reach will have a fencing requirement of 2km. Also assumes no fencing present and therefore figures and costs presented provide the worse possible scenario.

* assumes a average buffer width of 25 meters.

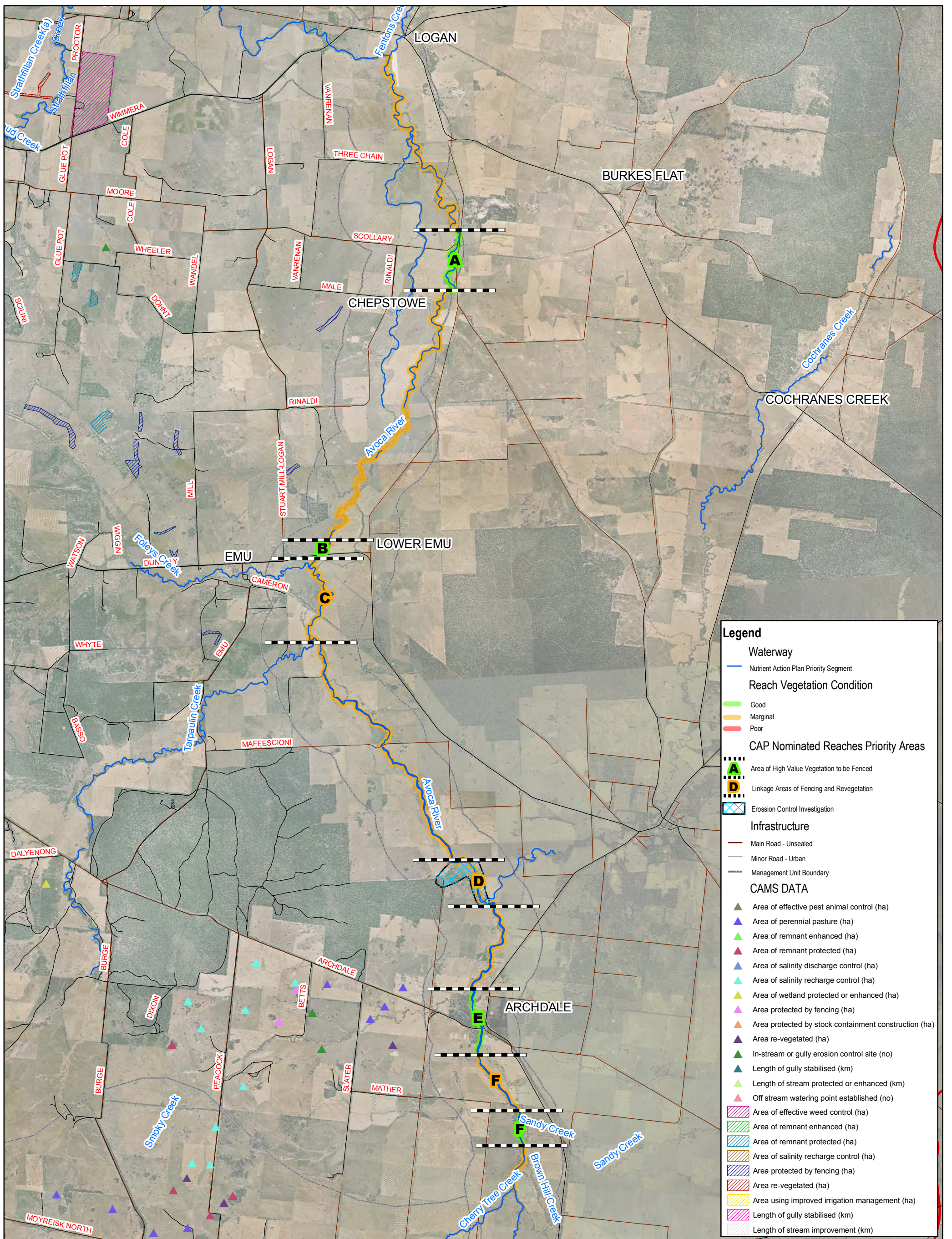
^ plants include a mix of 1/3 overstorey and 2/3 understorey

1 assumes \$5/m for materials and labour provided by landholder as part of a devolved grant process

2 assumes \$1000/ha

3 assumes 1000/site

4 planting assumes \$2.50/plant for materials and labour provided by landholder as part of a devolved grant process. also assumes \$5/m for fencing materials and labour provided by landholder as part of a devolved grant process



REACH 6 - AVOCA RIVER
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



DATUM GDA 1994, PROJECTION MGA ZONE 55
 0 390 780 1,560 2,340 3,120
 Metres

FIGURE

2

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Action Plan - REACH 7

Current Condition:

The indigenous vegetation of Reach 7 is a fragmented subset of the larger agriculturally dominated vegetation community. This means the existing remnants have a high edge to volume ratio allowing greater light and wind penetration creating conditions that favour exotic grasses and a poor environment for the establishment of seed from indigenous species. Along the reach the riparian buffer ranges from good condition with a diversity of over and understorey species to degraded which is significantly compromised by weeds and stock access. The areas of 'good' vegetation condition are the target for works in this 5 year plan and generally these areas have reasonably intact over and under storey communities but are in slow decline due to grazing pressure and ongoing weed invasion. These areas of 'good' condition are fairly minimal and are scattered along the length of Reach 7.



Proposed Condition:

The proposed condition of Reach 7 involves the exclusion of all stock through repair of existing fencing, and construction of new fences. A buffer will be created of a minimum of 25m along the length of the waterway that is identified as having 'good' vegetation condition. Areas of 'good' vegetation will be joined through linking plantations where appropriate to improve longitudinal connectivity. Weeds and vermin will be well controlled to allow the regeneration of robust over, middle and under storey species. Ground storey species may or may not establish depending on the extent of invasive grasses. With the exclusion of stock, the instream and ephemeral environment should improve in species diversity and density.

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Survey existing fences along all priority areas of high value vegetation and where necessary repair fences and gates to exclude stock.	N/A	X	X				Fences adequately exclude stock.	Fences adequately exclude stock.	Minimal	Landholder with support from NCCMA/DPI.
Where no fencing exists, construct fences to exclude stock in nominated priority areas of high value vegetation.	3.5km [#]	X	X	X			Fences adequately exclude stock 1 year after construction.	Improvement of one in the measurement of riparian condition within area of works.	\$17,000 ¹	Landholder with support from NCCMA/DPI.
Undertake weed and vermin control in all areas fenced off.	30ha [*]	X	X	X			All significant weed species have been eradicated after three years.	Improvement of one in the measurement of riparian condition within area of works.	\$30,000 ²	Landholder with support from NCCMA/DPI.
Install off stream watering where required at areas fenced off and if located in nominated priority areas	20 sites	X	X	X			Off stream watering installed and operational.	Improvement of one in the measurement of riparian condition within area of works.	\$20,000 ³	Landholder with support from NCCMA/DPI.
Fence and revegetate priority areas to link areas of high value vegetation (aim 25m buffer and 4 rows of vegetation) along waterway. Works include 8km fencing and 44,000 plants.	12km [#] 2000 plants [^]			X	X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$100,000 ⁴	Landholder with support from NCCMA/DPI.
Undertake maintenance on all new plantings to control weeds	12km			X	X	X	Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	Minimal	Landholder with support from NCCMA/DPI.

length includes both sides of waterway. i.e a 1km reach will have a fencing requirement of 2km. Also assumes no fencing present and therefore figures and costs presented provide the worse possible scenario.

* assumes a average buffer width of 25 meters.

^ Plants include a mix of 1/3 overstorey and 2/3 understorey

Priority Actions

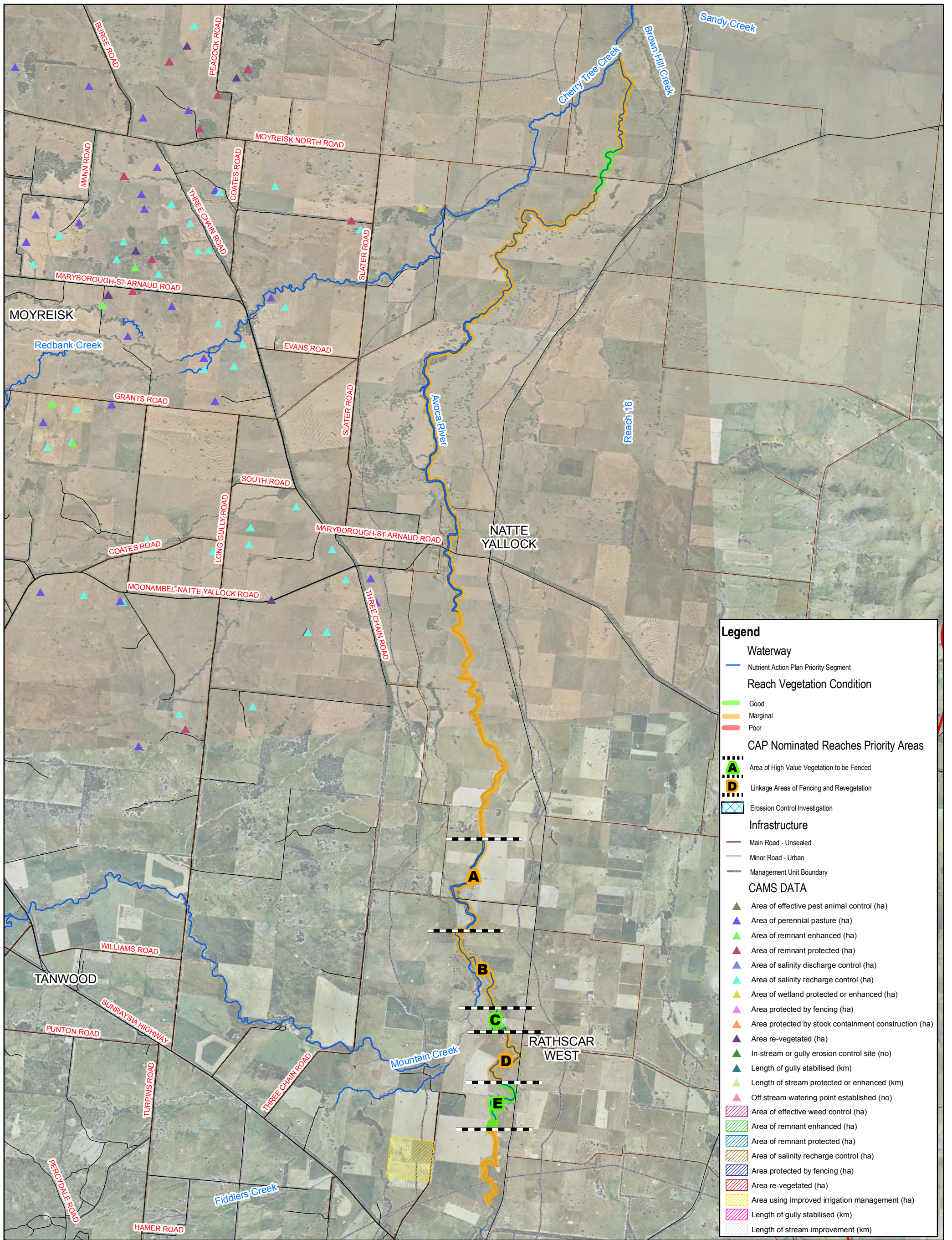
Action	Very High	High	Med	Low
Exclude stock from all areas of nominated high priority remnant vegetation.	X			
Eradicate weeds and vermin for all areas of nominated high priority remnant vegetation.	X			
Install off stream watering for all areas of nominated high priority remnant vegetation.		X		
Revegetate priority areas to link areas of nominated high value riparian vegetation.		X		

1 assumes \$5/m for materials and labour provided by landholder as part of a devolved grant process

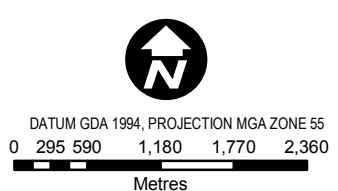
2 assumes \$1000/ha

3 assumes 1000/site

4 planting assumes \$2.50/plant for materials and labour provided by landholder as part of a devolved grant process. also assumes \$5/m for fencing materials and labour provided by landholder as part of a devolved grant process



REACH 7 - AVOCA RIVER
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



FIGURE

3

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Action Plan - REACH 8

Current Condition:

The indigenous vegetation of Reach 8 is a fragmented subset of the larger agriculturally dominated vegetation community. This means the existing remnants have a high edge to volume ratio allowing greater light and wind penetration creating conditions that favour exotic grasses and a poor environment for the establishment of seed from indigenous species. Along the reach the riparian buffer ranges from good condition with a diversity of over and under storey species to degraded which is significantly compromised by weeds and stock access. The areas of 'good' vegetation condition are the target for works in this 5 year plan and generally these areas have reasonably intact over and under storey community but are in slow decline due to grazing pressure and ongoing weed invasion. These areas of 'good' condition are scattered along the length of Reach 8 and not well connected.



Proposed Condition:

The proposed condition of Reach 8 involves the exclusion of all stock through repair of existing fencing, and construction of new fences. It is intended that a 25m buffer strip is created along the length of the waterway that is identified as having 'good' vegetation condition. Areas of 'good' vegetation will be joined through linking plantations where appropriate to improve longitudinal connectivity. Weeds and vermin will be well controlled to allow the regeneration of robust over, middle and understorey species. Ground storey species may or may not establish depending on the extent of invasive grasses. With the exclusion of stock the instream and ephemeral environment should improve in species diversity and density.

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Survey existing fences along all priority areas of high value vegetation and where necessary repair fences and gates to exclude stock.	N/A	X	X				Fences adequately exclude stock.	Fences adequately exclude stock.	Minimal	Landholder with support from NCCMA/DPI.
Where no fencing exists, construct fences to exclude stock in priority areas of high value vegetation.	7.3 km [#]	X	X	X			Fences adequately exclude stock 1 year after construction.	Improvement of one in the measurement of riparian condition within area of works.	\$36,500 ¹	Landholder with support from NCCMA/DPI.
Undertake weed and vermin control in all areas fenced off.	2ha*	X	X	X			All significant weed species have been eradicated after three years.	Improvement of one in the measurement of riparian condition within area of works.	\$2,000 ²	Landholder with support from NCCMA/DPI.
Install off stream watering where required at areas fenced off and if located in nominated priority areas.	20 sites	X	X	X			Off stream watering installed and operational.	Improvement of one in the measurement of riparian condition within area of works.	\$20,000 ³	Landholder with support from NCCMA/DPI.
Fence and revegetate priority areas to link areas of high value vegetation (aim 25m buffer and 4 rows of vegetation) along waterway. Works include 12km fencing and 12,000 plants.	12km [#] 12,000 plants [^]			X	X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$73,991 ⁴	Landholder with support from NCCMA/DPI.
Undertake maintenance on all new plantings to control weeds.	12km			X	X	X	Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works.	\$10,000	Landholder with support from NCCMA/DPI.

length includes both sides of waterway. i.e a 1km reach will have a fencing requirement of 2km. Also assumes no fencing present and therefore figures and costs presented provide the worst possible scenario.

* assumes a average buffer width of 25 meters.

[^] plants include a mix of 1/3 overstorey and 2/3 understorey

Priority Actions

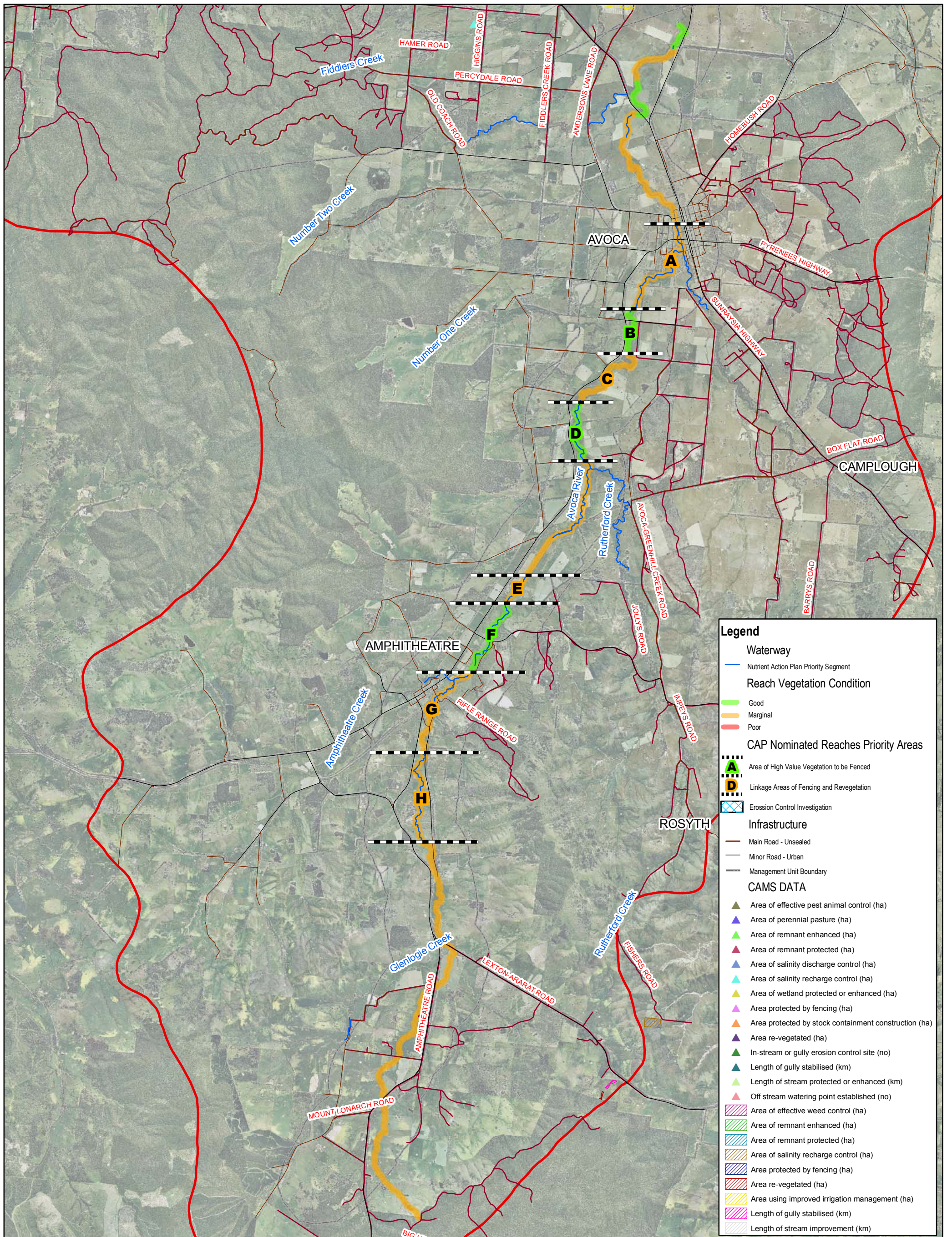
Action	Very High	High	Med	Low
Exclude stock from all areas of nominated high priority remnant vegetation.	X			
Eradicate weeds and vermin for all areas of nominated high priority remnant vegetation.	X			
Install off stream watering for all areas of nominated high priority remnant vegetation.		X		
Revegetate priority areas to link areas of nominated high value vegetation.		X		

1 assumes \$5/m for materials and labour provided by landholder as part of a devolved grant process

2 assumes \$1000/ha

3 assumes 1000/site

4 planting assumes \$2.50/plant for materials and labour provided by landholder as part of a devolved grant process. also assumes \$5/m for fencing materials and labour provided by landholder as part of a devolved grant process



Legend

Waterway

- Nutrient Action Plan Priority Segment

Reach Vegetation Condition

- Good
- Marginal
- Poor

CAP Nominated Reaches Priority Areas

- Area of High Value Vegetation to be Fenced
- Linkage Areas of Fencing and Revegetation
- Erosion Control Investigation

Infrastructure

- Main Road - Unsealed
- Minor Road - Urban
- Management Unit Boundary

CAMS DATA

- Area of effective pest animal control (ha)
- Area of perennial pasture (ha)
- Area of remnant enhanced (ha)
- Area of remnant protected (ha)
- Area of salinity discharge control (ha)
- Area of salinity recharge control (ha)
- Area of wetland protected or enhanced (ha)
- Area protected by fencing (ha)
- Area protected by stock containment construction (ha)
- Area re-vegetated (ha)
- In-stream or gully erosion control site (no)
- Length of gully stabilised (km)
- Length of stream protected or enhanced (km)
- Off stream watering point established (no)
- Area of effective weed control (ha)
- Area of remnant enhanced (ha)
- Area of remnant protected (ha)
- Area of salinity recharge control (ha)
- Area protected by fencing (ha)
- Area re-vegetated (ha)
- Area using improved irrigation management (ha)
- Length of gully stabilised (km)
- Length of stream improvement (km)



REACH 8 - AVOCA RIVER
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



DATUM GDA 1994, PROJECTION MGA ZONE 55
 0 360 720 1,440 2,160 2,880
 Metres

FIGURE

4

File Location: \\hla\maw\GIS\M60032901\ArcGIS\M60032901_Reach10_04-Jul-07.mxd

Action Plan - REACH 16 (HOMEBUSH CREEK)

Current Condition:

Reach 16 has vegetation ranging from marginal to very poor and in many areas has no waterway vegetation at all. The surrounding land is predominantly cleared and is an ongoing source of sediment and nutrients into the waterway. Two areas of gully erosion have been identified that appear to be active and would contribute sediment to Homebush Creek and ultimately the Avoca River. The major focus for the next five years is to address the obvious areas of erosion and sediment generation.



Proposed Condition:

The proposed condition of Reach 16 for the next 5 years involves the exclusion of stock from areas that have ongoing erosion issues. These areas will be further stabilised through the installation of rock chutes (where appropriate) and revegetation activities. The combination of revegetation and natural recruitment of grasses to the site will result in a stable systems that no longer contributes sediment to Homebush Creek, and in turn the Avoca River.

The majority of the watercourse of Homebush Creek will largely remain in the same condition but may continue to decline through ongoing stock access. Fencing and revegetation activities for this creek may be considered in future action plans when the higher priority actions are completed.

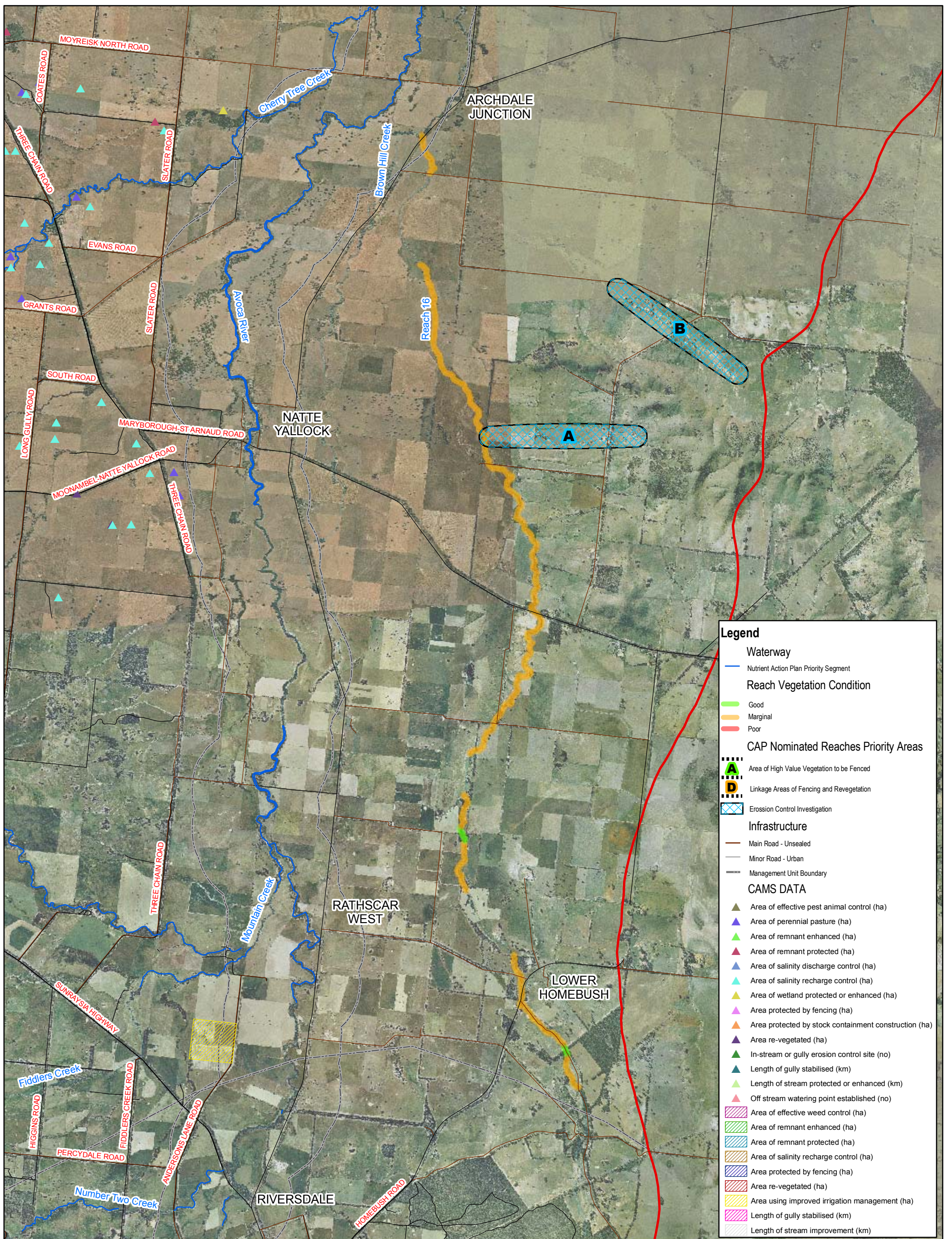
Priority Actions

Action	Very High	High	Med	Low
Initial investigation to determine if any detailed engineering design work is required.	X			
Exclude stock for all areas nominated for erosion control works.	X			
Undertake revegetation works to help stabilise the tributary.		X		
If required initiate functional design to install grade control structures.		X		
Ensure protection of fish refuge area (water hole) in nominated areas within this reach			X	

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Undertake initial investigation to determine the cause and extent of erosion. This would then identify if grade control structures are required and further design work can be initiated.	N/A	X					An initial understanding of the system and suite of treatment measures required.	As per output.	\$3000	NCCMA/DPI.
If grade control structures are required then initiate functional design and construction.	TBD [#]		X				Grade control structures designed and constructed.	Grade control structures stable after 2 normal years of flow events.	TBD [#]	NCCMA/DPI.
Where no fencing exists, construct fences to exclude stock from all sites of active erosion.	TBD [#]	X	X	X			Adequate fencing completed to effectively exclude stock.	With exclusion of stock pugging and stock trafficking are eliminated to reduce erosion and allow the growth of vegetation.	TBD [#]	Landholder with support from NCCMA/DPI.
Revegetate area with appropriate species. (note: low lying land may be subject to elevated salinity levels)	TBD [#]	X	X	X			Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Plants established and a sustainable self recruiting system is evident within 5 years.	TBD [#]	Landholder with support from NCCMA/DPI.
Undertake maintenance on all new plantings to control weeds	12km			X	X		Weeds controlled within fenced area for first three years.	Improvement of 1 in score of ISC Physical Form subindex in 10 years.	Minimal	Landholder with support from NCCMA/DPI.
Undertake inspection of the fish refuge area's adjacent to Natte Yalklock football ground, from Emu Road bridge to 2 km downstream and around Archdale Bridge with local angling clubs. Discuss the need for any fencing and revegetation activities, and to ensure no inappropriate amounts of water is being extracted from these specific deep pool locations.		X					An understanding of the site and improved protection and enhancement if required.	As per output.	Minimal	NCCMA/DPI in conjunction with local angling club.

needs site assessment to determine extent of issue



Legend

Waterway

- Nutrient Action Plan Priority Segment

Reach Vegetation Condition

- Good
- Marginal
- Poor

CAP Nominated Reaches Priority Areas

- Area of High Value Vegetation to be Fenced
- Linkage Areas of Fencing and Revegetation
- Erosion Control Investigation

Infrastructure

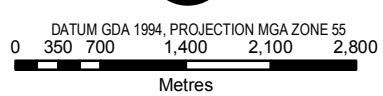
- Main Road - Unsealed
- Minor Road - Urban
- Management Unit Boundary

CAMS DATA

- Area of effective pest animal control (ha)
- Area of perennial pasture (ha)
- Area of remnant enhanced (ha)
- Area of remnant protected (ha)
- Area of salinity discharge control (ha)
- Area of salinity recharge control (ha)
- Area of wetland protected or enhanced (ha)
- Area protected by fencing (ha)
- Area protected by stock containment construction (ha)
- Area re-vegetated (ha)
- In-stream or gully erosion control site (no)
- Length of gully stabilised (km)
- Length of stream protected or enhanced (km)
- Off stream watering point established (no)
- Area of effective weed control (ha)
- Area of remnant enhanced (ha)
- Area of remnant protected (ha)
- Area of salinity recharge control (ha)
- Area protected by fencing (ha)
- Area re-vegetated (ha)
- Area using improved irrigation management (ha)
- Length of gully stabilised (km)
- Length of stream improvement (km)



REACH 16 - HOMEBUSH CREEK
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



FIGURE

5

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Action Plan - REACH 13 (FENTONS CREEK)

Current Condition:

Reach 13 is characterised by marginal to poor remnant riparian vegetation and degraded waterway values. Along the reach the riparian buffer ranges from poor condition to no buffer at all. The surrounding land is predominantly cleared and is an ongoing source of sediment and nutrients into the waterway. On the eastern side of the waterway there is an unnamed tributary that displays substantial erosion and is most likely a major contributor of sediment to this system. The areas of erosion and sediment generation will be the major focus for the next five years.



Proposed Condition:

The proposed condition of Reach 13 for the next 5 years involves the exclusion of stock from areas that have ongoing erosion issues. These areas will be further stabilised through the installation of rock chutes (where appropriate) and revegetation activities. The combination of revegetation and natural recruitment of grasses to the site will result in a stable systems that no longer contributes sediment to Fenton's Creek, and in turn the Avoca River.

The majority of the watercourse of Fentons Creek will largely remain in the same condition but may continue to decline through ongoing stock access. It is however proposed to capitalise on the works undertaken to manage erosion by fencing and revegetating Fentons Creek from the confluence of the Avoca and Fentons and confluence of Avoca and tributary displaying the erosion issue. This action largely provides some connectivity to the vegetation established for erosion control and the vegetation on the Avoca River.

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Undertake initial investigation to determine the cause and extent of erosion. This would identify the need for any grade control structures and further design work can be initiated.	N/A	X					An initial understanding of the system and suite of treatment measures required.	As per Output	\$3000	NCCMA/DPI
If grade control structures are required then initiate functional design and construction.	TBD [#]		X				Grade control structures designed and constructed.	Grade control structures stable after 2 normal years of flow events	TBD [#]	NCCMA/DPI
Where no fencing exists, construct fences to exclude stock from all sites of active erosion. Initial investigation can determine appropriate extent of fencing and revegetation activities.	TBD [#]	X	X	X			Adequate fencing completed to effectively exclude stock.	With stock pugging and stock trafficking eliminated, growth of vegetation (especially grasses) will be prolific.	TBD [#]	Landholder with support from NCCMA/DPI
Revegetate area with appropriate species. (note: low lying land may be subject to elevated salinity levels)	TBD [#]	X	X	X			Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Plants established and a sustainable self recruiting system is evident within 5 years.	TBD [#]	Landholder with support from NCCMA/DPI
Consider fencing and revegetating Fenton's Creek from the confluence with the Avoca River and the confluence with the tributary associated with the erosion works. (Aim for a 15m buffer and 3 rows of vegetation). This is a lower priority action and should only be pursued after the major sediment sources within the sub-catchment are effectively managed.	5km*				X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years.	Improvement of one in the measurement of riparian condition within area of works	\$40,000 ¹	Landholder with support from NCCMA/DPI
Undertake weed and vermin control in all areas fenced off in above actions.	TBD [#]	X	X	X	X	X	All significant weed species have been eradicated after three years.	As per Output	TBD [#]	Landholder with support from NCCMA/DPI

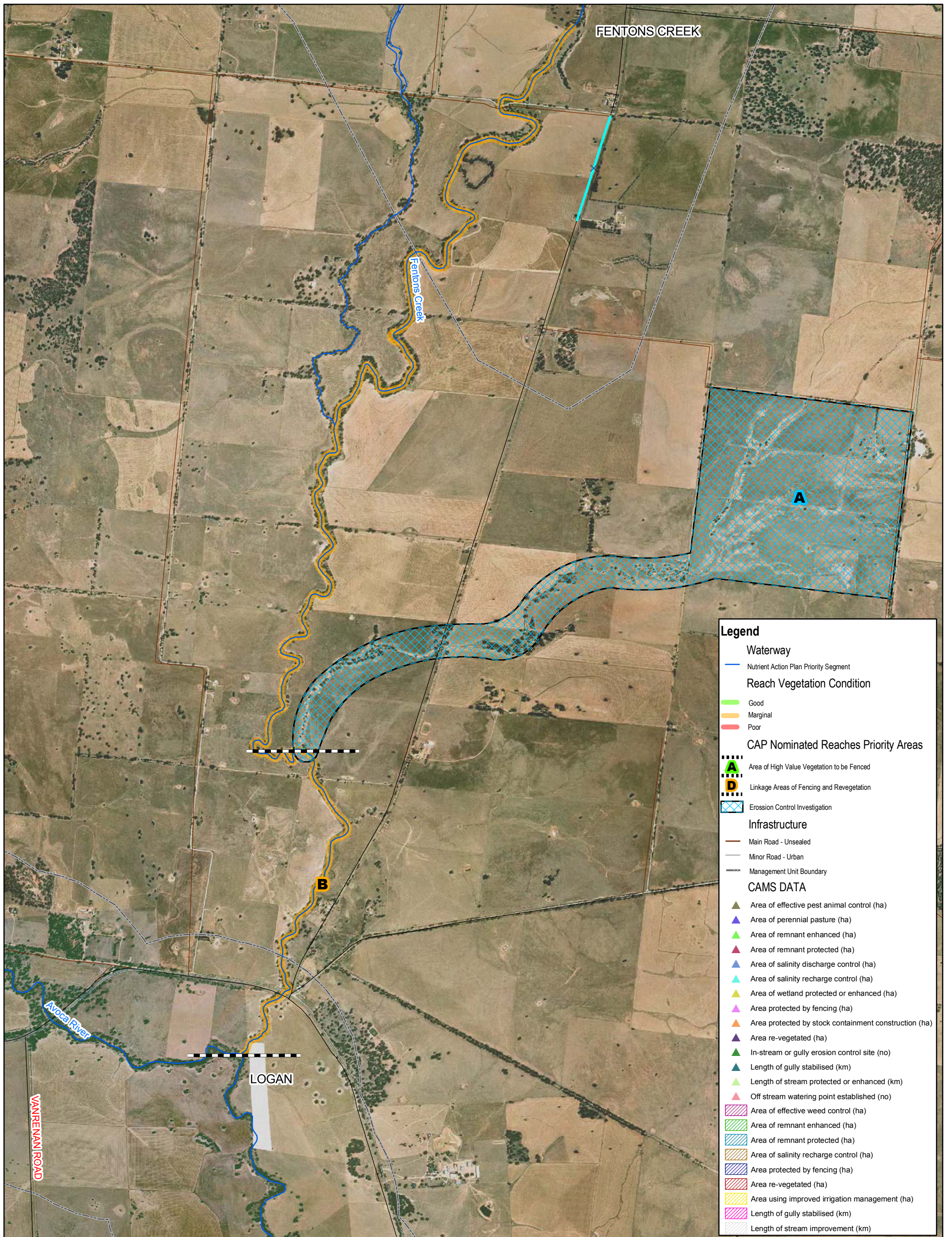
needs site assessment to determine extent of issue

* length includes both sides of waterway. i.e a 1km reach will have a fencing requirement of 2km. Also assumes no fencing present and therefore figures and costs presented provide the worse possible scenario.

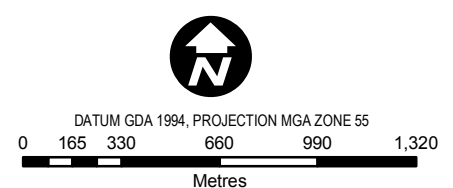
Priority Actions

Action	Very High	High	Med	Low
Initial investigation to determine if any detailed engineering design work is required.	X			
Exclude stock for all areas nominated for erosion control works.	X			
If required initiate functional design to install grade control structures.		X		
Undertake revegetation works to help stabilise the tributary.		X		
Consider fencing and revegetating Fentons Creek from the confluence with the eroded tributary to the confluence with the Avoca River.			X	

¹ Planting assumes \$2.50/plant for materials and labour provided by landholder as part of a devolved grant process. Also assumes \$5/m for fencing materials and labour provided by landholder as part of a devolved grant process



REACH 13 - FENTONS CREEK
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



FIGURE

6

Action Plan - REACH 17 (MOUNTAIN CREEK)

Current Condition:

Reach 17 has marginal to very poor riparian vegetation and in many areas has no vegetation at all. The surrounding land is predominantly cleared and is an ongoing source of sediment and nutrients into the waterway. One area of gully erosion has been identified that appears to be active and would contribute sediment to Mountain Creek and ultimately the Avoca River. The major focus for the next five years is to address the obvious areas of erosion and sediment generation.



Proposed Condition:

The proposed condition of Reach 17 for the next 5 years involves the exclusion of stock from areas that have ongoing erosion issues. These areas will be further stabilised through the installation of rock chutes (where appropriate) and revegetation activities. The combination of revegetation and natural recruitment of grasses to the site will result in a stable systems that no longer contributes sediment to Homebush Creek, and in turn the Avoca River.

The majority of the watercourse of Homebush Creek will largely remain in the same condition but may continue to decline through ongoing stock access. Fencing and revegetation activities for this creek may be considered in future action plans when the higher priority actions are completed.

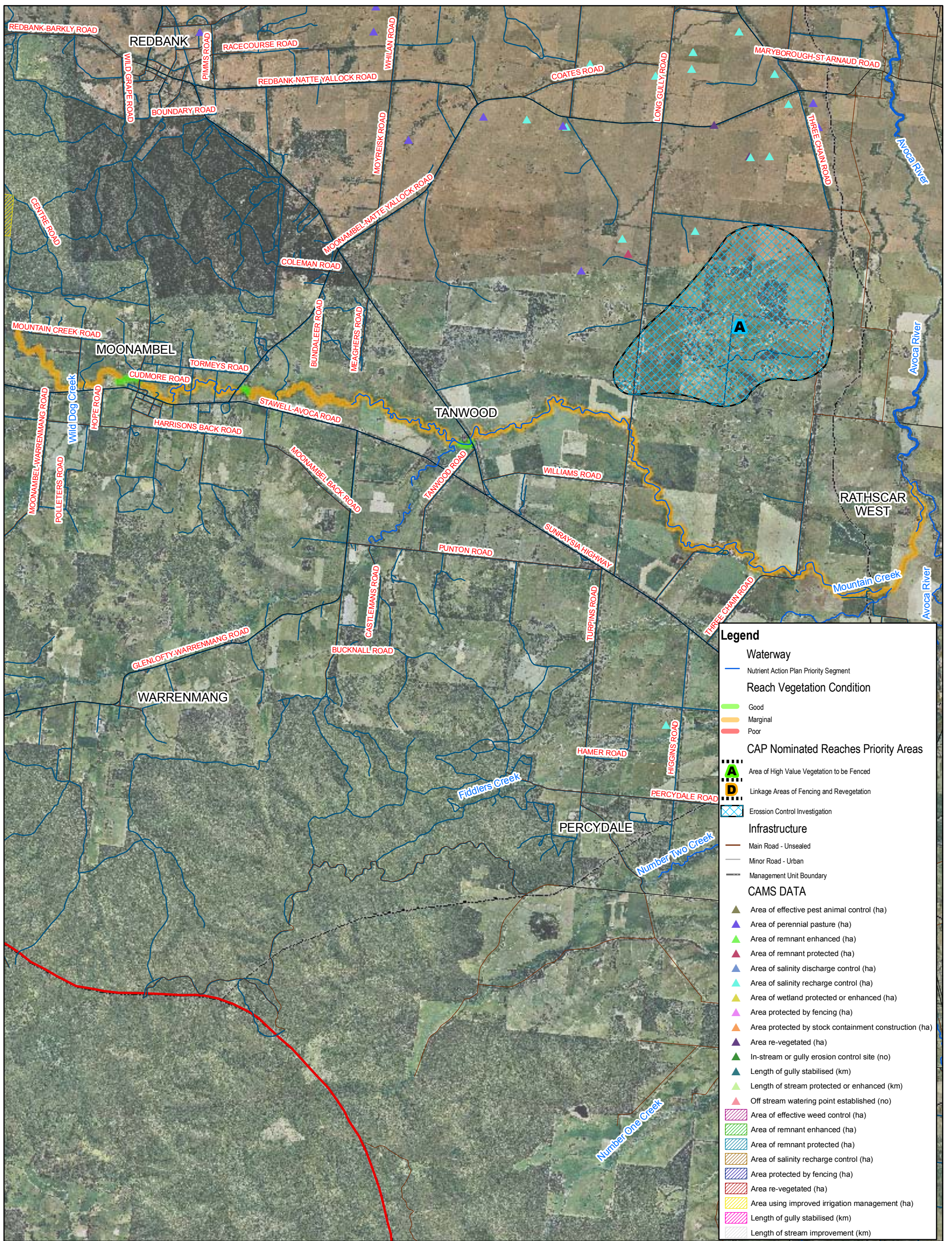
Priority Actions

Action	Very High	High	Med	Low
Initial investigation to determine if any detailed engineering design work is required.	X			
Exclude stock for all areas nominated for erosion control works.	X			
Undertake revegetation works to help stabilise the tributary.		X		
If required initiate functional design to install grade control structures.		X		

5 year action plan

Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Undertake initial investigation to determine the cause and extent of erosion. This would then identify if grade control structures are required and further design work can be initiated.	N/A	X					An initial understanding of the system and suite of treatment measures required.	As per Output	\$3000	NCCMA/DPI
If grade control structures are required then initiate functional design and construction.	TBD [#]		X				Grade control structures designed and constructed	Grade control structures stable after 2 normal years of flow events	TBD [#]	NCCMA/DPI
Where no fencing exists, construct fences to exclude stock from all sites of active erosion.	TBD [#]	X	X	X			Adequate fencing completed to effectively exclude stock	With exclusion of stock pugging and stock trafficking are eliminated to reduce erosion and allow the growth of vegetation	TBD [#]	Landholder with support from NCCMA/DPI
Revegetate area with appropriate species. (note: low lying land may be subject to elevated salinity levels)	TBD [#]	X	X	X			Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years	Plants established and a sustainable self recruiting system is evident within 5 years.	TBD [#]	Landholder with support from NCCMA/DPI
Undertake maintenance on all new plantings to control weeds	TBD [#]			X	X		Weeds controlled within fenced area for first three years	Improvement of 1 in score of ISC Physical Form subindex in 10 years	TBD [#]	Landholder with support from NCCMA/DPI

needs site assessment to determine extent of issue



REACH 17 - MOUNTAIN CREEK
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



DATUM GDA 1994, PROJECTION MGA ZONE 55
 0 305 610 1,220 1,830 2,440
 Metres

FIGURE

7

File Location: \\hla\frimaw\GIS\M60032901\ArcGIS\M60032901_Reach10_04-Jul-07.mxd

Action Plan - REACH 10 (CAMPBELL CREEK)

Current Condition:

Reach 10 is characterised by some areas of good remnant riparian vegetation but is still overall a degraded waterway environment. Along this reach the riparian buffer ranges from moderate condition to no buffer at all. The surrounding land is predominantly cleared and is an ongoing source of sediment and nutrients into the waterway. In parts of the upper catchment erosion appears to be active and would contribute sediment to Campbell Creek and ultimately the Avoca River. There are two areas of riparian vegetation considered to contain good vegetation values within this reach. The major focus for the next five years is to address the obvious areas of erosion and sediment generation as well as enhancing and protecting the large reach of good vegetation.



Proposed Condition:

All stock will be excluded from areas that have ongoing erosion issues. These areas will be further stabilised through the installation of rock chutes (where appropriate) and revegetation activities. The combination of revegetation and natural recruitment of grasses to the site will result in a stable systems that no longer contributes sediment to Campbell Creek, and in turn the Avoca River.

The majority of the watercourse of Campbell Creek will largely remain in the same condition but within the nominated area of high value vegetation, the exclusion of all stock and some complimentary planting will create a buffer strip of a minimum of 15 m. Weeds and vermin will be well controlled to allow the regeneration of robust over, middle and understorey species. Ground storey species are unlikely to establish but with the exclusion of stock, the instream and ephemeral environment should improve in species diversity and density within this reach.

Priority Actions

Action	Very High	High	Med	Low
Initial investigation to determine if any detailed engineering design work is required to control erosion within area marked 'Erosion Control Investigation' on attached map.	X			
If required initiate functional design to install grade control structures		X		
Exclude stock for all areas nominated for erosion control works.	X			
Undertake revegetation works to help stabilise the tributary displaying active erosion	X			
Undertake complimentary revegetation works along high value parts of Reach 10.		X		
Exclude stock from areas nominated areas for waterway fencing and revegetation		X		

5 year action plan

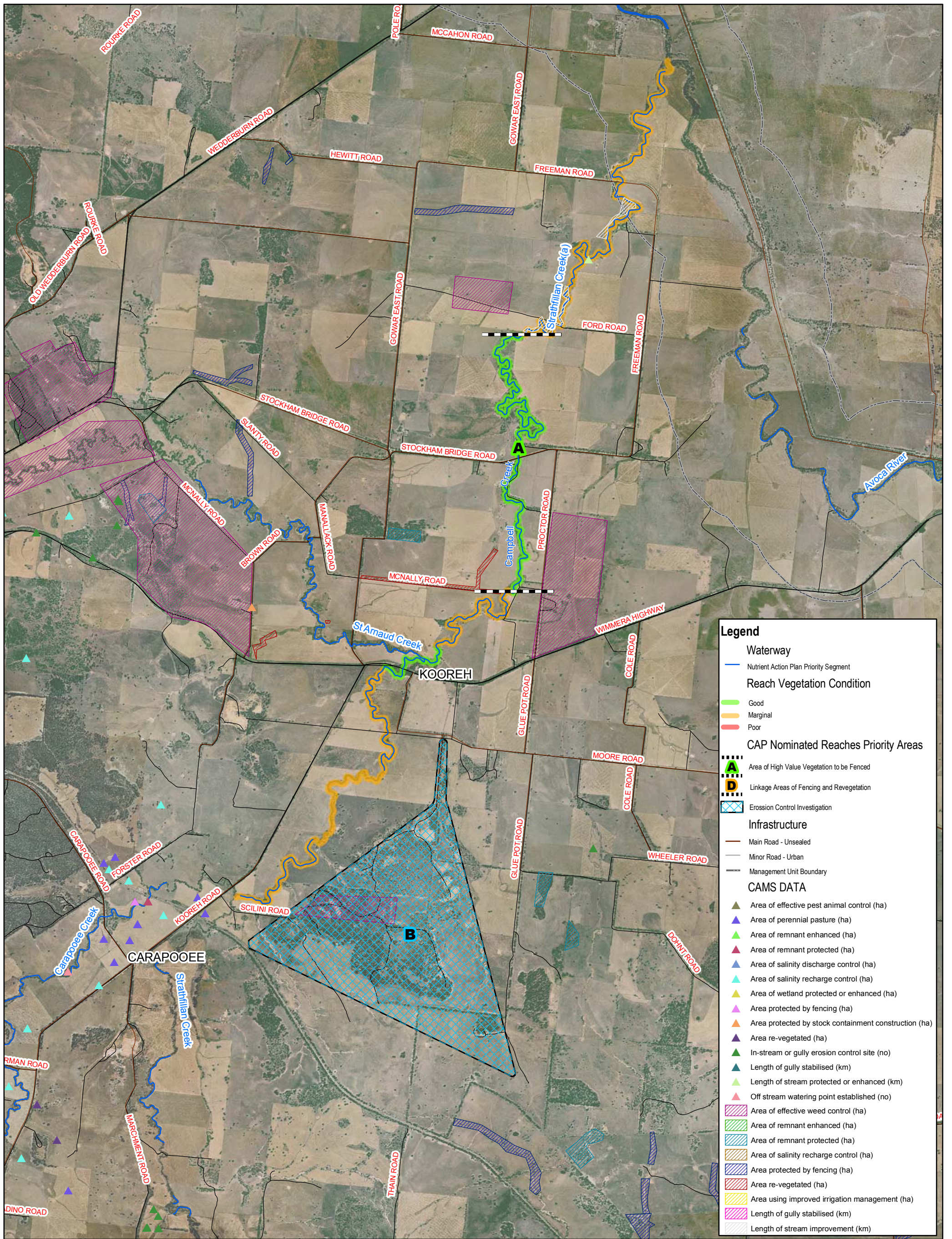
Action	Extent	Year					Output Target for action	Outcome Target for reach	Cost of activity	Responsibility
		1	2	3	4	5				
Undertake initial investigation to determine the cause and extent of erosion. This would then identify if grade control structures are required and further design work can be initiated.	N/A	X					An initial understanding of the system and suite of treatment measures required.	As per output.	\$3000	NCCMA/DPI
If grade control structures are required then initiate functional design and construction.	TBD [#]		X				Grade control structures designed and constructed.	Grade control structures stable after 2 normal years of flow events.	TBD [#]	NCCMA/DPI
Where no fencing exists, construct fences to exclude stock from all sites of active erosion.	TBD [#]	X	X	X			Adequate fencing completed to effectively exclude stock.	With stock pugging and stock trafficking eliminated, growth of vegetation (especially grasses) will be prolific.	TBD [#]	Landholder with support from NCCMA/DPI
Fence and revegetate along area of good vegetation condition (Aim for a 15 m buffer and 3 rows of vegetation) along waterway. Works include 7 km fencing and 5000 plants	7km [*] 5000 plants [^]			X	X	X	Fencing installed and stock adequately excluded. Plants survival rate of 80% at two years. Weeds controlled within fenced area for first three years	Improvement of one in the measurement of riparian condition within area of works	\$35,000 ¹	Landholder with support from NCCMA/DPI
Undertake maintenance on all new plantings to control weeds	TBD			X	X		Weeds controlled within fenced area for first three years	Improvement of one in the measurement of riparian condition within area of works	TBD [#]	Landholder with support from NCCMA/DPI

[#] needs site assessment to determine extent of issue

^{*} length includes both sides of waterway. i.e a 1km reach will have a fencing requirement of 2km

[^] plants include a mix of 1/3 overstorey and 2/3 understorey. Area is not a full buffer strip planting and it is expected that an existing seed source will to some degree contribute to natural regeneration once the site is fenced off. Planting should be opportunistic where required and plant numbers are an estimate only.

¹ Planting assumes \$2.50/plant for materials and labour provided by landholder as part of a devolved grant process. Also assumes \$5/m for fencing materials and labour provided by landholder as part of a devolved grant process



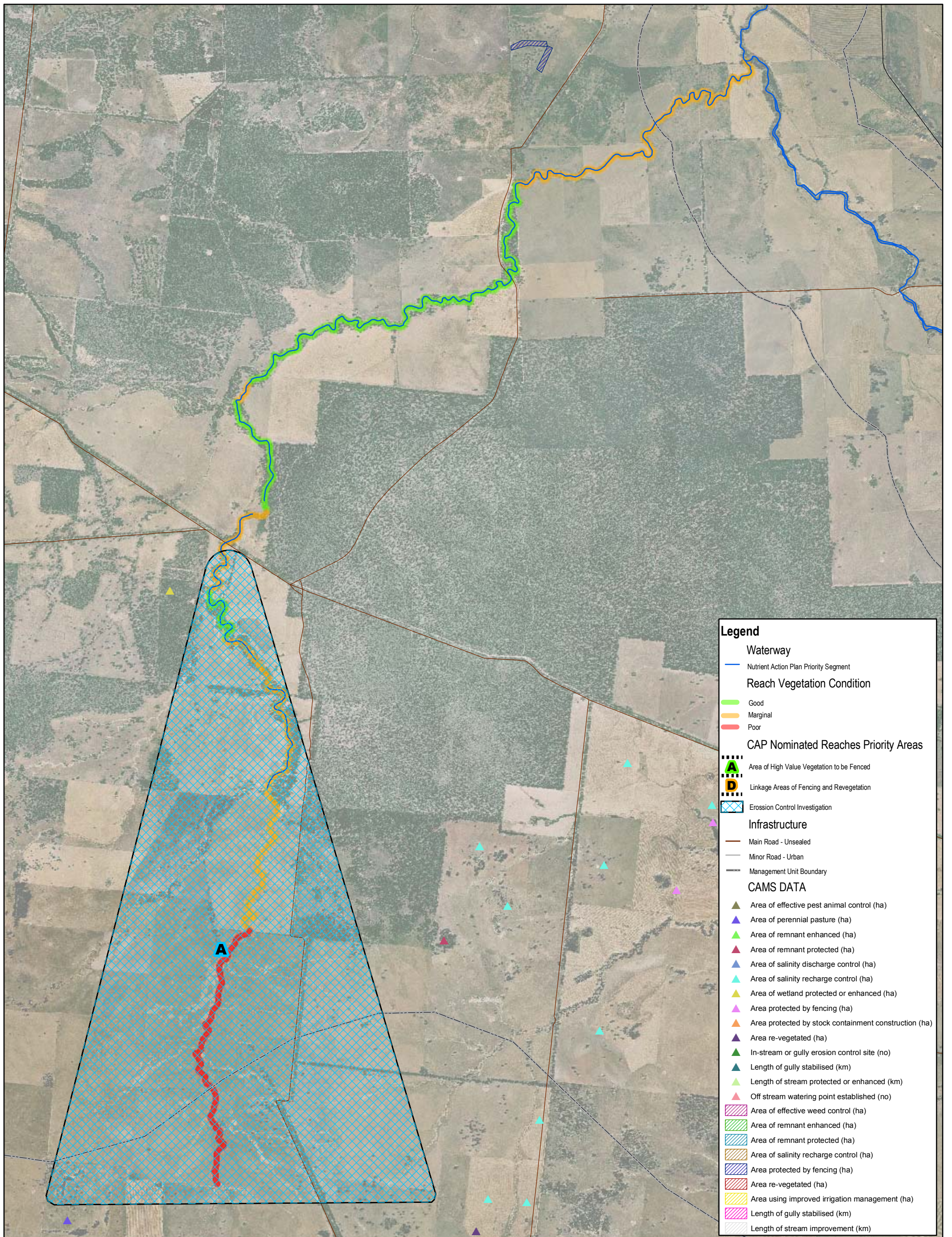
REACH 10 - CAMPBELL CREEK
 North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



DATUM GDA 1994, PROJECTION MGA ZONE 55
 0 260 520 1,040 1,560 2,080
 Metres

FIGURE

8



Legend

Waterway

- Nutrient Action Plan Priority Segment

Reach Vegetation Condition

- Good
- Marginal
- Poor

CAP Nominated Reaches Priority Areas

- Area of High Value Vegetation to be Fenced
- Linkage Areas of Fencing and Revegetation
- Erosion Control Investigation

Infrastructure

- Main Road - Unsealed
- Minor Road - Urban
- Management Unit Boundary

CAMS DATA

- Area of effective pest animal control (ha)
- Area of perennial pasture (ha)
- Area of remnant enhanced (ha)
- Area of remnant protected (ha)
- Area of salinity discharge control (ha)
- Area of salinity recharge control (ha)
- Area of wetland protected or enhanced (ha)
- Area protected by fencing (ha)
- Area protected by stock containment construction (ha)
- Area re-vegetated (ha)
- In-stream or gully erosion control site (no)
- Length of gully stabilised (km)
- Length of stream protected or enhanced (km)
- Off stream watering point established (no)
- Area of effective weed control (ha)
- Area of remnant enhanced (ha)
- Area of remnant protected (ha)
- Area of salinity recharge control (ha)
- Area protected by fencing (ha)
- Area re-vegetated (ha)
- Area using improved irrigation management (ha)
- Length of gully stabilised (km)
- Length of stream improvement (km)



TARPAULIN CREEK
North Central Catchment Management Authority
 Upper Avoca CAP
 Upper Avoca Catchment, Victoria



DATUM GDA 1994, PROJECTION MGA ZONE 55
 0 225 450 900 1,350 1,800
 Metres

FIGURE

9

File Location: \\hla\maw\GIS\M60032901\ArcGIS\M60032901_Reach10_04-Jul07.mxd

9 Monitoring success

The actions proposed in this CAP are focused on achieving outputs that over time will contribute to outcomes of catchment change. The timeframe for this transition is not years, but often decades and any monitoring program needs to consider the path of outputs (actions) to outcomes. Tables 6, 7 and 8 describe the key actions and the target changes in the system over time.

Table 6. Target outcomes from stock exclusion fencing (includes weed & vermin control)

Physical measure	Year				
	1	3	5	10	20
Stock are excluded (controlled well managed grazing may also be appropriate)	Yes	Yes	Yes	Yes	Yes
Presence of non ground storey weeds (means all weeds of under, mid and over storey)	< 15%	< 10%	< 5%	< 5%	< 5%
Natural regeneration of indigenous species	No	Yes	Yes	Yes	Yes
Diversity of original EVC recruiting (under, mid and over storey only)	0%	10%	30%	60%	80%

Table 7. Target outcomes from revegetation (includes weed & vermin control)

Physical measure	Year				
	1	8	16	24	32
Stock are excluded controlled well managed grazing may also be appropriate)	Yes	Yes	Yes	Yes	Yes
Presence of non ground storey weeds (means all weeds of under, mid and over storey)	< 5%	< 5%	< 5%	< 5%	< 5%
Mid and understorey % of planting reflect EVC structure	Yes	Yes	Yes	Yes	Yes
Plant survival (planting of tubestock or cells)	80%	70%	70%	50%	50%
Percent of woody life form (native trees and shrubs) – regenerating and recruiting i.e. at 8 years 15% of the species planted in the revegetation should be actively seeding and regenerating. By time the vegetation is 32 years old it is expected that around 90% of the species should display signs of regeneration.	0%	15%	30%	50%	90%

Table 8. Target outcomes from erosion control

Physical measure	Year				
	1	2	3	5	10
Stock are excluded	Yes	Yes	Yes	Yes	Yes
Grade control structures stable	N/A	Yes	Yes	Yes	Yes
Grasses (native & exotic) have strongly recruited	No	Yes	Yes	Yes	Yes
No further signs of erosion	N/A	Yes	Yes	Yes	Yes
Plant survival (planting of tubestock or cells)	80%	70%	70%	70%	70%

9.1 Monitoring program

The monitoring program is designed to be simplistic and not complicated. The program is effectively a series of site audits to assess the works against the expected path of the transition of outputs to outcomes. It is suggested the one of the most important outcomes of this monitoring program is simply to facilitate the ongoing communication and relationship between the CMA and landholders.

The program proposes only a small number of sites that will inform the need for any further and more detailed assessment. For instance, if the small sample indicates a substantial deviation from the expectations presented in Tables 6, 7 and 8, then it is suggested a greater level of effort is invested to determine if the problems are more widespread. However, if the small sample indicates a strong correlation with the expected quality, then there should be confidence that the entire works program is generally tracking well.

Monitoring programs should also be thought of as an opportunity to further develop a client relationship with the landholders. The monitoring may principally inform the CMA regarding any issues in the quality of the works, but the ongoing interest in the landholder's achievements should never be underestimated. The requirements of the program do increase as the number of landholders increases. This is geared to increasing the number of active relationships over the 5 years.

Table 9 summarises the monitoring requirements for the five years of the plans implementation.

Table 9. Monitoring Program

Works type	Monitoring
Fencing of areas of high value vegetation	Assess 10% of all works sites on an annual basis
Fencing and revegetation activities	Assess 10% of all works sites on an annual basis
Erosion control activities	Assess 10% of all works sites on an annual basis

This monitoring program rightly focuses on assessing the success of actions in the catchment and along the waterway; however the fundamental underlining principles of the CAP and the prioritisation process in the NCRHS is to protect and enhance the internationally important Kerang Wetlands and Avoca Mashas. Achieving this outcome is the ultimate measure of success. Monitoring and measuring the health of the Kerang Wetlands and Avoca Mashas is beyond the scope of this CAP, however it should be a high priority action to be coordinated between the NCCMA, DSE and DPI.

10 Data gaps

To prepare this CAP, extensive use of existing reports concerning natural resource management and condition of the Upper Avoca catchment was made. It should be noted that a number of other sources of information concerning the Upper Avoca catchment exist, but were not utilised for the CAP as some reports were not available. The Avoca Whole-of-Catchment Plan 2000–2002 (NCCMA, 2000a) integrates all major strategies relevant to the catchment to produce a prioritised works program.

The review of literature and information required to prepare this CAP reveals certain data gaps relevant to the Upper Avoca catchment (and the Avoca River catchment as a whole). This particularly applies to the terrestrial ecology and biodiversity of the catchment. There is data concerning remnant native vegetation (particularly riparian vegetation) and aquatic macro-invertebrates (e.g. from ISC assessments) in the Upper Avoca catchment. However, gaps in our knowledge of terrestrial fauna (birds, reptiles and mammals), threatened species and ecological communities are apparent, particularly at the fine scale level of the catchment. A comprehensive understanding of the ecological condition of the Upper Avoca catchment is not possible without such information. It is probable that considerable amounts of ecological data exist in various databases (government and non-government), but this has not been reviewed in a systematic or defined manner.

During community consultation, the issue of sedimentation was raised as a primary concern. NCCMA indicated that a geomorphic study had been commissioned and was being undertaken concurrently with the CAP. It is understood that the geomorphic study would identify sources of sediment entering the Upper Avoca. The information gained through this study may prove useful in identifying areas in the Upper Avoca tributaries for further erosion control works. The priority areas identified in this study should be compared with the priority areas identified in the results of the geomorphic study.

There are numerous references made to flood management issues within various reports and discussion with flood management staff indicated that lack of data is a major issue in the catchment. This issue requires further discussion with NCCMA Flood Plain Management Unit.

11 Education and training opportunities

The most obvious area of education and training is associated with the management of sediment and instream timber accumulation in the waterway. This was an emotive issue during the community consultation and a natural response from landholders is to mechanically remove these perceived blockages. The accumulation of sediment results from a combination of continuing input of sediment from upstream erosion sources and a prolonged period of low rainfall.

There appeared to be a limited understanding of the benefits of the presence of instream timber in a waterway system and the behaviour of large amounts of timber in high flow events. It is understood that this issue also concerns landholders in the lower Avoca region.

The management of instream timber in a waterway is a balance between protecting the values of the waterway and protecting important constructed assets such as road crossings or buildings. It is recommended that an education and training workshop aimed at helping the community to understand the value of instream timber (i.e. when it is appropriate to intervene and when it is not) would be very beneficial.

It is also recommended that some basic understanding of instream hydrology and sediment generation and transportation would help advance the community's understanding of why sediment build up occurs and what sort of flow conditions are required to naturally manage waterway systems.

It should be noted that the CMA is currently undertaking a project in the Lower Avoca on instream timber. Working with the local community the CMA will develop a method of identifying when instream timber accumulation is impacting on assets to a point where intervention is required.

At a strategic level, the CAP should provide the guide by which private and public resources should be spent in the Upper Avoca. It should be used proactively by landowners, State and Federal agencies, local governments and other stakeholders. Too often reports like this CAP do not have a 'life', are not well promoted, explained, audited, distributed or used in guiding catchment and waterway decisions (e.g. grant applications). As a result priorities are lost and resources are not wisely spent. From an education and training perspective there is a need for the NCCMA to raise the awareness and the profile of the CAP, amongst its own staff and all other stakeholders in the community to ensure it remains a 'reference' document for the next 3-5 years.

12 References

- Avoca DCWG. 1993. Avoca Catchment Draft Salinity Management Plan – A Land and Water Management Strategy. Avoca Dryland Community Working Group.
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Appendix A - Components of strategies and action plans

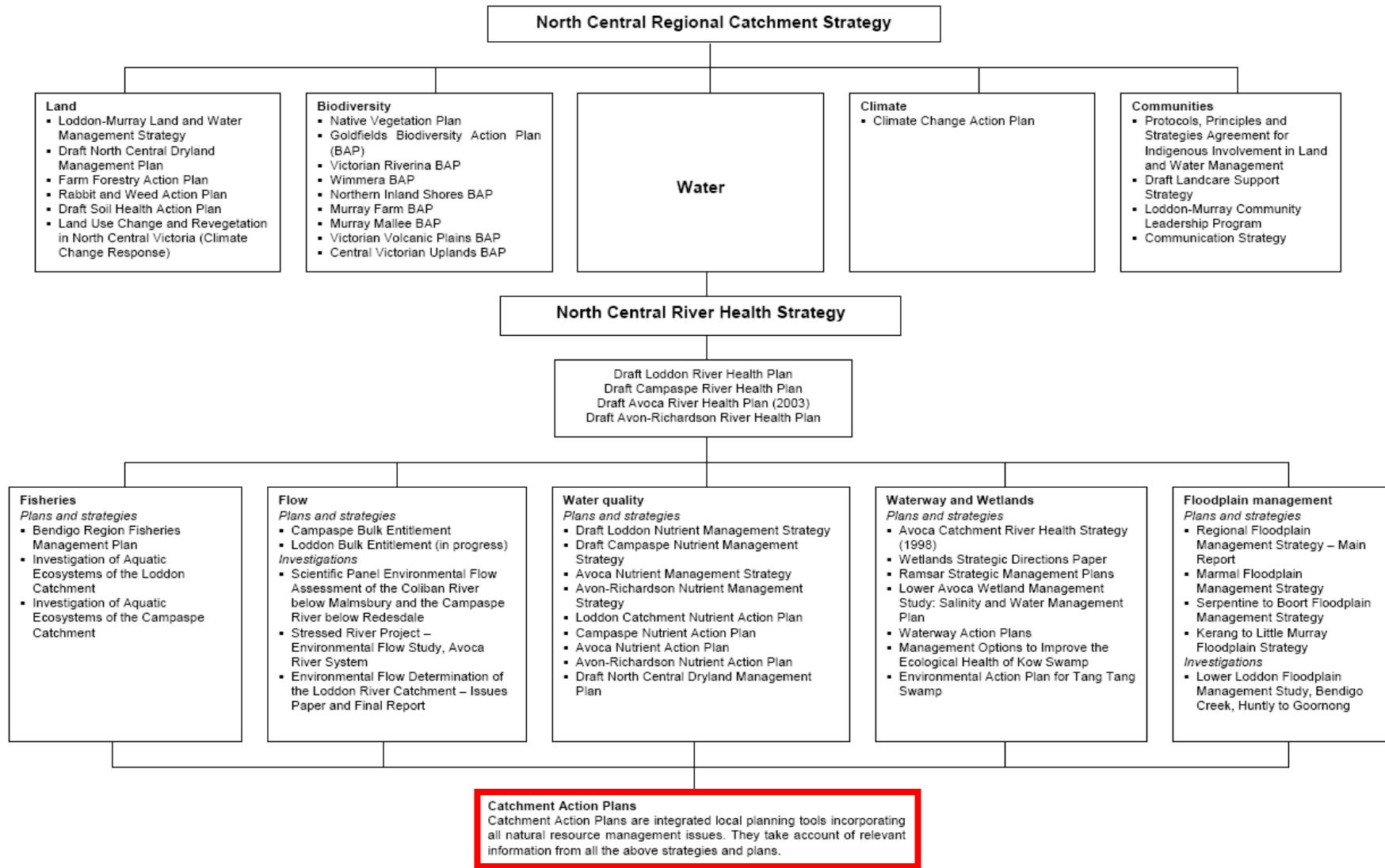


Figure A1: North Central River Health Strategy in context with the North Central Regional Catchment Strategy

Appendix B - Upper Avoca reach risk matrix tables



Table B1: Reach 5 Risk Matrix

Reach 5				Avoca River				57km			
Principles under which the reach is a priority		1, 2, 5, 6, 7									
Value ranking (compared to other 100 ISC reaches)		Environmental			Social			Economic			
Total risk ranking		23			15			36			39

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	2	2	4	4	3	6	1	2	2	5	1	1	10	5	53
		Statewide EVC	5	6	4	8	5	8	8	8	15	2	6	2	15	4	4	25	12	132
		Significant Fauna	5	12	8	8	20	8	8	20	8	12	8	12	20	16	20	15	215	
		Wetland Significance	1	3	3	3	6	4	5	4	8	2	4	5	4	2	3	8	4	68
		Wetland Rarity	1	4	2	4	6	4	4	4	8	1	4	5	4	2	2	8	4	66
		Sites Significance	1	3	3	3	2	3	4	2	4	1	2	2	3	1	3	6	3	45
		Heritage/Rep. Rivers	3	10	4	8	4	4	3	8	20	3	8	5	10	6	6	12	10	121
		Invertebrates Obs. Exp.	4	10	5	9	10	4	4	15	25	5	10	5	6	15	12	15	6	156
		Width Vegetation	4	6	2	9	10	3	2	3	10	1	2	1	8	3	3	25	6	94
		Struct Intactness Veg.	3	10	1	4	4	2	3	2	12	1	2	1	8	2	2	20	10	84
		Longitudinal Continuity	5	15	2	12	5	4	4	4	10	2	3	2	12	4	4	25	12	120
		Fish Obs. Exp.	1	3	3	3	10	5	4	5	10	5	5	5	3	5	5	6	4	81
		Fish Proportion	1	3	3	3	10	5	5	5	10	5	5	5	3	5	5	6	4	82
		Fish Migrations	4	2	3	12	25	5	4	15	15	4	8	2	4	3	12	15	2	131
	Eco. Healthy River	1	2	2	2	10	4	3	3	6	4	3	3	5	1	5	8	5	66	
	Social	Fishing	5	9	6	16	20	10	4	16	25	4	15	10	12	16	20	10	12	205
		Non Motor Sports	3	4	1	2	16	5	1	4	12	1	6	5	8	8	2	4	6	85
		Motor Sports	3	4	1	2	16	5	1	4	12	1	6	5	6	2	2	4	4	75
		Camping	3	4	1	2	4	4	1	8	20	1	10	5	8	2	4	12	8	94
		Swimming	3	8	4	2	12	5	1	10	20	1	10	5	8	4	4	12	6	112
		Passive Recreation	3	6	3	8	8	5	1	4	16	1	6	5	10	4	8	16	10	111
		European Heritage	1	4	3	3	2	2	1	1	6	1	2	3	3	2	1	6	3	43
		Flagship Species	3	8	3	6	4	1	1	2	4	1	2	1	8	4	2	16	6	69
		Listed Landscape	5	12	6	12	5	2	2	4	5	2	3	2	12	8	4	20	9	108
		Economic	Water Supply IRR	3	6	3	2	8	5	1	10	20	1	8	5	4	4	2	16	6
	Water Supply PC		1	4	4	1	4	5	1	5	10	1	4	5	2	2	1	8	3	60
	Infrastructure		5	15	10	20	5	4	2	16	5	2	3	2	6	8	4	10	9	121
	Land Value		4	10	3	12	5	4	1	9	10	1	4	2	10	6	3	25	10	115
	Tourism		3	4	3	2	4	4	1	6	20	1	8	5	8	4	6	16	8	100
	Power Generation		1	1	1	1	2	1	1	1	2	1	1	1	1	1	1	2	1	19
	TOTAL		191	99	181	244	129	85	201	366	65	164	114	208	149	147	386	203	2932	

***Table B2: Reach 6 Risk Matrix**

Reach 6 Avoca River 46km

Principles under which the reach is a priority	1, 2, 5, 6, 7			
Value ranking (compared to other 100 ISC reaches)	Environmental	Social	Economic	
	65	16	55	
Total risk ranking	43			

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	2	2	4	4	3	3	1	4	2	5	1	1	10	5	52
		Statewide EVC	5	6	8	8	5	8	8	8	15	2	10	2	15	4	4	25	16	144
		Significant Fauna	5	12	16	8	20	8	8	20	20	8	20	8	12	20	16	20	20	236
		Wetland Significance	1	3	3	3	6	4	5	4	4	2	8	5	4	2	3	8	4	68
		Wetland Rarity	1	4	2	4	6	4	4	4	4	1	8	5	4	2	2	8	4	66
		Sites Significance	1	3	3	3	2	3	4	2	2	1	4	2	3	1	3	6	3	45
		Heritage/Rep. Rivers	3	10	8	8	4	4	3	8	15	3	16	5	10	6	6	12	10	128
		Invertebrates Obs. Exp.	3	10	10	6	8	4	4	10	15	5	20	5	6	10	8	12	6	139
		Width Vegetation	2	3	4	6	6	3	2	2	4	1	3	1	4	2	2	15	6	64
		Struct Intactness Veg.	3	10	2	4	4	2	3	2	9	1	4	1	8	2	2	20	10	84
		Longitudinal Continuity	4	10	3	9	5	2	2	3	8	1	5	1	8	3	3	25	12	100
		Fish Obs. Exp.	1	3	3	3	10	5	4	5	5	5	10	5	3	5	5	6	4	81
		Fish Proportion	1	3	3	3	10	5	5	5	5	5	10	5	3	5	5	6	4	82
		Fish Migrations	1	1	3	4	10	5	4	5	3	4	8	2	2	1	4	6	1	63
		Eco. Healthy River	1	2	2	2	10	4	3	3	3	4	6	3	5	1	5	8	5	66
	Social	Fishing	5	9	12	16	20	10	4	16	25	4	25	10	12	16	20	10	16	225
		Non Motor Sports	3	4	2	2	16	5	1	4	9	1	12	5	8	8	2	4	6	89
		Motor Sports	3	4	2	2	16	5	1	4	9	1	12	5	6	2	2	4	4	79
		Camping	3	4	2	2	4	4	1	8	15	1	20	5	8	2	4	12	8	100
		Swimming	3	8	8	2	12	5	1	10	15	1	20	5	8	4	4	12	6	121
		Passive Recreation	3	6	6	8	8	5	1	4	12	1	12	5	10	4	8	16	10	116
		European Heritage	1	4	3	3	2	2	1	1	3	1	4	3	3	2	1	6	3	42
		Flagship Species	3	8	6	6	4	1	1	2	3	1	4	1	8	4	2	16	6	73
		Listed Landscape	5	12	12	12	5	2	2	4	5	2	5	2	12	8	4	20	12	119
		Economic	Water Supply IRR	1	3	3	1	4	5	1	5	5	1	8	5	2	2	1	8	3
	Water Supply PC		1	4	4	1	4	5	1	5	5	1	8	5	2	2	1	8	3	59
	Infrastructure		5	15	20	20	5	4	2	16	5	2	5	2	6	8	4	10	12	136
	Land Value		4	10	9	12	5	4	1	9	8	1	10	2	10	6	3	25	15	130
	Tourism		3	4	6	2	4	4	1	6	15	1	16	5	8	4	6	16	8	106
	Power Generation	1	1	1	1	2	1	1	1	1	1	2	1	1	1	1	2	1	19	
	TOTAL		179	168	163	219	127	83	179	250	64	299	113	196	138	132	356	223	2889	

Table B3: Reach 7 Risk Matrix

Reach 7		Avoca River			34km	
Principles under which the reach is a priority Value ranking (compared to other 100 ISC reaches)	1, 2, 3, 5, 6, 7					
	Environmental	Social		Economic		
Total risk ranking	29	6		54		27

Value/threat combinations of high risk (risk score > 20) shaded in grey

Values		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.	
Environmental	Significant Flora	1	3	2	2	2	4	4	6	3	1	2	2	5	1	1	10	5	53
	Statewide EVC	5	8	8	10	5	8	8	10	15	2	8	2	15	4	5	25	16	149
	Significant Fauna	5	16	16	10	20	8	8	25	20	8	16	8	12	20	20	20	20	247
	Wetland Significance	1	3	3	3	6	4	5	8	4	2	4	5	4	2	3	8	4	68
	Wetland Rarity	1	4	2	4	6	4	4	8	4	1	4	5	4	2	2	8	4	66
	Sites Significance	1	3	3	3	2	3	4	4	2	1	2	2	3	1	3	6	3	45
	Heritage/Rep. Rivers	3	10	8	12	4	4	3	16	15	3	8	5	10	6	9	12	10	135
	Invertebrates Obs. Exp.	4	15	15	12	10	4	4	25	20	5	15	5	6	15	16	15	9	191
	Width Vegetation	3	6	4	9	8	3	2	4	6	1	2	1	8	2	3	20	6	85
	Struct Intactness Veg.	3	10	2	6	4	2	3	4	9	1	2	1	8	2	3	20	10	87
	Longitudinal Continuity	3	10	2	9	4	2	2	4	6	1	2	1	8	2	3	20	8	84
	Fish Obs. Exp.	3	6	6	9	20	5	4	20	15	5	10	5	6	10	15	12	8	156
	Fish Proportion	1	3	3	3	10	5	5	10	5	5	5	3	5	5	6	4	82	
	Fish Migrations	4	3	9	16	25	5	4	25	12	4	12	2	4	3	16	15	3	158
	Eco. Healthy River	1	2	2	2	10	4	3	6	3	4	3	3	5	1	5	8	5	66
Social	Fishing	4	9	9	16	20	5	2	20	20	2	15	5	8	12	20	10	12	185
	Non Motor Sports	3	4	2	3	16	5	1	8	9	1	6	5	8	8	3	4	6	89
	Motor Sports	3	4	2	3	16	5	1	8	9	1	6	5	6	2	3	4	4	79
	Camping	3	4	2	3	4	4	1	16	15	1	10	5	8	2	6	12	8	101
	Swimming	3	8	8	3	12	5	1	20	15	1	10	5	8	4	6	12	6	124
	Passive Recreation	3	6	6	12	8	5	1	8	12	1	6	5	10	4	12	16	10	122
	European Heritage	5	16	12	15	5	4	2	5	15	2	8	6	9	8	5	15	12	139
	Flagship Species	3	8	6	9	4	1	1	4	3	1	2	1	8	4	3	16	6	77
Economic	Listed Landscape	5	16	12	15	5	2	2	5	5	2	4	2	12	8	5	20	12	127
	Water Supply IRR	1	3	3	1	4	5	1	10	5	1	4	5	2	2	1	8	3	58
	Water Supply PC	1	4	4	1	4	5	1	10	5	1	4	5	2	2	1	8	3	60
	Infrastructure	5	20	20	25	5	4	2	20	5	2	4	2	6	8	5	10	12	150
	Land Value	4	15	9	16	5	4	1	15	8	1	6	2	10	6	4	25	15	142
Tourism	3	4	6	3	4	4	1	12	15	1	8	5	8	4	9	16	8	108	
Power Generation	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	2	1	19	
TOTAL		224	187	236	250	124	82	338	281	63	189	111	207	151	193	383	233	3252	

Table B4: Reach 8 Risk Matrix

		Reach 8		Avoca River														28km		
Principles under which the reach is a priority		1, 2, 5, 6, 7																		
Value ranking (compared to other 100 ISC reaches)		Environmental				Social				Economic										
Total risk ranking		22				42				79				33						
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	2	2	4	4	6	6	1	2	2	5	1	1	10	5	56
		Statewide EVC	5	6	8	10	5	8	8	10	15	2	6	2	15	4	4	25	20	148
		Significant Fauna	5	12	16	10	20	8	8	25	20	8	12	8	12	20	16	20	25	240
		Wetland Significance	1	3	3	3	6	4	5	8	8	2	4	5	4	2	3	8	4	72
		Wetland Rarity	5	12	8	20	15	8	8	20	20	2	12	10	12	8	8	20	20	203
		Sites Significance	1	3	3	3	2	3	4	4	4	1	2	2	3	1	3	6	3	47
		Heritage/Rep. Rivers	3	10	8	12	4	4	3	16	20	3	8	5	10	6	6	12	15	142
		Invertebrates Obs. Exp.	5	15	20	15	10	8	8	25	25	10	15	10	9	20	16	15	15	236
		Width Vegetation	2	3	4	6	6	3	2	3	6	1	1	1	4	2	2	15	6	65
		Struct Intactness Veg.	3	10	2	6	4	2	3	4	12	1	2	1	8	2	2	20	15	94
	Longitudinal Continuity	2	5	2	6	3	2	2	3	6	1	1	1	4	2	2	15	8	63	
	Fish Obs. Exp.	3	6	6	9	20	5	4	20	20	5	10	5	6	10	10	12	12	160	
	Fish Proportion	1	3	3	3	10	5	5	10	10	5	5	5	3	5	5	6	4	87	
	Fish Migrations	2	1	6	8	15	5	4	15	9	4	4	2	2	2	8	9	2	96	
	Eco. Healthy River	1	2	2	2	10	4	3	6	6	4	3	3	5	1	5	8	5	69	
	Social	Fishing	4	6	9	16	20	5	2	20	25	2	10	5	8	12	15	10	16	181
		Non Motor Sports	1	2	1	1	8	5	1	4	6	1	3	5	4	4	1	2	3	51
		Motor Sports	1	2	1	1	8	5	1	4	6	1	3	5	3	1	1	2	2	46
		Camping	3	4	2	3	4	4	1	16	20	1	10	5	8	2	4	12	12	108
		Swimming	3	8	8	3	12	5	1	20	20	1	10	5	8	4	4	12	9	130
Passive Recreation		2	3	6	8	6	5	1	6	12	1	3	5	5	4	8	12	10	95	
European Heritage		1	4	3	3	2	2	1	2	6	1	2	3	3	2	1	6	3	44	
Flagship Species		3	8	6	9	4	1	1	4	4	1	2	1	8	4	2	16	9	80	
Economic	Listed Landscape	1	4	3	3	2	1	1	2	2	1	1	1	4	2	1	8	3	39	
	Water Supply IRR	1	3	3	1	4	5	1	10	10	1	4	5	2	2	1	8	3	63	
	Water Supply PC	1	4	4	1	4	5	1	10	10	1	4	5	2	2	1	8	3	65	
	Infrastructure	5	15	20	25	5	4	2	20	5	2	3	2	6	8	4	10	15	146	
	Land Value	2	5	6	8	3	4	1	9	6	1	2	2	5	4	2	15	10	83	
	Tourism	3	4	6	3	4	4	1	12	20	1	8	5	8	4	6	16	12	114	
Power Generation	1	1	1	1	2	1	1	2	2	1	1	1	1	1	1	2	1	20		
TOTAL		167	172	201	220	129	88	316	341	67	153	117	177	142	143	340	270	3043		

Appendix C - All actions from literature review

REACH 5 (MANAGEMENT UNIT 2)						
Avoca River						
Action Category	Action	Location	Cost	Timeframe	Action Target	Reference
Flood Management	Extend flood warning service to cover the catchment upstream of Yawong Weir.	Reach 5	not given	2010	Reduce adverse effects of flooding through implementation of Floodplain Management Strategy	Egis (2000); NCCMA (2005a)
	Flow and height correlations need to be extended to Archdale gauge.					
	Develop real time runoff routing forecast model for the catchment to Quambatook.					
Protecting Remnant Vegetation	Fencing and enhancement plantings along 85.5 hectares of riparian land (assume fencing one quarter of reach length - 28.5 km, riparian zone 30 m wide).	Reach 5 - unfenced areas	\$993,000 (government and other): To be spread across reaches 5 - 8.	2010	248 hectares of riparian land (in reaches 5, 6, 7 & 8) protected and enhanced and placed under management agreements in 5 years.	NCCMA (2005a)
	Fence and enhance 22 river segments (within Management Unit 2) totalling 43.7 km (0.5-4.8 km segments)	Refer to GIS dataset for locations on Reach 5		2012	Enhance and protect Creekline Grassy Woodland (EVC 68), Plains Grassy Woodland (EVC 175), Floodplain Riparian Woodland (EVC 56), Low Rises Grassy Woodland (EVC 175-1)	NCCMA (2003c) - Avoca Catchment Riparian Vegetation Investigation; see details of priority stretches in Chapter 4
	Fencing; Offstream watering over 5.3 km of waterway across Management Unit 2	Refer to GIS dataset for locations on Reach 5	Combined Costs for Reaches 5, 6 & 7: Fencing (\$52,740); Offstream watering (\$26,370)	2012	Improve water quality and reduce nutrient levels	SKM (2003); see GIS package (Part C of SKM report) for details on locations of actions.
Instream Habitat Works	Reinstate suitable instream habitat for fishing to 10 km of reaches 5 and 6	Avoca River Reach 5, 6	\$29,000	2012	Improvement of 1 in score of ISC Physical Form subindex in 10 years.	NCCMA (2005a)
Water Quality	Riparian Zone program: Install silt traps, plant buffer/filter strips in high priority areas.	Avoca River; priority from Yeungroon Creek to Campbell Creek	Riparian Zone: annual cost \$113,000 (includes MU 10 and part of lower Avoca catchment): Benefit/Cost 0.3	2012	Reduce phosphorous and nitrogen loads contributing to ANMS 2030 target Reduce nutrient loads from septic tanks Minimise nutrient exports from agricultural land by applying flow-reduction practices	NCCMA (2005a) DFA & DPH (1992) EPA (1996)
	Implement Best Management Practice to 80% of intensive animal industry (follow Code of Practice-Piggeries, implement quality assurance for waste management, implement extension program to increase industry awareness of effluent management)		Best Management practice: annual cost \$3,000 (includes area from Yeungroon Creek to Campbell Creek): Benefit/Cost 9.9			
	Septic Tank Management: Determine areas not suitable for septic tanks and investigate alternative systems, develop auditing procedure in accordance with EPA (1996) and implement recommendations from this audit process.		Septic Tank Management: annual cost \$18,000 (includes Management Unit 10): Benefit/Cost 5.4			
Flow Rate	Manage Flow Rate of Avoca River: At Coonooer Gauge 408200: Summer flow (Dec.-May): cease to flow (0ML/day) for 13-32 day period once every 2 years; minimum median flow (10ML/day) for entire summer period each year (excluding cease to flow period) Winter flow (July-Nov.): >90ML/day for 10 day period twice per year Winter flow (July-Nov.): Minimum median flow (90ML/day) for entire period	Coonooer Gauge		These flow recommendations were being met in 2002	To enhance aquatic life and improve native fish stocks and movements	SKM (2002)
Revegetation	Control bed and bank instability by structural and non-structural works (includes stabilisation of bed and bank, controlling weeds, fencing stream margins, protecting remnant native vegetation)	Avoca River from Yawong Weir to Charlton Weir	Total budget for Management Unit 2: \$660,000	2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
Removal of Fish Barriers	Construction of fish ladders at Charlton and Yawong Weirs	Avoca River from Yawong Weir to Charlton Weir	\$400,000		Aquatic links between all reaches of Avoca River	ID&A (1998)

REACH 6 (MANAGEMENT UNIT 2)						
Avoca River						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Flood Management	Extend flood warning service to cover the catchment upstream of Yawong Weir.	Reach 6	not given	2010	Reduce adverse effects of flooding through implementation of Floodplain Management Strategy	Egis (2000); NCCMA (2005a)
	Flow and height correlations need to be extended to Archdale gauge.					
	Develop real time runoff routing forecast model for the catchment to Quambatook.					
Protecting Remnant Vegetation	Fencing and enhancement planting on 34.5 hectares of riparian land (assume fencing one quarter of reach length - 11.5 km, riparian zone 30 m wide).	Reach 6 - unfenced areas	\$993,000 (government and other): Include reaches 5-8.	2012	248 hectares of riparian land (in reaches 5, 6, 7 & 8) protected and enhanced and placed under management agreements in 5 years.	NCCMA (2005a)
	Fence and enhance 22 river segments (within Management Unit 2) totalling 43.7 km (0.5-4.8 km segments)	Refer to GIS dataset for locations on Reach 6		2012	Enhance and protect Creeklane Grassy Woodland (EVC 68), Plains Grassy Woodland (EVC 175), Floodplain Riparian Woodland (EVC 56), Low Rises Grassy Woodland (EVC 175-1)	NCCMA (2003c); see details of priority stretches in Chapter 4
	Fencing; Offstream watering over 5.3 km of waterway across Management Unit 2	Refer to GIS dataset for locations on Reach 6	Combined Costs for Reaches 5, 6 & 7: Fencing (\$52,740); Offstream watering (\$26,370)	2012	Improve water quality and reduce nutrient levels	SKM (2003); see GIS package (Part C of SKM report) for details on locations of actions.
Instream Habitat Works	Reinstate suitable instream habitat for fishing to 10 km of reaches 5 and 6	Avoca River Reach 5, 6	\$29,000	2012	Improvement of 1 in score of ISC Physical Form subindex in 10 years.	NCCMA (2005a)
Revegetation	Control bed and bank instability by structural and non-structural works (includes stabilisation of bed and bank, controlling weeds, fencing stream margins, protecting remnant native vegetation)	Avoca River from Natte Yallock to Archdale	Total budget for Management Unit 2: \$660,000	2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)

REACH 7 (MANAGEMENT UNIT 2)						
Avoca River						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Flood Management	Extend flood warning service to cover the catchment upstream of Yawong Weir.	Reach 7	not given	2010	Reduce adverse effects of flooding through implementation of Floodplain Management Strategy	Egis (2000); NCCMA (2005a)
	Flow and height correlations need to be extended to Archdale gauge.					
	Develop real time runoff routing forecast model for the catchment to Quambatook.					
Protecting Remnant Vegetation	Fencing and enhancement planting on 25.5 hectares of riparian land (assume fencing one quarter of reach length - 8.4 km, riparian zone 30 m wide).	Reach 7 - unfenced areas	\$993,000 (government and other): Include reaches 5-8.	2012	248 hectares of riparian land (in reaches 5, 6, 7 & 8) protected and enhanced and placed under management agreements in 5 years.	NCCMA (2005a)
	Fence and enhance 22 river segments (within Management Unit 2) totalling 43.7 km (0.5-4.8 km segments)	Refer to GIS dataset for locations on Reach 7		2012	Protect and enhance Creeklane Grassy Woodland (EVC 68), Plains Grassy Woodland (EVC 175), Floodplain Riparian Woodland (EVC 56), Low Rises Grassy Woodland (EVC 175-1)	NCCMA (2003c); see details of priority stretches in Chapter 4
	Fencing; Offstream watering over 5.3 km of waterway across Management Unit 2	Refer to GIS dataset for locations on Reach 7	Combined Costs for Reaches 5, 6 & 7: Fencing (\$52,740); Offstream watering (\$26,370)	2012	Improve water quality and reduce nutrient levels	SKM (2003); see GIS package (Part C of SKM report) for details on locations of actions.
Revegetation	Control bed and bank instability by structural and non-structural works (includes stabilisation of bed and bank, controlling weeds, fencing stream margins, protecting remnant native vegetation)	Avoca River from Natte Yallock to Archdale Natte Yallock town	Total budget for Management Unit 2: \$660,000	2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
Instream Habitat Works	Reinstate suitable instream habitat for significant fauna to 5 km of Reach 7	Avoca River; Reach 7	\$31,000	2012	Improvement of 1 in score of ISC Physical Form subindex	NCCMA (2005a)

REACH 8 MANAGEMENT UNIT 1						
Avoca River						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Flood Management	Extend flood warning service to cover the catchment upstream of Yawong Weir.	Reach 8	not given	2010	Reduce adverse effects of flooding through implementation of Floodplain Management Strategy	Egis (2000); NCCMA (2005a)
	Flow and height correlations need to be extended to Archdale gauge.					
	Develop real time runoff routing forecast model for the catchment to Quambatook.					
Protecting Remnant Vegetation	Fencing and enhancement planting on 21 hectares of riparian land (assume fencing one quarter of reach length - 7 km, riparian zone 30 m wide).	Reach 8 - unfenced areas	\$993,000 (government and other): Include reaches 5-8.	2012	248 hectares of riparian land (in reaches 5, 6, 7 & 8) protected and enhanced and placed under management agreements in 5 years.	NCCMA (2005a)
	Control bed and bank instability by stabilisation programs, fencing riparian vegetation and stream margins, control of weeds, protecting and enhancing remnant native vegetation	Avoca River from Mills Corner to Pelletts Lane; Pelletts Lane to Headwaters and Avoca township	\$410,000			ID & A (1998)
	Fence and enhance 4 segments of Reach 8, totalling 6.8 km (1.1-2.2 km segments)	Refer to GIS dataset for locations on Reach 8		2012	Protect and enhance Creeklane Grassy Woodland (EVC 68), Low Rises Grassy Woodland (EVC 175-1)	NCCMA (2003c); see details of priority stretches in Chapter 4
	Fencing; Off-stream watering; Revegetation; Riparian Maintenance (including weed control) over 0.31 km stretch of Avoca River	Refer to GIS dataset for locations on Reach 8	Fencing (\$3110); Offstream watering (\$1,555); Revegetation (\$16,794); Riparian Maintenance (\$622)	2012	Improve water quality and reduce nutrient levels	SKM (2003); see GIS package (Part C of SKM report) for details on exact locations of actions.
	Fencing; Off-stream watering over 4.3 km of Avoca River	Refer to GIS dataset for locations on Reach 8	Fencing (\$43,140); Offstream watering (\$12,135)	2012	Improve water quality and reduce nutrient levels	SKM (2003); see GIS package (Part C of SKM report) for details on exact locations of actions.
Nutrient Management	Implement priority programs from Avoca Nutrient Management Strategy (ANMS).	Reach 8	Annual cost \$3,000 to be split between two sub-catchments.	2010	Reduce annual phosphorous and nitrogen loads by 0.9 and 7.8 tonnes respectively	NCCMA (2005a) DFA & DPH (1992)
	Implement Best Management Practice to 80% of intensive animal industry (follow Code of Practice-Piggeries, implement quality assurance for waste management, implement extension program to increase industry awareness of effluent management)					
Wetlands	Undertake Index of Wetland Condition assessment of wetlands connected to reach 8. Implement specific wetland management actions identified in Regional Wetlands Strategy (in development).	Wetlands connected to Reach 8	not given		Improvement in condition of high environmental value wetlands and no further decline in extent of wetlands	NCCMA (2005a)

REACH 10 MANAGEMENT UNIT 10						
Campbell Creek						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Protecting Remnant Vegetation	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc.on Campbell Creek: 3 segments totalling 7.5 km (0.5-5.8 km)	Refer to GIS dataset for locations of segments			Protect and enhance existing EVC's	NCCMA (2003c)
	Fencing; Off-stream watering; revegetation; riparian maintenance over 23.0 km stretch of waterway (within entire Management Unit)	Refer to GIS dataset for locations of works	Fencing (\$229,610); Off-stream watering (\$114,805), revegetation (\$1,239,894); riparian maintenance (\$45, 922)		Stabilisation of bank and bed erosion; reduction in nutrient sources from urban centres.	SKM (2003a) Part B, pg 30
	Control bed and bank erosion by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Campbell Creek	\$1,850,000 (to be split between whole Management Unit)	2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
Instream Habitat Works	Maintain aquatic diversity through riparian/instream management; includes revegetation and fencing riparian zone and adopting catchment specific guiding principles under Significantly Enhanced Aquatic Refuges (SEARs) network	Campbell Creek		2012	Increased natural productivity and biodiversity, instream cover and hydraulic diversity	ID & A (1998)
Nutrient Management	Planting of buffer/filter strips, expanding buffer/filters strip widths and buffer/filter strip maintenance; installation of wetlands or silt traps; installation of diversion banks; implement extension program to promote the adoption of flow reduction measures.	Campbell Creek (and catchment)	Riparian Zone: annual cost \$113,000 (to be split between four sub-catchments)	2012	To minimise nutrient exports from agricultural land by applying flor-reducing practices to retain suspended nutrients.	NCCMA (2003b)
	Undertake erosion control works including ongoing maintenance requirements	Campbell Creek (and catchment)	Erosion Control: annual cost \$29,000	2012	Stabilise streambeds and banks and gullies to reduce nutrients generated in catchment.	NCCMA (2003b)
	Septic Tank Management: Determine areas not suitable for septic tanks and investigate alternative systems, develop auditing procedure in accordance with EPA (1996) and implement recommendations from this audit process.	Campbell Creek (and catchment)	\$7,000 (to be split between two sub-catchments)	2012	To reduce nutrient loads from septic tanks entering waterways in the Avoca catchment.	NCCMA (2003b)
	Develop or expand on existing awareness campaigns, involve local environmental groups, Landcare and Waterwacht in the awareness campaign.	Campbell Creek (and catchment)	Nutrient Awareness: annually \$8,000 (to be split between three sub-catchments)	2012	To raise awareness of nutrient issues in urban areas and provide information on the impacts that urban centre have on nutrient loads.	NCCMA (2003b)
	Develop stormwater management plans and implement the high priority recommendations of the stormwater management plans.	Campbell Creek (and catchment)	\$6,000 (to be split between four sub-catchments)	2012	To improve the quality of urban stormwater runoff within the Avoca catchment.	NCCMA (2003b)
	Investigate alternative to emergency discharge from the St Arnaud WWTP	Campbell Creek (and catchment)	Not given	2012	To minimise nutrient contributions from wastewater treatment plants	NCCMA (2003b)
	Implement high priority actions from Northern Grampians Stormwater Management Plan, particularly those concerning nutrient sources from St. Arnaud township.	Across Management Unit 10	Cost not given		Reduction of nutrient sources from urban centres.	SKM (2003a) Part B, pg 30

REACH 11 (MANAGEMENT UNIT 10)							
Strathfillian Creek							
Category	Action	Location	Cost	Timeframe	Action Target	Reference	
Flow Rate Management	Manage Flow Rates in Strathfillian Creek as follows: December-May: 0ML/day (180 days); >2ML/day (6 day duration/once annually) July-October: 2ML/day (entire period); >9ML/day (7 days twice annually); >550ML/day (2 days, twice annually)	Upper Avoca catchment: Strathfillian Creek (at Kooreh): Reach 11				To enhance aquatic life and improve native fish stocks and movements	SKM (2005)
Protecting Remnant Vegetation	Fencing; Off-stream watering; revegetation; riparian maintenance over 23.0 km stretch of waterway (within entire Management Unit)	Refer to GIS dataset for locations of works	Fencing (\$229,610); Off-stream watering (\$114,805), revegetation (\$1,239,894); riparian maintenance (\$45, 922)			Stabilisation of bank and bed erosion; reduction in nutrient sources from urban centres.	SKM (2003a) Part B, pg 30
	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc. in Strathfillian Creek: 7 segments totalling 5.5 km (0.2-2.1 km)	Refer to GIS dataset for segment locations.				Protect and enhance remnant EVCs.	NCCMA (2003c)
	Control bed and bank erosion by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	\$1,850,000 (to be split between whole Management Unit)	2012		Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
Instream Habitat	Maintain aquatic diversity through riparian/instream management; includes revegetation and fencing riparian zone and adopting catchment specific guiding principles under Significantly Enhanced Aquatic Refuges (SEARs) network	Strathfillian Creek (included as part of Campbell Creek sub-catchment).		2012	Increased natural productivity and biodiversity, instream cover and hydraulic diversity	ID & A (1998)	
Nutrient Management	Planting of buffer/filter strips, expanding buffer/filters strip widths and buffer/filter strip maintenance; installation of wetlands or silt traps; installation of diversion banks; implement extension program to promote the adoption of flow reduction measures.	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	Riparian Zone: annual cost \$113,000 (to be split between four sub-catchments)	2012		To minimise nutrient exports from agricultural land by applying flor-reducing practices to retain suspended nutrients.	NCCMA (2003b)
	Undertake erosion control works including ongoing maintenance requirements	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	Erosion Control: annual cost \$29,000	2012		Stabilise streambeds and banks and gullies to reduce nutrients generated in catchment.	NCCMA (2003b)
	Septic Tank Management: Determine areas not suitable for septic tanks and investigate alternative systems, develop auditing procedure in accordance with EPA (1996) and implement recommendations from this audit process.	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	\$7,000 (to be split between two sub-catchments)	2012		To reduce nutrient loads from septic tanks entering waterways in the Avoca catchment.	NCCMA (2003b)
	Develop or expand on existing awareness campaigns, involve local environmental groups, Landcare and Waterwatch in the awareness campaign.	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	Nutrient Awareness: annually \$8,000 (to be split between three sub-catchments)	2012		To raise awareness of nutrient issues in urban areas and provide information on the impacts that urban centres have on nutrient loads.	NCCMA (2003b)
	Develop stormwater management plans and implement the high priority recommendations of the stormwater management plans.	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	\$6,000 (to be split between four sub-catchments)	2012		To improve the quality of urban stormwater runoff within the Avoca catchment.	NCCMA (2003b)
	Investigate alternative to emergency discharge from the St Arnaud WWTP	Strathfillian Creek (included as part of Campbell Creek sub-catchment).	Not given	2012		To minimise nutrient contributions from wastewater treatment plants	NCCMA (2003b)
	Implement high priority actions from Northern Grampians Stormwater Management Plan, particularly those concerning nutrient sources from St. Arnaud township.	Across Management Unit 10	Cost not given			Reduction of nutrient sources from urban centres.	SKM (2003a) Part B, pg 30
Fish Management	Enhance recreational fishing through stock enhancement by maintaining stock program and monitoring angler activity	Teddington Reservoir in Campbell Creek catchment (along Strathfillian Creek)	\$20,000/year for five years			ID&A (1998)	

REACH 12 (MANAGEMENT UNIT 10)							
Middle Creek							
Category	Action	Location	Cost	Timeframe	Action Target	Reference	
Protecting Remnant Vegetation	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc. in Middle Creek: 1 segment of 1.4 km	Refer to GIS dataset for location of segment.				To protect and enhance remnant EVCs	
	Fencing; Off-stream watering; revegetation; riparian maintenance over 23.0 km stretch of waterway (within entire Management Unit)	Refer to GIS dataset for locations of works	Fencing (\$229,610); Off-stream watering (\$114,805), revegetation (\$1,239,894); riparian maintenance (\$45, 922)			Stabilisation of bank and bed erosion; reduction in nutrient sources from urban centres.	SKM (2003a) Part B, pg 30
	Control bed and bank erosion by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Middle Creek (as part of Campbells Creek sub-catchment)	\$1,850,000 (to be split between whole Management Unit)	2012		Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
Instream Habitat Works	Maintain aquatic diversity through riparian/instream management; includes revegetation and fencing riparian zone and adopting catchment specific guiding principles under Significantly Enhanced Aquatic Refuges (SEARs) network	Middle Creek (as part of Campbells Creek sub-catchment)		2012	Increased natural productivity and biodiversity, instream cover and hydraulic diversity	ID & A (1998)	
Nutrient Management	Planting of buffer/filter strips, expanding buffer/filters strip widths and buffer/filter strip maintenance; installation of wetlands or silt traps; installation of diversion banks; implement extension program to promote the adoption of flow reduction measures.	Middle Creek and tributaries (as part of Campbells Creek sub-catchment)	Riparian Zone: annual cost \$113,000 (to be split between four sub-catchments)	2012		To minimise nutrient exports from agricultural land by applying flow-reducing practices to retain suspended nutrients.	NCCMA (2003b)
	Undertake erosion control works including ongoing maintenance requirements	Middle Creek and tributaries (as part of Campbells Creek sub-catchment)	Erosion Control: annual cost \$29,000	2012		Stabilise streambeds and banks and gullies to reduce nutrients generated in catchment.	NCCMA (2003b)
	Septic Tank Management: Determine areas not suitable for septic tanks and investigate alternative systems, develop auditing procedure in accordance with EPA (1996) and implement recommendations from this audit process.	Middle Creek and tributaries (as part of Campbells Creek sub-catchment)	\$7,000 (to be split between two sub-catchments)	2012		To reduce nutrient loads from septic tanks entering waterways in the Avoca catchment.	NCCMA (2003b)
	Develop or expand on existing awareness campaigns, involve local environmental groups, Landcare and Waterwatch in the awareness campaign.	Middle Creek and tributaries (as part of Campbells Creek sub-catchment)	Nutrient Awareness: annually \$8,000 (to be split between three sub-catchments)	2012		To raise awareness of nutrient issues in urban areas and provide information on the impacts that urban centres have on nutrient loads.	NCCMA (2003b)
	Develop stormwater management plans and implement the high priority recommendations of the stormwater management plans.	Middle Creek and tributaries (as part of Campbells Creek sub-catchment)	\$6,000 (to be split between four sub-catchments)	2012		To improve the quality of urban stormwater runoff within the Avoca catchment.	NCCMA (2003b)
	Investigate alternative to emergency discharge from the St Arnaud WWTP	Middle Creek and tributaries (as part of Campbells Creek sub-catchment)	Not given	2012		To minimise nutrient contributions from wastewater treatment plants	NCCMA (2003b)
	Implement high priority actions from Northern Grampians Stormwater Management Plan, particularly those concerning nutrient sources from St. Arnaud township.	Across Management Unit 10	Cost not given			Reduction of nutrient sources from urban centres.	SKM (2003a) Part B, pg 30

REACH 13 MANAGEMENT UNIT 13						
Fentons Creek						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Revegetation	Fence stream margins, manage riparian zone throughout catchment, including fencing, revegetation and adopting SEARs network	Fentons Creek - Reach 13	\$3,075,000 to be split between works on Fentons, Sandy, Homebush, Yawong Creeks and Coonooer Bridge	2012	Increased hydraulic diversity, instream cover, natural productivity and biodiversity	ID & A (1998)
Protecting Remnant Vegetation	Control bed and bank erosion in entire Management Unit by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Fentons Creek - Reach 13		2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc. in Fentons Creek (4 segments totalling 8.5 km) split between Reach 13 and Reach 14.	Refer to GIS dataset for segment locations.			To protect and enhance remnant EVCs.	NCCMA (2003c)
Nutrient Management	Fencing, offstream watering, revegetation, riparian maintenance over 4.48 km of Management Unit 13	Refer to GIS dataset for segment locations	Fencing (\$44,760), Offstream watering (\$22,380), revegetating (\$241,704), riparian maintenance (\$8,952) Costs to be split across entire Management Unit		Stabilisation of bank and bed erosion; long term improvement in ISC and ARH (DSS) scores; reduction in nutrient sources from urban centres.	SKM 2003a Part B pg 37
	Fencing, offstream watering, revegetation, riparian maintenance over 17.05 km of Management Unit 13	Refer to GIS dataset for segment locations	Fencing (\$170,510), Offstream watering (\$82,255), revegetating (\$920,754), riparian maintenance (\$34,102) Costs to be split across entire Management Unit		Stabilisation of bank and bed erosion; long term improvement in ISC and ARH (DSS) scores; reduction in nutrient sources from urban centres.	SKM 2003a Part B pg 37
	Fencing and offstream watering over 2.07 km of Management Unit 13	Refer to GIS dataset for segment locations	Fencing (\$20,670), offstream watering (\$10,335) Costs to be split across entire Management Unit		Stabilisation of bank and bed erosion; long term improvement in ISC and ARH (DSS) scores; reduction in nutrient sources from urban centres.	SKM 2003a Part B pg 37

REACH 14 (MANAGEMENT UNIT 8)						
Fentons Creek						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Protecting Remnant Vegetation	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc. in Fentons Creek (4 segments totalling 8.5 km) split between Reach 13 and Reach 14.	Refer to GIS dataset for segment locations.			To protect and enhance remnant EVCs.	NCCMA (2003c)

REACH 15 (MANAGEMENT UNIT 11)						
Cherry Tree Creek						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Flow Rate Management	Manage Cherry Tree Creek flow rate: December-May: 0ML/day (180 days) to facilitate decomposition of organic matter; >2ML/day (6 day duration/once annually) July-October: 2ML/day (entire period) ; >6ML/day (7 days twice annually) ; >450ML/day (2 days, twice annually).	Cherry Tree Creek			To enhance aquatic life and improve native fish stocks and movements	SKM (2005)
Protecting Remnant Vegetation	Protection and enhancement of remnant EVCs (easting and northings in reference give midpoints of reach) in Cherry Tree Creek: 5 segments totalling 4.3 km	Refer to GIS dataset for locations.			Protect and enhance remnant EVCs.	NCCMA (2003c)
	Fencing, offstream watering, revegetation and riparian maintenance over 104.8 km of waterway (across Management Unit, Reaches 15 and 17).	Refer to GIS dataset for locations.	Fencing (\$1,047,610); Offstream watering (\$523,805); Revegetation (\$5,657,094); Riparian Maintenance (\$209, 522) (Costs to be split across Management Unit)			SKM (2003).
	Control bed and bank erosion in entire Management Unit by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Cherry Tree Creek (as one of four creeks within Management Unit)	\$1,805,000 (to be split between four waterways including Reach 15 and 17)		Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
Revegetation	Maintain aquatic diveristy through riparian/instream management; includes revegetation and fencing riparian zone and adopting catchment specific guiding principles under Significantly Enhanced Aquatic Refuges (SEARs) network	Cherry Tree Creek (as one of four creeks within Management Unit)			Increased natural productivity and biodiversity, instream cover and hydraulic diversity	ID & A (1998)

REACH 16 (MANAGEMENT UNIT 13)						
Homebush Creek						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Revegetation	Fence stream margins, manage riparian zone throughout catchment, including fencing, revegetation and adopting SEARs network	Homebush Creek	\$3,075,000 to be split between works on Fentons, Sandy, Homebush, Yawong Creeks and Coonooer Bridge	2012	Increased hydraulic diversity, instream cover, natural productivity and biodiversity	ID & A (1998)
Protecting Remnant Vegetation	Control bed and bank erosion in entire Management Unit by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Homebush Creek		2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc. in Homebush Creek: 4 segments totalling 3.9 km	Refer to GIS dataset for segment locations			Protect and enhance remnant EVCs.	NCCMA (2003c)
Nutrient Management	Fencing, offstream watering, revegetation, riparian maintenance over 4.48 km of Management Unit 13	Refer to GIS dataset for segment locations	Fencing (\$44,760), Offstream watering (\$22,380), revegetating (\$241,704), riparian maintenance (\$8,952) Costs to be split across entire Management Unit		Stabilisation of bank and bed erosion; long term improvement in ISC and ARH (DSS) scores; reduction in nutrient sources from urban centres.	SKM 2003a Part B pg 37
	Fencing, offstream watering, revegetation, riparian maintenance over 17.05 km of Management Unit 13	Refer to GIS dataset for segment locations	Fencing (\$170,510), Offstream watering (\$82,255), revegetating (\$920,754), riparian maintenance (\$34,102) Costs to be split across entire Management Unit		Stabilisation of bank and bed erosion; long term improvement in ISC and ARH (DSS) scores; reduction in nutrient sources from urban centres.	SKM 2003a Part B pg 37
	Fencing and offstream watering over 2.07 km of Management Unit 13	Refer to GIS dataset for segment locations	Fencing (\$20,670), offstream watering (\$10,335) Costs to be split across entire Management Unit		Stabilisation of bank and bed erosion; long term improvement in ISC and ARH (DSS) scores; reduction in nutrient sources from urban centres.	SKM 2003a Part B pg 37

REACH 18 MANAGEMENT UNIT 12						
Number Two Creek						
Category	Action	Location	Cost	Timeframe	Action Target	Reference
Revegetation	Control bed and bank erosion in entire Management Unit by structural and non-structural works; includes stabilisation programs, fencing riparian vegetation and stream margins, protecting and enhancing native vegetation	Eroded areas of Number Two Creek	\$825,000 to be split across six locations (Number 1 and 2 Creeks, Cockings and Mangans Rd Gullies, Rutherford and Amphitheatre Creeks)	2012	Increased bank stability; reduced risk of erosion; decreased runoff; improved water quality; increased aesthetic appeal; reduced grazing pressure	ID & A (1998)
	Fencing, offstream watering over 2.7 km of western tributaries	Refer to GIS dataset for location of segments on Number Two Creek.	Fencing (\$27,440), Offstream watering (\$13,720) (Costs to be split across Management Unit)		Stabilisation of bank and bed erosion.	SKM (2003A) Part B, pg 36
Protecting Remnant Vegetation	Protect and enhance remnant EVCs by fencing, weed control, removal of stock etc. in Number Two Creek: 2 segments totalling 1.5 km	Refer to GIS dataset for location of segments.			To protect and enhance remnant EVCs.	NICOMA (2003c)