



SPECIFIC MANAGEMENT ISSUES

4

This section outlines management arrangements and policies for specific management activities affecting river health which will assist in protection and restoration and will minimise the damage to river health from future river management activities. These include:

- water allocation and the management of river flows;
- management of water quality;
- management of riparian land; and
- management of the river channel.

6. Environmental Flows and Water Allocation

6.1 INTRODUCTION

The flow of a river is its single most valuable aspect for our communities from an economic point of view. The water provided by our rivers supplies drinking water for four million people across Victoria and supports irrigated agriculture worth \$5.2 billion. In the future, the importance of Victoria's irrigated agriculture will grow as annual exports of food and fibre are increased to the target of \$12 billion by 2010.

However, the flow of a river is also fundamental to its ecology. Box 6.1 outlines the dependence of river ecology on its flow regime.

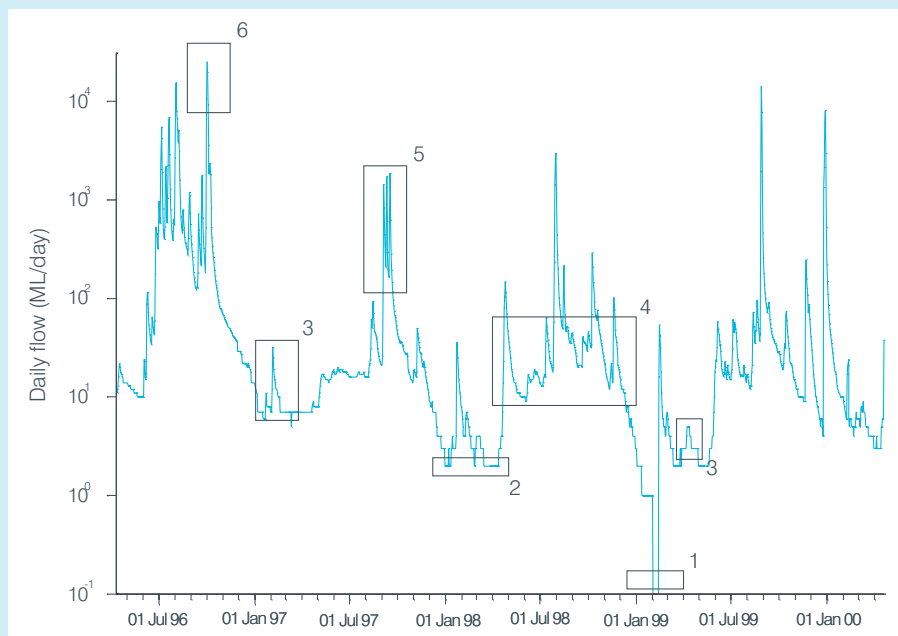
Box 6.1 The Importance of River Hydrology for River Ecology

As described in Chapter 2, the flow of a river is fundamental to its ecology. The flow regimes of rivers across Victoria are inherently variable. The variability of a flow regime occurs in three different time scales:

- daily - small changes in day-to-day river height;
- seasonally - the changes in flows due to seasonal rainfall or snowmelt, which include small freshes or larger flushes within the river, bankfull flows and annual floods; and
- interannually - larger floods that occur periodically, such as 1 in 5 years or 1 in 20 years.

Figure 6.1 shows a flow regime for a typical river in northern Victoria. From an ecological perspective, this flow regime can be broken up into a number of components, all of which have some ecological significance for the river, the riparian zone and the floodplain. These are outlined in Table 6.1.

Figure 6.1 Typical daily flow series



1 - cease to flow, 2 - low flow, 3 - freshes, 4 - base winter flows, 5 - bank full, 6 - overbank

Table 6.1 Ecological significance of the major components of a typical river flow regime

NB: the ecological significance of flooding periodicities is indicative and is dependent on actual locations.

Flow Component	Channel Flow Characteristics	Timing	Frequency	Duration	Features
Cease to flow	No surface flow	Summer	Annual	Varies from months to days	Ecological disturbance Dries habitats and substrates
Low flow	Minimum flow in channel Continuous flow in some parts of channel	Summer	Annual	Weeks to months	Connects inter-stream habitats
Freshes	Flow greater than median flow for that period	Summer Spring	Can be several in each period	Generally days	Biological triggers Input to habitats
High flow	Connects most in channel habitats Less than bankfull May include flow in minor floodplain channels	Autumn Winter Spring	May be several annually	Days to weeks	Inundation of instream habitats Channel connectivity Allows migration Inundation of organic matter Sediment movement
Bankfull	High flow within channel capacity Flow in other channels (anabranches etc.)	Winter Spring	Generally at least annually	Days to weeks	Channel and habitat forming Sediment movement
Overbank	Flow extends to floodplain Surface flows	Winter Spring	Can be annual or less frequent	Days	Floodplain connectivity Organic matter inputs

(Figure 6.1 and Table 6.1 adapted from NRE et al., 2001)

The harnessing of rivers to provide secure water supplies for towns and irrigation has had profound effects on the ecology of rivers, floodplains and estuaries. The introduction of dams and other regulating structures, of diversions from streams, of groundwater bores and of small catchment dams have impacted on the natural flow regime of our rivers. Furthermore, water resource development is not the only activity that can impact on river hydrology. Changes in land use within catchments, such as land clearing and urbanisation, have also modified the water regimes within our rivers.

Table 6.2 outlines how the various water resource management operations can affect ecologically significant aspects of river flow regimes and the probable impacts on river health. In addition to these flow-related effects, water resource management structures may also have other ecological impacts, such as disturbing the longitudinal continuity of a river by creating barriers. These other effects are discussed in later chapters.

Table 6.2 Potential ecological effects of changed flow regimes due to water resource management operations

Water Resource Management Operation	Ecologically Significant Component of Flow Regime that can be impacted Downstream	Probable Impacts on River Health
Groundwater bores (depending on volume extracted)	<ul style="list-style-type: none"> reduction in summer baseflow in rivers decrease in water depth in wetlands 	Loss of critical summer habitat resulting in loss in biodiversity
Catchment dams (depending on degree of development in catchment)	<ul style="list-style-type: none"> reduction in summer baseflow reduction in winter baseflow reduction in freshes 	As above plus: <ul style="list-style-type: none"> loss of opportunities for movement between habitats reduction in breeding cues
River diversions (depending on volume of water extracted) <ul style="list-style-type: none"> summer 	<ul style="list-style-type: none"> reduction in summer baseflows considerable reduction or increase in daily variability of summer baseflows (depending on the pumping regime) 	<ul style="list-style-type: none"> loss of critical summer habitat resulting in loss in biodiversity loss of opportunities for movement between habitats
<ul style="list-style-type: none"> winter 	<ul style="list-style-type: none"> reduction in winter baseflow reduction in freshes 	<ul style="list-style-type: none"> loss of opportunities for movement between habitats reduction in breeding cues
Small on-stream dams	As above	As above plus: <ul style="list-style-type: none"> physical barrier to movement
Large regulating weirs (depending on their function)	As above plus: <ul style="list-style-type: none"> reduction in winter baseflows general reduction in freshes loss of daily variability in baseflows change to the seasonality of flows (e.g. increased summer flows for irrigation) rapid rise and fall of water levels 	As above plus: <ul style="list-style-type: none"> loss of breeding cues erosion of river banks and deepening of river channel (this may impact on the groundwater table) loss of bank habitat and species conditions may favour blue-green algae loss of natural sediment transport stillwater habitats may favour exotic species (e.g. Carp)
Diversion/irrigation channels	<ul style="list-style-type: none"> alteration to natural flow paths and patterns 	<ul style="list-style-type: none"> spread of exotic species transport of native species into irrigation areas – loss of biodiversity

Water Resource Management Operation	Ecologically Significant Component of Flow Regime that can be impacted Downstream	Probable Impacts on River Health
<p>Large dams (capacity < mean annual run-off)*</p> <ul style="list-style-type: none"> • generally built to supply irrigation and town water supply • often run at high flows during the irrigation season 	<ul style="list-style-type: none"> • reduction in frequency and duration of 1 in 2 year floods • increase in summer baseflows • decrease in cease-to-flow events • reduction in winter baseflows • general reduction in freshes and flushes • loss of daily variability in both summer and winter baseflows • increase in unseasonal summer flooding 	<p>As above plus:</p> <ul style="list-style-type: none"> • loss of lower areas of floodplain and wetland habitat • loss of breeding cues and opportunities with subsequent loss of biodiversity • loss of trigger flows may favour reproductive success of exotic species (e.g. Carp) • reduction in organic exchange between floodplain and river resulting in reduction in ecological processing • changes in water temperature resulting in reduction of breeding of fauna • erosion of river banks and scouring of river beds • loss of bank habitat and species • changes in river bed with loss of instream habitat • loss of nutrients, sediments and organic matter downstream • reduction of organic debris and sediment input into floodplains and estuaries • changed frequency/duration of estuary closure
<p>Very large dams (capacity > mean annual run-off)*</p> <ul style="list-style-type: none"> • if built to supply irrigation and town water supply <ul style="list-style-type: none"> - generally releases at high flows during the irrigation season - may have a constant release pattern 	<p>As above plus:</p> <ul style="list-style-type: none"> • reduction in frequency and duration of all categories of flood events 	<p>As above</p>
<p>* if run for hydroelectricity generation</p>	<ul style="list-style-type: none"> • may have greatly increased daily variability 	<ul style="list-style-type: none"> • bank slumping • bed scouring and deepening of river channel resulting in loss of habitats and species

Many rivers are showing a number of the impacts outlined in Table 6.2. Much of this is due to historical practices where rights to water extraction were granted with no understanding of the environmental effects. As these environmental effects started to become apparent, there was a dawning realisation that not only are we dealing with a finite and scarce resource, but that much of our resource use is dependent on the quality of the resource base; that is, our maintenance of our system of water use is dependent on the ecological health of the rivers.

In the last fifteen years, this realisation has totally changed the way water is managed in Victoria. The emphasis has moved from exploitation to careful resource management with full recognition of the importance of the environment. The framework for water management was laid down in the *Water Act 1989*, which provides for:

- protection of the environment through the provision of environmental flow regimes and related measures;
- consumptive entitlements to be clearly defined; and
- water to be reallocated to its best use through the establishment of water markets.

The challenge now is to manage a finite and scarce resource in an environmentally responsible way, balancing the needs of current and future users and the rivers themselves. In many cases, the environmental condition of rivers will need to be improved if they are to sustain current levels of use.

The focus for the future will be on:

- much smarter operations;
- vigorously pursuing opportunities for water savings and reuse;
- the movement of water to more productive use through water markets;
- combining environmental objectives with water supply objectives;
- improving environmental flows in high priority rivers; and
- continuous improvement in water resource management practices.

The water allocation framework has been evolving rapidly in recent years to enable these objectives to be met. Section 6.2 describes the current Victorian water allocation arrangements incorporating a number of recent changes. Section 6.3 describes issues associated with water allocation and management that may impact on river health. These sections provide specific policy direction on how these issues should be dealt with within the water allocation process is provided.

6.2 THE VICTORIAN WATER ALLOCATION FRAMEWORK

The Victorian water allocation framework is based on the understanding that water is a finite resource, and is designed to:

- protect river health by providing water to sustain rivers, floodplains and associated wetlands and estuaries;
- provide all users with entitlements to water that are explicit, exclusive, enforceable and tradeable;
- enable water users to make informed choices about their use and management of water and to allow certainty for long-term planning;
- protect social and cultural values;
- provide clarity on the entitlements of all users in times of drought;
- facilitate the movement of water to its highest value use; and
- enable community input into decisions on water allocation.

The framework is based on a hierarchy of legal entitlements to water, starting with the right of the Crown to control all groundwater and any water in a waterway. Below this, bulk entitlements (BEs) are established for both urban and rural water authorities. BEs for rural authorities cover the water rights held by irrigators in authority-supplied districts, plus the losses incurred by the authority in distributing the water. Finally, individuals taking water must have a licence issued by the Minister. Recent amendments to legislation mean that this now not only includes water taken from waterways or groundwater but also water harvested from the catchment for commercial purposes. These amendments complete the water allocation framework in Victoria by ensuring that all significant water use within a catchment is now included within the framework.

Within the current water allocation framework, provisions for environmental flows are made under the Water Act through two mechanisms, either:

- by placing conditions on the BEs or licences of other users which ensure an appropriate water regime for the environment; or
- by providing a BE or licence for environmental purposes.

The allocation framework is being implemented in the following types of water management systems:

- regulated systems;
- unregulated rivers; and
- groundwater.

The sections below describe the process and mechanism for water allocation in each of these water resource management systems, the type of entitlement provided to water users and how the environment is provided for in each system. A key principle in the implementation of the allocation framework has been the recognition of the existing rights of current water users. These sections also describe the other major features of the water allocation framework which enable reallocation amongst users and uses or which constrain allocations within currently acceptable limits.

6.2.1 Bulk Entitlements in Regulated Rivers

Regulated systems are those where the flow of the river is regulated through the operation of large dams or weirs. The types of environmental impacts that may occur within regulated systems are shown in Table 6.2. In regulated systems, BEs are issued to rural and urban water authorities, and in some cases for the environment. A BE defines the volume of water that an authority may take from a river or storage, the rate at which it may be taken and the reliability of the entitlement. Water for the environment is generally provided by placing conditions on the BE of a consumptive user, for example by requiring a water authority to release a particular environmental flow regime from a storage. In addition, it is possible for a BE to be provided for the environment. This is generally done when allocations are required for wetland watering which need some flexibility of use.

Currently, Victoria is converting previously poorly-defined rights to BEs. In the conversion of these previously held rights, the operation of the system is reviewed in a negotiation process between environmental managers, irrigators, water authorities and other groups, with the aim of improving the environmental flow regime where possible. Whilst a BE conversion process is primarily aimed at clarifying the rights of existing users, in 82% of these negotiations some improvements to environmental flow regimes have been achieved.

6.2.2 Unregulated Systems

Unregulated systems are those that do not have large structures which provide water for extractive uses. In these systems, BEs are issued to water authorities that divert directly from rivers. In addition, there are a large number of private diverters who are licensed to extract water by pumping directly from rivers. The types of environmental impacts that can occur as a result of these diversions are shown in Table 6.2. Currently, the majority of this water is taken during the summer months, often causing ecological stress through major loss of habitat and poor water quality.

Management of unregulated systems is based on three factors:

- recognition of the ecological stress caused by diversions, particularly by existing summer diversions;
- recognition of the need for reliability of supply for consumptive use; and
- the need for a risk-based approach to management of diversions where the level of management effort increases with the level of environmental risk.

Because of the ecological stress caused by summer diversions, for the past 15 years new summer diversion licences have generally not been issued.

The risk-based management approach classifies streams into three management priority categories based on:

- environmental/ecological values that need to be protected or enhanced;
- the amount of water authorised to be taken and the amount of water used in the area;
- the history of management difficulty in terms of water shortages;
- the likelihood of further demand for water;
- the need to protect downstream entitlements; and
- the Permissible Annual Volume (the volume of entitlements that can be safely diverted) for the area.

Streams with a high environmental value and a high level of risk will be given the highest level of management effort – the development of a community-based Streamflow Management Plan (SFMP).

Streams where either the level of risk or the values are not as high will be categorised as medium. These streams are intended to eventually be managed using a SFMP but are currently a lower priority for SFMP development. In the interim, they will be managed by statewide management rules directed at relieving summer ecological stress, utilising trading to improve environmental flow regimes, managing winter diversions within a sustainable limit and collecting data on water use to input to the eventual SFMP process.

Streams where the level of risk is clearly low will also be subject to statewide rules for management which protect their current values and which therefore address issues including the protection of summer flows and freshes, managing winter diversions within a sustainable limit, and trading.

This approach is summarised in Table 6.3 and will be phased in by December 2002.

Table 6.3 Management of unregulated rivers in Victoria

Category	Management Priority	Management Activities
1	High	<p>Streamflow Management Plan During SFMP development where there is a declared Water Supply Protection Area under the <i>Water Act 1989</i>, no further licences will be allowed until the completion of the SFMP and then licences will only be granted in accordance with SFMP provisions.</p>
2	Medium	<p>Will have an SFMP in time In the interim, will be managed in accordance with Statewide Rules covering:</p> <ul style="list-style-type: none"> • no further licences issued for summer diversion • summer rostering rules to protect summer flows • introduction of metering to provide data on water usage - refer Note no. 1 • granting of new winter licences up to the SDL - refer Note no. 2 • trading <ul style="list-style-type: none"> - of summer licences <ul style="list-style-type: none"> → downstream only in the Murray-Darling Basin and elsewhere unless specific impact assessment establishes otherwise → reduction of 20% of entitlement on trade (only in Murray-Darling Basin) → of winter licences within the SDL • monitoring • compliance
3	Low	<p>Will be managed in accordance with Statewide Rules covering:</p> <ul style="list-style-type: none"> • no further licences issued for summer diversion • summer rostering rules to protect summer flows • introduction of metering to provide data on water usage - refer Note no. 1 • granting of new winter licences up to the SDL - refer Note no. 2 • trading <ul style="list-style-type: none"> - of summer licences downstream only in the Murray-Darling Basin and elsewhere unless specific impact assessment establishes otherwise - reduction of 20% of entitlement on trade (only in Murray-Darling Basin) - of winter licences only within the SDL • monitoring • compliance

Notes:

1. The introduction of metering in Category 2 and 3 catchments will be in accordance with programs agreed between Licensing Authorities and Government.
2. This is subject to the completion of implementation programs for SDLs agreed between Licensing Authorities and Government.

There are two key components to the risk-based approach outlined in Table 6.3:

- winter Sustainable Diversion Limits (SDLs); and
- community-based SFMPs.

Winter Sustainable Diversion Limits are being developed for catchments and subcatchments for the winter months. The SDL will specify, for each catchment and subcatchment, a limit for winter diversions and an allowable rate of extraction. The specification of SDLs is based on an analysis of the hydrology of the system and will be a conservative estimate of how much water can be extracted from these systems during winter with minimum environmental impact.

Streamflow Management Plans are developed in consultation with the community. The regional planning process described in Chapter 5 shows how SFMPs and BEs are integrated into the larger context of regional river health planning. SFMPs take account of the environmental, social, cultural and economic assets associated with a river.

The objective of a SFMP is to establish a water-sharing plan for the management of diversions on an unregulated river that will provide water users with agreed levels of security under various climatic conditions, and provide the environmental flow regime required to maintain an ecologically healthy river and protect the environmental assets. In developing these plans, it is recognised that in a number of streams, the level of existing diversions particularly in summer may not enable the environmental flow requirements to be met immediately. However, there is a requirement that the environmental flow regime will be improved over the planning period with the aim of ultimately providing the agreed environmental flow regime.

A Streamflow Management Plan includes:

- immediate negotiated environmental flow provisions;
- flow-sharing rules for a range of climatic conditions;
- trading rules;
- provisions to improve the environmental flow regime over time, where necessary to meet the environmental flow requirements;
- rules covering the granting of any new licences;
- roles and responsibilities;
- cost-sharing; and
- provisions for monitoring, compliance and plan review.

The detailed policy principles and management arrangements for the development of SFMPs are outlined in the *Stream Flow Management Plan Framework* (NRE 2002). This framework includes an audit and review process which establishes an Independent Technical Review Panel to review the environmental flow and hydrological assessments, and predictions of impacts and risks.

6.2.3 Groundwater Management

Groundwater extraction has the potential to affect baseflows in rivers and water depth in wetlands. Groundwater is allocated via groundwater licences. Similar to the management of unregulated rivers, Victoria's groundwater resources are managed using a risk-based approach.

As a first step, the sustainable yield of the aquifers in the 64 groundwater management areas in the State has been quantified, as has the volume of groundwater allocated to users. Within these areas, a Permissible Annual Volume (PAV) has been set to reflect the sustainable yield of the aquifer. This is a 'first cut' estimate which has taken into account the need to maintain river baseflows but is limited by the available information. When resource commitments reach 70% of the PAV, the second stage is triggered. This involves the establishment of a Groundwater Supply Protection Area, increased monitoring and the development of a community-based Groundwater Management Plan for the management of the resource.

Groundwater Management Plans (GMPs) are developed by consultative committees, comprising landholders, resource management agencies, environmental management agencies and environmental interest groups. They:

- establish rules for the allocation of groundwater, including the ability to transfer water between landholders;
- establish arrangements for metering and monitoring;
- make provision for more intensive studies into resource availability;
- identify the extent of groundwater usage and provide opportunities for additional usage where the resource is available; and
- provide more certainty to existing users thereby enabling long-term planning.

A key principle behind this approach is the investment in better information as the resource utilisation increases. First estimates of groundwater PAVs use the best available data, but are quite imprecise. As resource utilisation gets close to these first-cut assessments, further data collection takes place, refining these estimates of PAVs for use in the detailed community-based GMPs.

6.2.4 Stressed Rivers

Where provisions in BEs and the immediate negotiated environmental flows in SFMPs do not meet environmental needs, these rivers are considered within the water allocation framework to be stressed. The management provisions for stressed rivers are outlined later in this chapter.

6.2.5 The Water Market

The Water Act provides for the trading of entitlements as a mechanism for facilitating the movement of water to its highest value use. The establishment of the water market in northern Victoria has been very successful in enabling more efficient water use. Trades of irrigator entitlements, licences and BEs are permitted to occur on either a temporary or a permanent basis. Environmental allocations may be traded on a temporary basis. The Government recently announced the establishment of a new statewide water exchange, Watermove, to facilitate trading of water licences across Victoria. Watermove will be in place for the 2002-03 irrigation season.

6.2.6 Sustainable Catchment Limits

A sustainable catchment limit restricts the amount of water that can be extracted from a system. Placing sustainable catchment limits on diversions within systems protects the security of existing consumptive users and protects environmental flows. The concept of a sustainable catchment limit, whilst restricting the amount of water able to be diverted from a system, need not limit new or further development occurring within the catchment. Such developments can continue to occur through the water market.

The MDB Cap

Victoria is a member of the Murray-Darling Basin Ministerial Council, which in 1994 instituted a cap on all diversions within the Murray-Darling Basin. This means that there will be no increase in diversions over the amount that was being diverted at the 1993-94 level of development. Defining the cap in terms of the 1993-94 level of development enables annual variations in diversions caused by climatic variability to be taken in to account. The MDB Cap was put in place because over two-thirds of the flow in the Murray is diverted and the river is in poor environmental condition. Victoria is committed to implementing the MDB Cap.

Implementation of sustainable catchment limits

Implementation of the MDB Cap is an over-riding consideration in the north of the State and is implemented through the BE, SFMP and SDL processes and trading rules in this area. Over time, sustainable catchment limits will also be required for both surface and groundwater in southern Victoria as diversions reach sustainable limits. Limits have already been put in place in some groundwater systems. By 2005, sustainable catchment limits will be put in place for all catchments and aquifers.

6.2.7 Targets for the Implementation of the Victorian Water Allocation Framework

The following are the statewide targets for the implementation of the Victorian water allocation framework.

- Winter SDLs will be in place in all catchments by December 2002.
- Statewide water market will be in operation for the 2002-03 irrigation season.
- All BE conversions on major water supply systems will be completed by 2003.
- 16 GMPs will be completed by 2003.
- 33 SFMPs will be completed in priority areas by 2004.
- Sustainable catchment limits will be in place by 2005.
- 100% compliance with the MDB Cap.

6.3 RIVER HEALTH ISSUES ASSOCIATED WITH WATER ALLOCATION

The Victorian water allocation framework is based on property rights and a water market, and is aimed at properly managing a finite and scarce resource for which there are many competing uses. The entire framework is premised on healthy rivers. Should the health of the water resource decline, the entire system is put at risk.

Victoria recognises that it is in the interest of all sectors of the community to ensure that our use of the resource is sustainable in the long term. A number of issues arise in the implementation of the water allocation and management framework that relate to river health and the sustainability of water resource management. The major environmental issues include:

- defining an environmental flow;
- providing and managing water for the environment;
- restoring stressed river systems where the existing levels of extraction are causing environmental damage;
- protecting river systems by:
 - enabling new development to occur in an ecologically sustainable way,
 - integrating surface water and groundwater management and catchment impacts, and
 - dealing with uncertainty in water resource management; and
- defining the roles of water supply and management authorities.

These issues are discussed below. Policy direction is provided on how these issues will be dealt with within community decision-making frameworks for water allocation and waterway health.

6.3.1 Defining an Environmental Flow

One of the key information inputs into a BE conversion process or a SFMP process is an understanding of the environmental flow requirements of a particular river system. This involves an environmental flow assessment.

The science of environmental flow assessment is one that has evolved very rapidly over the past five years. Over this time, the significance of the various aspects of the flow regime for components of the river ecosystem has been recognised, although our understanding of these relationships is still developing (see Box 6.1). In addition, it is understood that there is no magic number for ensuring that riverine ecosystems are sustained. Any extraction of water puts the river system at some risk. The more water abstracted, the higher the risk of environmental damage.

Given this, the following principle has been adopted as a precaution to assist with the assessment of environmental water requirements.

An environmental flow regime should retain and/or reinstate as many of the features of the natural flow regime as possible.

An environmental flow assessment will:

- be based on the best available science;
- be aimed at identifying a flow regime that will, at a low level of risk:
 - maintain the ecological assets of a river, including those associated with linked floodplains and downstream estuaries and/or terminal lakes, and
 - maintain the river in ecologically healthy condition;
- include specific recommendations addressing those parts of the hydrograph likely to be affected by water allocation; and
- include specific recommendations protecting those aspects of the hydrograph that are not likely to be affected by water allocation.

To ensure a consistent approach to the assessment of environmental flow requirements, the Department of Natural Resources and Environment will update the statewide methodology for the assessment of environmental flow requirements for use in BE conversions, SFMPs and other water allocation processes by August 2002.

This work will ensure that communities making decisions on environmental flows and water allocation should have access to the best available scientific information on the environmental requirements of their river system. However, in undertaking BE and SFMP processes, all stakeholders negotiate to arrive at an agreed water sharing arrangement. This process needs to consider all the environmental risks and consequences of not providing the recommended environmental flow.

6.3.2 Providing and Managing Water for the Environment

Providing water for the environment

Actual environmental water provisions are made as a result of the BE and SFMP processes. During these processes, the recommendations of the environmental flow assessments are considered together with the needs of existing users and an environmental flow provision is negotiated. In many cases, the negotiated environmental water provisions are less than those recommended by the environmental flow assessment as a result of the trade-offs made between the economic, social and environmental requirements of the systems.

Currently, these negotiated environmental water provisions are provided through conditions on other users, either through SDLs or SFMPs or by conditions on BEs. Whilst the Water Act enables the provision of a BE for the Environment, this has currently only been used where flexibility of use for wetland watering has been required. At present, there is one specific BE for the Environment — for the Murray wetlands.

Now that these arrangements have been in place for some time, it is timely to review whether this method of providing water for the environment through conditions on other users provides an adequate level of protection, security and status for the environment's share of the resource compared with other users. Other options that need to be considered include:

- in fully allocated systems, providing a BE for the Environment for the residual water, with a process to deal with priority stressed rivers;
- providing a BE for the Environment for all unallocated water with a process for granting new consumptive entitlements in systems which are not fully or over-allocated; and
- providing BEs for the Environment in systems of high environmental value.

There are considerable implications for each of the options outlined above and these need to be fully considered by the community. The Department of Natural Resources and Environment (NRE) will develop a Discussion Paper on 'Options for Providing Bulk Entitlements for the Environment'. This will also review the management arrangements including any costs for BEs for the Environment. It will also consider opportunities for third parties to make their water allocations available for environmental use on either a temporary or permanent basis.

NRE will develop a Discussion Paper on 'Options for Providing Bulk Entitlements for the Environment' by December 2002 for public comment.

Managing environmental water provisions

The current arrangements for the management of negotiated environmental water provisions are:

- Where water for the environment is provided through conditions on other users, those users are responsible for providing this water and must report on an annual basis on their management of their BE or SFMP.
- Where water for the environment is provided through a BE for the Environment, responsibility for its management is held by the Executive Director, Parks, Flora and Fauna Division (NRE). There are a number of policy principles which govern its management. These are outlined in Box 6.2. As for other BE holders, the Executive Director, Parks, Flora and Fauna reports on the management of each BE on an annual basis.

It is important to ensure that negotiated environmental flow regimes are being provided and managed in the most effective way to achieve their agreed objectives.

NRE will develop a 'Best Management Practice' framework for the management of negotiated environmental water provisions by June 2003.

Box 6.2 Current Arrangements for the Management of Existing BEs for the Environment

- The purpose of the water is identified in the BE.
- The BE is used in conjunction with a watering schedule which will nominate all possible wetland or river areas that can be watered using the BE and the conditions for each under which the allocation would be used. The schedule is based on trying to reinstate as much of the natural wetting/drying cycles of the individual wetlands as possible.
- Where the water is provided as an annual allocation which cannot be stored and there is no environmental need for all or part of it in a particular year due to climatic conditions, it is possible to sell all or part of the allocation on the temporary water market, provided that:
 - all possible options for use of the water for environmental purposes have been examined,
 - appropriate consultation with other water users and interested community groups has been undertaken, and
 - funds from the sale are used for projects across the State aimed at:
 - improving the effectiveness of environmental flow regimes,
 - providing or improving environmental flows, and
 - increasing knowledge of environmental flow regimes.
- The Executive Director, Parks, Flora and Fauna, consults with the relevant CMAs on use of the allocation.

6.3.3 Restoring Flow-Stressed River Systems

A key part of the BE conversion process and SFMP development has been the recognition of the existing rights of water users. These processes have clarified existing rights and have, in general, provided improvements in the environmental flow regimes. However, there are a number of river reaches where the water provided for the environment under these processes may not be enough to maintain an ecologically healthy river and protect environmental assets. Where negotiated environmental flow provisions do not meet environmental flow requirements, it is likely that significant environmental damage either has occurred or is occurring and the river will be considered to be flow-stressed. The further away the negotiated flow regime is from the scientific environmental flow recommendations, the higher the risk and severity of environmental damage.

Improvements in river flow regimes of these stressed rivers, or actions to ameliorate flow stress, will, depending on the level of improvement:

- reduce the rate/risk of further environmental damage;
- safeguard current environmental values;
- restore significant ecological features of the river; and
- restore ecological health.

The aim for these flow stressed rivers is to achieve an ecologically healthy river over time. The process to achieve this aim has two parts. The first part will apply to all flow-stressed rivers and is different for regulated and unregulated rivers. The second component, the development of a Stressed River Proposal, will be available for rivers of high value. This process is described below.

Part 1 for unregulated rivers

As stated in section 6.2.2, unregulated rivers where there are high levels of flow stress are a priority for developing SFMPs. A principle of the SFMP process is that environmental flows provided through the plan must be sufficient to sustain agreed ecological values and be consistent with statewide requirements (see the *Stream Flow Management Plan Framework*). However, if achieving the environmental flow recommendations is likely to have significant impacts on existing users, then the measures required to meet these flow specifications will be phased in over some period of time proposed by the SFMP.

SFMPs will aim to achieve, over time, the recommended environmental flow regimes as outlined in the *Stream Flow Management Plan Framework*.

Part 1 for regulated rivers

Many stressed reaches occur within regulated systems, downstream of dams and/or as parts of irrigation systems. Often the reduction in flow in reaches downstream of a dam has turned these rivers into streams of a much smaller size. In many cases, because of the economic and social value of the agricultural industries and towns dependent on them, it will not be possible to return them to anything approaching their natural environmental condition. But it may be possible to reduce the rate of their decline, to improve their environmental condition and, in a number of these cases, to achieve ecologically healthy rivers, albeit of a smaller size or different river type or, in a few cases, different ecosystem type. This can be done by improving their current environmental condition with some changes to their hydrology and/or with improvements to their riparian and instream environments.

Water authorities, as part of their duty of care, will ensure that in stressed river reaches in regulated systems:

- a review of the operation of that water management system will be undertaken to see if changes can be made to improve the environmental flow regime without impact on other users; and
- a demand management program will be developed and implemented.

Government will:

- ensure that no further diversions will be allowed;
- consider whether any unallocated water in storages can be used to improve the environmental condition of these reaches before a decision is made on new abstractions; and
- ensure, where possible, that trading rules facilitate an improvement of the environmental flow regime.

Part 2 - stressed river proposals

In some cases, the process outlined above may not be enough to restore ecological health, or the time predicted to do so may be considered too long. In these cases, the relevant CMA and water authorities may develop a Stressed River Proposal with their communities to achieve further environmental improvement in rivers identified to be of high priority in the regional RHS.

These proposals will be developed by CMAs and the relevant water authority with their communities as an outcome of their BE and SFMP processes, and will build on or aim to accelerate the improvements already negotiated through these processes. These proposals will identify the environmental flow improvements required, proposals for how these could be best achieved, any complementary habitat restoration activities and cost sharing. Proposals may include mechanisms for water savings, water reuse, supply rationalisation, changes to system or on-farm operations, or use of the market. They may have multiple benefits, such as salinity or industry efficiency benefits. These proposals will be considered by Government on the basis of:

- the level of regional commitment;
- the environmental and community value of the river;
- the overall benefits to the broader community;
- the level of environmental improvement predicted; and
- complementarity with the objectives of joint State/Commonwealth funding initiatives, such as the National Action Plan for Salinity and Water Quality and the National Heritage Trust Mark II.

Principles for restoring flow-stressed rivers:

- The aim will be to achieve flows that ultimately sustain an ecologically healthy river and protect environmental assets.
- Water authorities and individuals have a duty of care for the environment and will be expected to contribute to improving flow regimes in a way that is consistent with that duty of care.
- Where further effort is required to achieve an ecologically healthy river and protect environmental assets or to accelerate the achievement of this objective in rivers identified as high priority within a regional RHS, CMAs together with the relevant water authority and the community will develop a Stressed River Proposal which will identify:
 - the environmental flow improvements required and how these will be achieved;
 - complementary habitat restoration activities;
 - the level of regional commitment;
 - the overall benefits to the broader community;
 - the level of environmental improvement predicted; and
 - complementary funding.

Government will consider Stressed River Proposals and may:

- consider these rivers as a priority for joint Commonwealth/State funding programs; and
- co-invest with the region on behalf of the broader community in rivers of high environmental and/or community value.

This approach will align and build on the work undertaken in the existing water allocation and regional river health planning processes to achieve ongoing improvement across the State in rivers that are of the highest value to the community.

Two special cases – the Snowy and Murray rivers

There are two special cases which, because of the importance of these rivers to all Victorians, will be funded outside the process outlined above. These are:

- **The Snowy River.** The Snowy River is an Australian icon. However, it has been degraded over the last 50 years as a result of the Snowy Mountains Hydro-electric Scheme which diverts much of its flow to supply irrigation and hydroelectricity. The Victorian, New South Wales and Commonwealth Governments will restore this river with a combination of flow improvements generated by water saving projects and habitat improvements. The three governments have agreed to provide \$375 million over 10 years to achieve this and to improve the River Murray. This project will be the biggest river restoration project ever undertaken in Australia and will be one of the biggest in the world. It will be undertaken in a way that maximises information for other river restoration projects around Australia. It will not only restore the Snowy River but will provide great increases in our knowledge base on river restoration.
- **The River Murray.** Roughly two-thirds of the flow in the River Murray is now diverted, with the result that the mean annual flow from the Murray to the sea can be as low as 35% of the natural flows. The MDB Ministerial Council is developing a River Restoration Strategy for the Murray which will build on the existing Cap on diversions. Victoria is committed to implementing the Cap and will work with the other States to put in place an environmental flow regime in both the Murray and its Victorian tributaries that will improve the environmental condition of the Murray. In addition to the funds referred to above to rehabilitate the Snowy and Murray Rivers, Victoria has committed a further \$15 million to this work, in partnership with South Australia.

6.3.4 Protecting Rivers Whilst Enabling New Development

The future prosperity of regional and rural Victoria depends on sustaining existing effective development and bringing new investment to these areas. However, we need to ensure that any new development is undertaken in an ecologically sustainable manner.

New development can occur through two major mechanisms:

- improved use of existing allocations, either by:
 - acquiring water through trading of existing allocations on the water market; or
 - utilisation of water resulting from improvements in the efficiency of water use either:
 - on-farm,
 - in water supply systems, or
 - through water conservation programs and water reuse; and
- new allocations.

The environmental issues associated with these mechanisms are quite different. These and the necessary environmental safeguards are discussed below.

Improved use of existing allocations – trading and the water market

The water market has been established to allow the movement of water from low value uses to high value uses. From an environmental perspective, it has the benefit of ensuring that existing consumptive allocations are utilised in the most efficient way possible and enabling increased economic returns without further water allocation.

The Victorian Government has recently announced the establishment of a new statewide water exchange to facilitate trading of water licences across Victoria compared to the present regional approach through water authorities. It will be called 'Watermove' and will enable trade in all regulated supply systems across Victoria and will include the permanent sale of water licences between landholders, as well as temporary trades. Trade in water licences on unregulated streams and groundwater licences will be possible through the exchange.

However, it is important to ensure that the redistribution of water use occurring through the water market does not have an adverse impact on the environment. In fact, careful construction of the rules governing water markets can achieve improvements in environmental conditions. However, in developing these rules, the question of scale must be considered. As the pattern of water use is changed due to trading, there may be small local changes in environmental condition. Rather than cease trading in these areas, consideration needs to be given to whether there is an overall environmental benefit resulting from the trade; that is, whether where the water is moving to is actually providing significant environmental benefits.

The Government and authorities responsible for the operation of water markets will make sure that the rules governing water markets are developed:

- to drive the movement towards more efficient water use; and
- to give positive environmental flow outcomes wherever possible.

In addition, they should ensure that there is no adverse impact on local ecological values unless there is an overall net ecological benefit.

Improved use of existing allocations – water use efficiency gains

There is significant room for improvement in the efficiency of water use in both urban and rural areas. Water can be saved by on-farm efficiencies and in improved management of water supply systems in rural areas, and by water conservation programs and water recycling in urban areas. Water saved through these efficiency gains can be used to expand agricultural production and safeguard and/or improve environmental flow regimes.

In rural areas, on-farm water savings funded by landholders themselves are to be encouraged as they increase the economic returns of water used without increasing extractions or impacting further on river health.

Improved management of water supply systems offers major opportunities for water savings which can be used for a variety of purposes including improving environmental water provisions. For example, the increase in environmental flows for the Snowy River will be largely provided through investment in water efficiency projects. Investment in the Wimmera-Mallee pipeline will provide 93 000 ML in water savings to be used to improve environmental flow regimes and for new developments. However, whilst there are some real gains to be made in water savings in water management systems, there may be some risks to the environment in implementation. For example, leaky systems may be providing water that is having environmental benefits (i.e. a de facto environmental flow) and fixing such leaks can have local impacts, as transmission losses may, in fact, be contributing to essential recharge to adjacent groundwater or wetland systems.

In implementing any water savings projects, the following principles must be followed:

- environmental impacts will be positive, where possible, or must be at least neutral;
- supplies to existing users must not be affected; and
- water savings will be shared equitably in proportion to funding contributions.

The Government is directly promoting more efficient water use. In September 2000, the Minister for Environment and Conservation announced a \$30 million 'Water for Growth' initiative, to unlock the potential of Victoria's water resources through smarter irrigation and reuse systems.

The initiative includes a program offering grants to farmers for innovative, water-use efficiency projects, and to authorities or private companies to facilitate regional, water infrastructure efficiency projects. The environmental gains coming out of these proposals, including improvements to river flows and to water quality through nutrient and salinity management, are considered in the grants process.

Where government funds are used to implement water savings projects (both on-farm and within system) the project outcomes will include improvements to river health and environmental flows.

The Government has also encouraged urban communities to use water more efficiently by implementing a statewide water conservation education program, ensuring that urban water authorities are implementing water conservation plans and promoting water recycling. This focus on water conservation and reuse will be strengthened in the future, providing further environmental protection.

A Victorian Water Recycling Strategy will be completed in 2003.

Water conservation targets will be established by all rural and urban water authorities within their conservation plans.

A Water Resources Strategy for the Melbourne area will be completed by December 2002.

New allocations

The granting of any new entitlements occurs within the general framework of the Water Act. However, it must be recognised that the granting of any new consumptive allocations will take further water away from the environment. (It should be noted that 'new' in this context means 'additional' and does not apply to new entitlements which have to be generated as part of the administration of the water market as entitlements are traded.)

As a general rule, new allocations will only be made on the basis that natural ecological processes, habitats and biodiversity are sustained; that is, that the environmental water requirements of the system are met.

In accordance with this policy, granting of new diversion licences will only occur when allowed for under the catchment SDL or within an SFMP.

The granting of new BEs is governed by the Water Act, which states that approval for a new BE can only be given after consideration of matters that are listed in section 40, notably:

- existing and projected water availability and water quality;
- any adverse effect that use of water is likely to have on:
 - existing authorised uses of water,
 - a waterway or aquifer, and
 - the environment;
- the need to protect the environment, including riverine and riparian; and
- the Government's conservation policy and its policies on water resources.

It is anticipated that any proposals for new BEs will generally be either for a new urban water supply system or for augmentation of an existing system. Any proposal for a new BE is required to undertake a full environmental assessment including a detailed study of environmental water requirements, according to guidelines currently being developed by NRE. These assessments are required as an integral part of a proposal and consequently will be paid for by the proponent.

It is expected that in developing a proposal for a new BE, a water authority will have firstly examined all options for meeting future water demand which do not require new water. These include:

- efficient utilisation of existing water diversions;
- water reuse;
- water demand management strategies;
- water trading; and
- adopting an integrated urban water cycle management approach as demonstrated by:
 - on-site water cycle management,
 - water product differentiation (matching the quality of the product requirements), and
 - 'catchment-to-tap' and 'toilet-to-environment' management strategies.

Where the need for a new allocation is unavoidable, water authorities should then examine options including:

- expansion of existing systems, including drainage and effluent management; and
- use of groundwater;

prior to the investigation of a new source of surface water.

A proposal for a new BE will include an outline of the costs and benefits, including environmental costs and benefits, of all options that have been examined.

As a general rule, the Government will only approve new BEs where they fully meet the environmental water requirements of the system including any downstream ecosystems, address existing environmental flow issues within the system and do not impact on other authorised users.

It is acknowledged that, in a few cases, the choice might have to be made between augmentation of an existing site causing further environmental stress or impounding a river currently in pristine condition. In these cases, the decision should be made after a full community consultation process as required under the Water Act and the *Environmental Effects Act 1978*.

Should the decision be made to further stress a river, then options for river restoration elsewhere must be considered as part of the evaluation process undertaken by the authority to ensure that there is no net loss of environmental values.

NRE will develop a set of detailed guidelines for the application of new BEs which outline:

- the requirements for assessments of environmental flow regimes and general environmental impacts;
- the requirements for assessments of water resource availability;
- the obligations of water authorities; and
- links with other planning process.

NRE will develop 'Guidelines for New Bulk Entitlements' by June 2003.

6.3.5 Protecting River Health by Integration within the Water Resource Management Framework

Existing water allocations and environmental flow provisions can be put at risk by changes in the hydrology of the system due to other land and water use within the catchment. Examples of where this can occur include:

- where there are major changes in land use within the catchment; and
- where the management of surface water and groundwater are not properly integrated.

Land use change

Broad-scale catchment management is a critical factor in controlling catchment hydrology. Clearance of native vegetation and urbanisation in many catchments have greatly modified runoff patterns, with consequent impacts on the hydrology of our river systems. A change in hydrology can also occur when broad-scale reforestation occurs on cleared land. The trend for increased pine and eucalypt forestry, in some cases as part of salinity control or achieving 'carbon credits' for 'greenhouse effect' control purposes, may modify the rate of hydrologic changes in the Australian landscape. For example, based on information provided in Bradford et al (2001), if there were to be a 200 000 ha increase in plantation areas in the north-east of Victoria (an approximate trebling of the existing area), and it was assumed that these plantations were to be situated in areas having an average annual rainfall of 800 mm, then run-off into the River Murray could be reduced by around 260 GL per annum, which is about 16% of all the water used by Victoria from the Murray. If such a change were to occur there could be major impacts on both existing users and environmental flows. However, such an increase is currently considered unlikely. A more realistic estimate would be a 50% increase in plantation extent to approximately 100 000 hectares.

Where large-scale land use changes are planned, the approvals processes will be developed/amended to take into account the likely impact on existing water resource users and the environment.

NRE will work with the Department of Infrastructure, CMAs, local government and other appropriate groups to explore mechanisms to implement this principle, taking into consideration national principles and guidelines currently under development.

Surface water – groundwater interactions

Studies indicate that up to 50% of the base-load of streams can be fed by groundwater. The actual situation varies. In some cases, the link is very strong and there can be an instantaneous impact on river flows from groundwater pumping. In others, the reverse is true, and streams contribute significantly to the recharge of groundwater. Wherever there is a strong linkage between groundwater and surface water, the linkages need to be recognised in the planning processes. Otherwise, the allocations to existing users and the environment may be impacted in an unplanned way.

When a high level of interaction between surface water and groundwater is likely:

- **the relevant planning processes for SFMPs, GMPs and BEs will be undertaken in a way that provides the appropriate linkages; and**
- **the intent will be to develop in the future, a single integrated cap at the local scale covering both surface water and groundwater use.**

6.3.6 Protecting Rivers against Uncertainty

Currently, environmental flow regimes provided through the SFMP or the BE processes can be affected by uncertainty in two ways:

- Our current knowledge of the ecological importance of flow regime is imperfect and therefore our best estimates of the flow regimes required to maintain ecologically healthy rivers may be incorrect. For example, the first BE to be developed was the BE for the Goulburn system which was approved in 1995. The environmental flow negotiated at that time included minimum passing flows and a flushing component based on the science available at the time. Current evidence suggests the water provided to the environment for river flushing flows under this BE could be better utilised for other environmental purposes.
- There is uncertainty in the external environment due to climate change. Current climate change predictions suggest that available water resources will be reduced. The effect of reduced resources may fall disproportionately on the environment, depending on how the environmental flow regimes are specified.

Both these considerations point to the need to be adaptable. In the face of such potential changes, and indeed because of our increasing knowledge about the ecology of rivers and the pressures they are under, it seems clear that the community will need to be able to reassess provisions made for environmental purposes.

It will be important to keep monitoring environmental conditions to assess whether our objective of ecologically healthy rivers is being achieved. Monitoring is discussed further in Chapter 13.

However, a mechanism is required to allow reassessment to occur where required. The Stream Flow Management Plan Framework requires that all SFMPs be reviewed at least every five years. Currently, only some BEs include review provisions.

Commencing not later than 2003 when the BE conversion process will be completed, the environmental water provisions of BEs of all major water supply systems will be progressively reviewed taking into account whether:

- **the expected environmental outcomes from the water are provided by the agreed flow regime; and**
- **the delivery should be changed in response to any new information that indicates the potential for achieving a better environmental outcome with the water.**

6.3.7 Roles of Water Authorities

Whilst the institutional arrangements and the roles and responsibilities for the management of river health are discussed in Chapter 11, it is clear that both rural and urban water authorities have a very significant role in the management of river health, particularly as it relates to environmental flow regimes. The way these authorities manage their businesses, deal with their customers and plan for the future has the potential to have a major impact on the health of our rivers, both positive and negative.

Government regards water authorities as having a key role and interest in achieving sustainable management of water resources, given their dependence on the resource and their potential impact.

By December 2002, Government will review and make explicit the obligations of water authorities with regard to:

- sustainable management of natural resources and regional economic development;
- sustainable water resource management;
- integrated catchment management;
- biodiversity conservation;
- water conservation;
- triple bottom line reporting;
- good environmental practice and corporate citizenship; and
- reporting and accountability.

Pending these reviews, rural and urban water authorities will:

- manage water abstractions within entitlements;
- minimise any detrimental impacts of their business operations on river health wherever possible; and
- ensure that building new assets and asset renewal is undertaken to the current best practice environmental standards.

7. Management of Water Quality

7.1 IMPORTANCE OF WATER QUALITY

Deterioration of water quality is a major threat to Victorian waterbodies, including rivers, wetlands and lakes, causing serious social, economic and environmental problems. It is important to maintain good quality water to protect agriculture, industry and environmental systems, and for human consumption. Poor water quality poses threats to:

- human and livestock health;
- the health of waterways;
- water supplies, resulting in high costs to ensure the provision of safe water;
- preservation of the quality of water resources for future generations;
- biodiversity;
- 'Clean and Green' agriculture and regional economic development; and
- recreation in and alongside waterbodies, including losses in tourist revenue.

Deterioration of water quality can significantly impact water dependant ecosystems. Key threats to riverine ecosystems from poor water quality include rising salinity, increasing sediment and nutrient loads, changing pH and temperature levels, and reduced dissolved oxygen. The ecological risk of poor water quality is outlined in Table 7.1.

Table 7.1 *Examples of likely ecological impacts of poor water quality*

Water Quality Issue	Ecological Impact	Systems Most at Risk
High salinity levels	<ul style="list-style-type: none"> • can have significant impacts on freshwater ecosystems by causing lethal and sub-lethal effects on a wide range of flora and fauna • discharge of saline groundwater and associated waterlogging of floodplains and wetlands 	<ul style="list-style-type: none"> • wetlands are especially susceptible to increased salinity • many of the Victorian catchment salinity management plans identify wetlands and floodplain depressions as areas at high risk of salinisation over the next 10-50 years.
Alterations to the relative contributions of fresh and saline waters	<ul style="list-style-type: none"> • systems that were formerly fresh/brackish have been altered to ones that are estuarine/marine • significant impacts on salinity regimes, as well as siltation events with consequent ecological effects, particularly on fish migration and breeding cycles 	<ul style="list-style-type: none"> • freshwater wetlands that receive saline drainage waters • alterations to oceanic and riverine flows in estuaries and lower river reaches, for example Gippsland Lakes
High levels of nutrients	<ul style="list-style-type: none"> • can greatly increase the likelihood of algal blooms in an aquatic system • species composition of aquatic flora and fauna will also be affected 	<ul style="list-style-type: none"> • lowland rivers • water storages and weirs • natural lake systems such as Gippsland Lakes • Port Phillip Bay and Western Port Bay • estuaries
High turbidity	<ul style="list-style-type: none"> • transport of contaminants (e.g. heavy metals, nutrients and toxic organic compounds) which are bound to the particulate matter • reduction of light with impacts for aquatic flora and fauna, particularly visual predators • mechanical and abrasive impairment of fish gills and smothering of benthic habitats • clogging of filter-feeding apparatus of animals such as mussels 	<ul style="list-style-type: none"> • lowland rivers and wetlands

Table 7.1 cont.

Water Quality Issue	Ecological Impact	Systems Most at Risk
Altered pH values	<ul style="list-style-type: none"> • spawning failure and diminished hatching success for fish have been associated with pH values less than 6.0 and greater than 8.0 • macro-invertebrate communities generally have reduced numbers, fewer species and altered species at lower pH values • mobilising and toxicity of pollutants at low pH 	<ul style="list-style-type: none"> • lowland rivers • lakes, dams and weirs (particularly associated with algal blooms)
Low dissolved oxygen levels	<ul style="list-style-type: none"> • oxygen depletion can be lethal to biota and promote nutrient release from sediments 	<ul style="list-style-type: none"> • instream environment – of particular concern for deep pools during summer, on which larger fish species rely • lowland rivers, dams and weirs • estuaries
Thermal water pollution	<ul style="list-style-type: none"> • profound adverse impact upon native warmwater fish communities both directly and indirectly, including slower growth rates, cold water shock, disruption of breeding cycles and increased egg and fingerling mortality 	<ul style="list-style-type: none"> • release of extremely cold water from the base of water storages into river systems • urban areas with warm water run-off • release of warm water from industrial cooling processes
Toxicants	<ul style="list-style-type: none"> • chronic and acute effects • bioaccumulation of environmental toxicants such as heavy metals and pesticides 	<ul style="list-style-type: none"> • slow flowing lowland rivers are largely depositional environments and are the final receptor for critical contaminants derived from upstream reaches of the river • static sections of a river and weir pools, lakes and wetlands • waters with low pH

7.2 MANAGEMENT ISSUES

The management of water quality is the most complex issue to be dealt with in the management of river health. This is primarily because of the nature of the pollutant sources and the implications this has for management.

Pollutant sources can be categorised into two types:

- point sources where there is a direct input of pollutants into a river system. These can include:
 - domestic wastewater from wastewater treatment plants; and
 - industrial wastewater.
- diffuse sources where pollutants are carried in surface run-off or via groundwater to the river system. These can include:
 - erosion of farmland, roadsides and stream banks;
 - agricultural runoff;
 - runoff from forestry activities and construction sites;
 - septic tanks;
 - urban stormwater runoff;
 - irrigation drainage;
 - waste and litter;
 - intensive animal industry effluent; and
 - rising water tables.

The control of point sources is theoretically straightforward through a range of regulatory mechanisms. By contrast, the control of diffuse sources is much more difficult because it essentially involves every land use and/or activity taking place within a catchment. This means that as land uses and management practices change within a catchment, there will be impacts on water quality, either positive or negative. Moreover, whilst the impact of any one land manager in a particular land use in a catchment may be small, the cumulative impacts of all the land managers in that land use may be quite significant.

The implications of this are huge. It means that the management of water quality can only be successfully undertaken with an integrated catchment management approach, involving all of the land uses and land managers within a catchment, ensuring that they are aware of their impacts on water quality and river health, and are committed to reducing these impacts.

An effective framework for the management of water quality needs to recognise this dependence on an integrated management approach for managing both point and diffuse sources. Such a framework requires:

- a state policy context which recognises regional catchment management arrangements as the predominant mechanism for the management of water quality;
- regional planning arrangements for water quality which:
 - are developed in the broader context of management of river health;
 - are catchment-based;
 - provide clear mechanisms for coordination; and
 - integrate the various aspects of water quality which impact on river health;
- the establishment of minimum acceptable standards for undertaking specific activities within the catchment, particularly to minimise the impact of various land uses and other diffuse sources on water quality; and
- an ongoing understanding of current and emerging water quality issues.

To date, parts of this framework are developed and being implemented. This chapter builds on this work and suggests a further evolution of the framework to ensure that water quality management is a key component of integrated catchment management.

7.3 FRAMEWORK FOR THE MANAGEMENT OF WATER QUALITY

7.3.1 State Policy Context

The key statewide statutory policy framework for water quality protection in Victoria is the *SEPP (Waters of Victoria)*. The SEPP was first developed in 1988 and identifies the beneficial uses of water and sets the environmental quality and policy directions required to address specific impacting activities. 'Beneficial uses' is the term used in the SEPP to describe current or future environmental values or uses of surface waters, which depend upon clean water. Over time, the statewide *SEPP (Waters of Victoria)* has been supplemented by the development of schedules for certain regions, which contain region-specific beneficial uses and environmental quality objectives (this term is used in the SEPP to describe the level of environmental quality needed to avoid risks to beneficial uses and to protect them).

While the 1988 *SEPP (Waters of Victoria)* provided a useful and essential framework for the management of point sources through licensing agreements, it pre-dated the Victorian catchment management arrangements and did not address diffuse sources of pollution effectively. Addressing these issues has relied on other statewide policies focused on specific water quality related issues such as the *Victorian Nutrient Management Strategy* and *Victoria's Salinity Management Framework*. These policies link directly to the regional catchment planning process where priorities and regional targets to address water quality issues have been outlined in the RCS and associated action plans.

The SEPP is now being revised. It will continue the role of providing long term environmental quality objectives for the management of Victorian surface waters. However, the intent of the revised policy is to provide benchmarks that can be used to assess impacts on water environments and to assess progress towards the sustainable use of these environments. The revised policy has been drafted to link directly to the regional catchment management process where communities decide how to progressively move towards achieving sustainable use and protection of natural resources, including water, in terms of quality and quantity.

The revised *SEPP (Waters of Victoria)* will set environmental quality objectives that can be used as direction on the water quality and biological requirements for ecologically healthy rivers and on the water quality and biological requirements to protect various environmental, economic and social assets. The revised SEPP will recognise the regional catchment planning processes whereby regional communities set regional targets to move towards these environmental quality objectives after consideration of economic, social and environmental implications. It will recognise that the regional water quality targets, which will be included as a schedule in the RCS, outline community agreement for progress towards reaching the long-term environmental quality objectives outlined in the *SEPP (Waters of Victoria)* and that the progress of a region may be audited against this schedule.

The revised *SEPP (Waters of Victoria)* will therefore empower these regional communities by providing an additional statutory basis for the regional planning processes and the regional targets that are generated through these processes.

The revised *SEPP (Waters of Victoria)* will recognise:

- the regional planning processes that generate regional targets for water quality and other river health related issues after consideration of environmental, social and economic considerations and the identification of achievable management options; and
- the regional water quality targets that will form the basis for a schedule of regional resource condition targets in the RCSs, during their update in 2002;

and provide:

- a process for auditing progress towards regional targets.

Effectively, the proposed revisions to the SEPP provide some environmental quality objectives for the regional communities and ensure that communities move towards achievement of them, whilst considering the social, economic and environmental factors that will realistically influence this progress. Through supporting the regional planning processes, the proposed new arrangements will also reduce the need to develop regional SEPP schedules, although there is still an imperative to have regional SEPP schedules in coastal and marine environments.

7.3.2 Regional Arrangements for the Management of Water Quality

Currently, as outlined in Chapter 5, catchment-based water quality related action plans have been developed to deal with specific issues such as nutrients and salinity. In addition, there are a number of other plans where the primary objective is not the management of a water quality issue but where the management actions will have water quality impacts. These are outlined in Table 7.2. However, because of the range of activities which impact on water quality, there is no one plan that encompasses all water quality issues and projects and articulates the integrated water quality targets that these aim to achieve.

Table 7.2 Summary of regional plans and programs in Victoria which have implications for water quality

Primary Purpose	Plan or Program	Description
Water quality	Plans developed directly linked to meeting SEPP objectives	Plans completed to date include the <i>Macalister Irrigation District Nutrient Reduction Plan</i> and the <i>Port Phillip Bay Environmental Management Plan</i> (NRE 2002), both of which focus primarily on nutrient reduction.
Water quality	Catchment Nutrient Management Plans, developed as part of the Victorian Nutrient Management Program	Plans that recommend a range of priority management actions targeted at the major nutrient sources (such as irrigation drainage, sewage treatment, urban stormwater, dryland diffuse sources, forests and intensive animal industries) to meet agreed nutrient levels. These have been developed/are currently under development in each CMA region.
Water quality	Salinity Management Plans / Land and Water Management Plans	Plans, particularly in irrigation regions, which set priorities to reduce river salinities. These have been developed/are currently under development in each major irrigation region in Victoria.
Water quality	Stormwater Management Plans	Focus on urban stormwater and associated with the Victorian Stormwater Action Program.
In-channel management	Waterway Management Plans	Have a significant focus on turbidity. Also see Chapter 5.
Rural drainage	Rural Drainage Plans	See Chapter 5.
Water allocation	Bulk Entitlements and Streamflow Management Plans	See Chapter 5.
Floodplain management	Floodplain Management Plans	See Chapter 5.

Table 7.2 cont.

Primary Purpose	Plan or Program	Description
Industry/land use based plans and programs	Includes plans and programs developed by both industry and agencies for a range of industries/land uses including horticulture, dairy, private forestry, etc.	Key components of plans include a focus on water quality and resource management, e.g. environmental management systems, national quality assurance programs, Clean & Green. Linked to industry/agency based programs including FarmBis, Target 10, Water for Growth, Crop Check and Grape Check, to ensure adoption of current accepted best management practices for land use.
Land use based plans	Plans for managing protected catchments for the provision of drinking water	
Environment improvement plans	Includes Environment Improvement Plans (EIPs) developed as part of EPA approved licences and Neighbourhood EIPs.	Licences, set by EPA, contain conditions that aim to control the operation of certain premises in order to ensure that there is no adverse impact on the environment. The conditions vary but typically include waste discharge limits, monitoring requirements and reporting requirements. Increasingly, licences include environment improvement plans that aim to continually reduce the impact of the premises on the environment.
Asset protection plans	For example, Wetland Management Plans, Estuary/Coastal Action Plans and Water Storage Management Plans	Wetland and estuary management plans developed to protect high priority environmental assets and include water quality priorities. Water storage management plans developed by water authorities to ensure reliable delivery of water to customers and can include water quality as a key management issue.

Consequently, the current management arrangements may result in regional objectives, targets and outcomes that are not developed within the broader context of river health, not integrated and may be misaligned. The current arrangements also increase the likelihood of not capturing the progress we are actually making in terms of addressing water quality issues.

The current regional planning arrangements for water quality need to be improved to ensure that they:

- are developed in the broader context of management of river health; and
- integrate the various aspects of water quality which impact on river health.

Water quality management in the context of river health

The priorities for the management of water quality within the context of broader river health outcomes will be established and integrated through the development of the regional RHSs. As mentioned in Chapter 5, these strategies identify the ecological, economic and social assets of all the major river reaches in a river system. In many cases, degrading water quality will be a significant threat to a number of the ecological, social and economic assets within a region, such as supply of water for towns and irrigation, and high value wetlands. In developing programs to protect or restore assets at risk from degrading water quality, communities will be able to use the environmental quality objectives for various beneficial uses identified in the *SEPP (Waters of Victoria)* as a guide.

Where high value environmental, economic or social assets are at risk, this will be dealt with through the development of a Catchment Water Quality Action Plan (CWQAP). Such plans will build on the existing water quality related action plans, namely catchment nutrient management plans and salinity management plans, to more fully address water quality issues in addition to nutrients and salinity. Thus catchment nutrient management plans will be expanded over the next five years to address a range of water quality issues. The CWQAP may exclude salinity where this is already addressed in an existing salinity management plan. In such cases, the salinity management plan will need to ensure consistency in plan development, consideration of assets and priority setting with the CWQAP.

As with current catchment nutrient management plans and salinity management plans, new CWQAPs are where the regional communities will:

- undertake the detailed analysis of the impacts of water quality on ecological, economic and social assets;
- develop and evaluate management options which focus on sources rather than problems;
- undertake cost-benefit analysis;
- work through trade-offs (including potential win-win options in some cases);
- set regional targets for water quality; and
- identify clear management actions and roles and responsibilities.

The detailed work needed to determine the actions to improve water quality is therefore undertaken within the CWQAP process. As mentioned in Chapter 5, the regional targets set through these processes are then drawn together to provide integrated regional targets for water quality and then, more broadly, river health. Final priorities for water quality will be influenced by broader river health considerations as part of the development of the regional RHSs.

Through this regional RHS planning process, priorities relating to the protection of assets will be set in a consistent way for the management of water quality. This will help to align implementation projects and works undertaken by the range of land and water management agencies, organisations and individuals. Thus, implementation activities will be required to focus on achieving community agreed water quality outcomes (whether specifically addressing urban stormwater, water efficiencies, instream erosion, horticultural production or dryland management practices) as well as regulatory requirements.

The regional RHS will set the priorities for the management of water quality that will then be used as a common basis for water quality related plans and programs.

Developing integrated catchment water quality action plans

Whilst there are a number of water quality related action plans either developed or currently under development across the State, there are still a number of issues to be resolved to ensure that they can fit the model outlined above. These include:

- **inconsistent approach to asset protection.** Many of the existing water quality related action plans that are either developed or currently under development have undertaken some form of asset protection analysis but this is inconsistent between catchment nutrient management plans and salinity management plans. Existing catchment nutrient management plans are focused on the management of nutrients to minimise the risk of algal blooms and have used a statewide methodology to explicitly identify the economic assets at risk but have not covered the environmental assets in the same way. Salinity management plans have incorporated an asset protection approach but the degree of consideration of river-related environmental assets has varied across plans. In addition, the cost-benefit analyses in these plans reflect these inconsistent approaches to the consideration of assets.
- **insufficient acknowledgment of the need to protect existing areas of good water quality.** In general, this will occur with the use of appropriate protection policies rather than with the need for investment. Nevertheless, it needs to be included to ensure that these areas receive proper consideration.
- **limited consideration of the risks posed by other water quality contaminants or issues.** As mentioned above, water quality related action plans developed specifically for water quality issues have focused primarily on nutrients and salinity to date. This is reasonable given that these are the two principal water quality issues across Victoria. Importantly, many of the activities undertaken to address these issues also provide wider water quality benefits. For example, protection of stream banks from erosion not only reduces nutrient inputs to rivers but also addresses turbidity issues.

Although the approach of managing a range of water quality issues by focusing on the key issues of salinity and nutrients has been widely accepted, there is little documentation of associated water quality benefits within catchment nutrient management plans or salinity management plans. Similarly, the broader multiple benefits that can be achieved through water quality protection and/or restoration actions are not well documented. Improving the documentation of all water quality and other multiple benefits within existing and future water quality related action plans will provide a stronger basis for the development of regional RHSs for particular systems. It will also allow more consistent analysis and reporting on a range of potential water quality issues within a region, improving our ability to undertake proactive protection of good water quality.

To address these issues and to ensure that water quality related action plans fit into the broader context and priorities of regional RHSs and address all relevant water quality issues, the following actions will be undertaken.

NRE will develop ‘Guidelines for the Development of Action Plans’ which will ensure that existing water quality related action plans and future CWQAPs are consistent with the VRHS. These plans will:

- **set water quality priorities based on a consistent asset protection approach;**
- **include protection of areas of good water quality as well as priorities for restoration of areas with poor water quality; and**
- **undertake appropriate and consistent cost-benefit analyses in setting priorities for water quality related activities.**

CMAs will develop a set of regional water quality targets based on an analysis of the likely outcomes of all water quality related plans. This will form part of the regional resource condition schedule of targets for the RCS. This will be used as the driving mechanism for the progressive integration of water quality related plans into a CWQAP.

The latter recommendation will be achieved by:

- documenting all water quality and other multiple benefits likely to occur as a result of implementation of existing catchment nutrient management plans and salinity management plans, and identifying possible regional targets for these parameters. These will be incorporated into regional reporting and evaluation frameworks.
- expanding the scope of catchment nutrient management plans to become CWQAPs over the coming five years and including regional targets for water quality issues, including as a minimum, nutrients, salinity, turbidity, thermal water pollution and toxicants (in particular associated with urban stormwater). Other localised water quality considerations should also be included as appropriate, such as the potential impact of imported water from areas outside of CMA boundaries. Salinity must also be considered either as part of the CWQAP or within a regional salinity management plan that is consistent with the CWQAP in terms of plan development, consideration of assets and priority setting.

The development of CWQAPs is already starting to occur around Victoria, in particular with the current development of plans in both West and East Gippsland. The above recommendations are applicable to areas of Victoria where CMAs are in effect. The exception to this is the Melbourne metropolitan area where institutional arrangements differ from the rest of the State. The expected policy direction associated with the metropolitan region is outlined in Chapter 11.

7.3.3 Establishment of Acceptable Standards

In addition to determining priority activities for pollutant reduction through CWQAPs, there is a need to establish minimum acceptable standards for all the significant activities within the catchment in order to minimise their impact on water quality.

There are a range of mechanisms for establishing minimum acceptable standards, of which *SEPP (Waters of Victoria)* is the key statutory policy and regulatory mechanism. The revised *SEPP (Waters of Victoria)* includes a range of clauses to specifically address point and diffuse source pollution to complement the *Victorian Nutrient Management Strategy* and *Victoria's Salinity Management Framework*. As mentioned in section 7.2, there are a number of pollutant sources that impact on riverine systems. The revised *SEPP (Waters of Victoria)* will include a series of policy directions to reduce the impact of pollutants on rivers and streams from the following key sources:

- soil loss from farmland, roadsides and stream banks;
- agricultural runoff;
- runoff from forestry activities and construction sites;
- domestic wastewater and trade waste;
- urban stormwater runoff;
- irrigation drainage; and
- intensive animal industry effluent.

In addition, Codes of Practice for different activities and industries are an important regulatory instrument. Best management practices (BMPs) are a voluntary approach that ensure use of best scientific information in directing activities.

While there are many existing Codes of Practice and BMPs for industries and activities, an area requiring further support is land use and management practices. Whilst the CWQAPs will indicate areas where current land management is a problem for water quality, in many cases the current institutional processes or information available are not adequate to facilitate change in land management practices or use. Key areas where further work is needed are:

- the inclusion of regional river health and water quality issues into local government planning processes;
- a consistent approach to the management of rural drainage; and
- the provision of information to land managers on best management practices for a range of specific land uses. Management practices should seek to optimise water quality improvements and broader river health benefits with economic returns.

CMAAs will work in partnership with municipalities to facilitate the adoption of community agreed water quality priorities and regional targets outlined in the regional RHSs into local government planning processes.

NRE, in partnership with EPA, Department of Infrastructure, rural water authorities, industries, CMAAs and other relevant groups will continue to develop Codes of Practice, best management practices guidelines and Environmental Management Systems for different land uses, particularly related to agriculture.

NRE in partnership with CMAAs, rural water authorities and other relevant groups will develop statewide principles for the management of rural drainage.

NRE in partnership with relevant stakeholders will further investigate and document the benefits derived by implementing various water quality management activities, particularly focusing on the scientific basis, assumptions and quantifiable water quality improvements for 'best management practices'.

7.3.4 Understanding Current and Emerging Water Quality Issues

Many potential water quality issues are not currently covered as part of the regional planning process until they are clearly impacting on assets within the catchment. Yet this is contrary to the central tenet of the VRHS, namely a hierarchy of management effort where protection of rivers and streams of high value is the highest priority. Thus, there is a need to ensure that potential water quality issues, particularly current and emerging issues such as nitrates in groundwater, endocrine disruptors, contaminants in sediments (particularly metals and other toxicants in streams in urbanised catchments) and increasing acidity, are managed proactively. The following research recommendations should assist in identifying, understanding and managing current and emerging water quality issues.

Groundwater

At present water quality management focuses on surface waters. Yet there is growing evidence that contamination of groundwater is a critical issue. For example, groundwater contributions may be a more important source of nitrates for some streams than that entering in surface run-off. The *SEPP (Groundwaters of Victoria)* aims to protect the beneficial uses dependent on groundwater quality. As with the *SEPP (Waters of Victoria)*, although the *SEPP (Groundwaters of Victoria)* does assist in addressing point sources through licensing agreements, it does not address diffuse sources of pollution effectively. Importantly, our current understanding of the impact of diffuse sources is poor – impacts can be widespread, specific pollutants are hard to identify, and the groundwater contamination can be difficult or impractical to clean up.

NRE will undertake research into the impact of groundwater contributions on water quality, particularly in times of low flow, including consideration of how the groundwater is being contaminated.

Increasing acidity

Altered pH levels can have significant and complex impacts on riverine ecosystems. As mentioned in Chapter 3, trend analysis results to date suggest that pH is falling in many regions of Victoria. Current data is limited and there is little research into the causes and implications of such changes.

NRE will undertake research into the impact of increasing acidity on river health, including consideration of the mechanism by which pH is being altered.

Thermal water pollution

A recent national workshop identified thermal pollution as a major emerging issue in river health. However, we know little about the ecological implications and management options for addressing the broader issue of thermal water pollution. For example, warm water runoff from paved urban areas or release of cold water from storages may both have adverse ecological impacts.

No new water storages will be developed without appropriate consideration and avoidance of potential thermal water pollution impacts.

By 2002, NRE in partnership with relevant stakeholders will complete an investigation to identify and broadly prioritise rivers likely to be at risk from thermal water pollution based on the characteristics and operational regime of dams.

NRE will work with water authorities to implement a monitoring program to verify temperatures associated with dam releases in priority rivers at risk from thermal pollution.

By 2006, NRE in partnership with relevant stakeholders will establish priorities for biological monitoring of the effects of thermal pollution in rivers shown by water authority temperature monitoring to be a problem and will establish priorities for mitigation.

8. Management of Riparian Land

8.1 IMPORTANCE OF RIPARIAN LAND

From an ecological perspective, riparian land is regarded as:

the area of land that adjoins, regularly influences, or is influenced by, a river.

It can vary from a fairly narrow band in upland reaches of waterways to wide floodplains along lowland rivers. The width of riparian land cannot be precisely defined as it varies according to local conditions. In the VRHS, the riparian land is identified in the upland and valley reaches as that land where riparian Ecological Vegetation Classes (EVCs) grow or to the best of our knowledge would have existed under pre-1770 conditions. In the floodplain reaches, riparian land is defined as those areas regularly wetted by floodwaters under natural flow conditions. Where an administrative boundary is required for planning purposes, this is taken to be the 'floodway' as defined in Victorian Planning Provisions. Floodways comprise the channel, the stream and the portion of the floodplain that conveys the main flow of floodwaters.

Riparian land is important in an aquatic and terrestrial sense. It is vitally important to the health of a waterway. Riparian land with intact vegetation provides:

- organic matter to a river – a major food source for instream biota;
- a supply of woody debris within the river, which forms key habitat areas for many fish and invertebrates and influences the shape of the river substrate;
- a source of shade in upland areas which influences water temperature and light penetration, and therefore regulates instream primary production; and
- stability to banks, minimising erosion in many areas.

In addition, the riparian land is a buffer between the catchment and the river. It can filter nutrients and sediment from catchment run-off and reduce the impacts of catchment land use on the river itself, although its effectiveness will depend on the structure, width and health of the riparian vegetation, as well as the adjacent land use.

Intact riparian land is also an important part of the terrestrial landscape. Riparian land:

- has a highly diverse flora and fauna, being on the edge of an aquatic and terrestrial system;
- acts as a refuge in dry times, when it may be the only place where plants have new growth, flowers or are producing seed – so it can be an important source of food;
- is often the only reasonably healthy remnant of native vegetation in catchments which have been largely cleared, giving it special importance to biodiversity; and
- depending on the size and structure, can act as a wildlife corridor linking habitats, especially in cleared catchments.

In addition to their ecological significance for both rivers and the terrestrial landscape, riparian zones can be of significant value to the community. They are used for recreation (e.g. bushwalking, fishing and picnicking) and are often the sites of considerable heritage value, particularly to Indigenous communities, because of their close association with water.

Riparian and floodplain lands are of importance to agriculture because they provide easy access to water and are often a highly productive part of the landscape, being damper and often having better soils than the surrounding catchment.

However, the capacity of riparian land to perform the ecological functions outlined above and maintain its recreational and heritage values will depend on its width, connectivity, and the quality, quantity and structure of the vegetation present. The major threats to riparian land are those which affect one or more of these key attributes, and include clearing, erosion, uncontrolled stock access, recreational use (e.g. trampling of understorey layers), weed invasion, stream crossings (e.g. roads, powerlines), removal of timber for firewood, salinity, and water management.

These threats are very real. Because of their importance for agriculture and because their other values were poorly understood, a large proportion of riparian areas were cleared or heavily grazed in the past. The condition of riparian land was assessed as part of the 1999-2000 statewide benchmarking of stream condition. It showed that less than 10% was in good to excellent condition, around 40% in reasonable to good condition, and over 50% in poor to very poor condition.

8.2 MANAGEMENT ISSUES

There are three issues that complicate the management of riparian land. These are:

- the mismatch between ecological and administrative definitions of riparian land;
- the varying tenure of riparian land; and
- the dynamic nature of rivers.

Administrative definitions

In the past, riparian land was defined for administrative purposes as the land within some fixed width (generally between 20 and 60 m) running alongside specific rivers. This definition does not recognise all the potential ecological functions that riparian land can provide and is clearly at odds with the ecologically-based definition outlined above. It particularly ignores the importance of floodplain linkages for rivers. This is because much of our current knowledge of the ecological importance of the riparian zone and floodplains for the river has only been generated in the last ten to twenty years. All of the current land tenure and licensing arrangements are based on these administrative definitions and have been since early settlement. Changing these to incorporate ecological considerations would be extremely difficult so alternative management approaches will be adopted in preference.

Tenure of riparian land

A further factor complicating the management of riparian land is the variety of possible land tenures which exist in urban and rural Victoria. These include:

- Crown land water frontage reserves:
 - licensed, and
 - unlicensed;
- Crown land reserved for other purposes, such as National or State Parks, State forest and a range of other reserves set aside for conservation, recreation or other public purposes;
- unreserved Crown land; and
- privately owned land.

Crown land water frontage reserves are generally 20-30 m wide strips along the major Victorian waterways. Of about 128 000 km of frontage in Victoria, there are 25 000 km (approximately 20%) of frontage reserves. These reserves can be licensed for agricultural use to adjoining landholders. The type of use is, in the main, grazing and, in a few cases, cultivation.

Often the exact boundaries of the various reserved and unreserved Crown lands have not been formally surveyed and therefore are effectively unknown.

The nature of rivers

Management is made more complex by the fact that rivers are dynamic, sometimes changing their course during floods. As a result of this, the relationship to the river of the various reserved and unreserved frontage lands may have changed over time due to geomorphological changes in the river itself.

Conclusion

As a consequence of these major issues, the formal land tenure and administrative arrangements for riparian land can be complicated and do not reflect the ecological significance of the land for the river. This is particularly true for the lowland reaches of rivers where there are extensive floodplain areas that are often in private ownership. However, it would be both unnecessary and very difficult to try to change these formal tenure arrangements.

What is required is a management framework where all managers of riparian lands, both public and private, recognise the ecological importance and functions of that land and aim to manage their land in a way which protects and/or restores these functions.

We recognise that currently we are a long way from achieving this goal. The VRHS aims to put in place a framework where all the current tools and incentives for managing riparian lands are aligned and aimed at achieving this outcome.

8.3 MANAGEMENT FRAMEWORK FOR RIPARIAN LAND

To develop a management framework in which all riparian land managers (i.e. any people or agencies who own or manage riparian land) are encouraged to manage their land to protect and/or restore the ecological functions of the riparian zone requires five major prerequisites. These are:

1. a clear set of goals and objectives for river systems, with clear priorities, tools to provide guidance and measurement of progress toward objectives, and targets for riparian protection and restoration;
2. an acknowledged partnership approach between all riparian land managers;
3. a clearly established caretaker of riparian condition;
4. mechanisms in place which encourage and facilitate riparian land managers to manage their land in accordance with the goals and objectives; and
5. a common understanding in the community of the importance of riparian land.

There is an existing management framework for native vegetation, described in *Victoria's Draft Native Vegetation Management Framework – A Framework for Action* at a statewide level and translated to a regional level in draft regional Native Vegetation Plans. This management system encompasses riparian vegetation. The approach described in the VRHS has been developed to complement and add to existing regional Native Vegetation Plans, not to replace them with a different system.

8.3.1 Goals, Objectives and Priorities for Riparian Management

In considering the various ecological, economic and social values provided to the community by riparian land, the Government has, in the past, provided direction on the preferred management of riparian zones. The LCC (1991) provided major directions in its *Rivers and Streams Special Investigation*, which were endorsed by Government. The recommendations are that public water frontages be used to:

- conserve native flora and fauna;
- restore indigenous vegetation;
- protect adjoining land from erosion;
- protect the scenic quality of the local landscape;
- provide protection for cultural heritage; and
- provide access for recreational activities;

and where this does not conflict with the above, to allow access for water and for grazing of stock by adjoining landowners under licence.

These statements recognise the importance of riparian land and provide the general direction for the management of riparian zones in the ownership of the Crown. Whilst this is a crucial first step, it does not apply to riparian lands in private ownership. Clear policy direction is required which indicates the preferred direction for the management of all riparian land regardless of tenure.

Wherever possible, the management and restoration of riparian land should assist in river restoration, maintenance of healthy rivers and landscapes, and the protection of cultural and social values.

This general direction for the management of riparian land will be integrated into the regional management framework for rivers and the development of clear management objectives and priorities for each of the major river reaches.

The goals and objectives for the management of riparian land will be established through the development of the regional RHSs described in Chapter 5. These strategies identify the ecological, economic and social assets of all the major river reaches in a river system. Ecological assets associated with the riparian land include areas with rare or threatened species or vegetation communities, riparian zones considered to be ecologically healthy, areas of high cultural and social significance, and floodplain wetland areas of high conservation value. The strategies will establish where the current condition and/or management of the riparian zone is a threat to these assets and where there may be major opportunities for restoration. Crown Frontage Management Plans are continuing to be developed for riparian land on Crown frontages and similarly identify assets and threats. These plans will form an input to the regional River Health Strategies.

Using this approach, the regional RHSs, along with the Crown Frontage Management Plans, will establish the objectives for each major river reach in terms of the level of asset protection to be provided. In doing this, they will establish the priorities and targets for riparian protection and restoration. Priorities will be established using the three key tenets of the VRHS, that is:

- protect those areas of highest value;
- maintain areas which are ecologically healthy; and
- achieve an overall improvement in the environmental condition of the rest.

In establishing priorities and targets for riparian protection and restoration, the full range of benefits will be identified and considered. These include benefits to the biodiversity of riparian and instream habitats, to economic assets such as bridges, to recreational values and to cultural values.

Priorities for riparian protection and restoration will be established through assessment of multiple benefits.

Priorities for protection and restoration of riparian lands will be established through this integrated planning process, regardless of the tenure of riparian land.

Integration with regional Native Vegetation Plans is an important issue in riparian management. These plans identify priorities on the basis of the conservation significance and quality of the EVCs. A variety of tools and approaches have been developed to assess significance and habitat quality and to assess the expected ecological benefits of restoration works. To ensure complementarity, measures of the significance and quality of EVCs are also used in setting waterway priorities. However, identification of priorities through both the regional RHSs and Native Vegetation Plans may differ slightly as assessments of waterway priorities also take into account instream values, and assessments made under the regional Native Vegetation Plans cover a larger range of vegetation types and a larger area. Management of high priority areas identified through both plans will be supported by both programs under appropriate cost-sharing arrangements. Priorities identified through only one plan will be addressed by that program, and CMAs will ensure that management addresses the values identified in both programs.

Priorities for protection and restoration of riparian lands will be established through regional river health and regional vegetation planning processes and implemented, where possible, regardless of the tenure of riparian land.

8.3.2 Partnership Approach on Riparian Land Management

Any person or agency who owns or manages riparian land is a riparian land manager. This applies to private landholders, those with Crown frontage licences, committees of management as well as government agencies. Management and restoration of riparian land will only succeed if there is a clear partnership between riparian land managers and Government. Riparian land managers will be encouraged to be involved in all aspects of frontage management, including the development of regional RHSs, prioritisation, target setting and implementing actions.

Restoration activities will only be undertaken in priority areas in partnership with riparian land managers.

Activities associated with the protection and restoration of riparian land will only be undertaken in partnership with riparian land managers. Formal management agreements will be entered into between the private riparian land managers and the CMA. These management agreements will be ongoing. They will articulate: the purpose for protecting or restoring the riparian land, the restoration activities, cost-sharing, long term management/maintenance arrangements including weed management, and conditions for stock access. Wherever possible riparian management should be integrated with the planning of whole of farm management.

8.3.3 Caretaker of Riparian Land

Whilst there are many potential riparian land managers including individual farmers, local governments, government authorities (e.g. Melbourne Water, Parks Victoria) and government departments (e.g. various NRE divisions), one group needs to be given the responsibility for the overall oversight and coordination of river management and restoration including riparian protection and restoration. This group will be the CMAs in regional Victoria. Melbourne Water (MWC) will fulfil this role in areas currently under its management. In areas within the Port Phillip and Westernport CALP Board's jurisdiction but outside Melbourne Water's, the two agencies will act in partnership to develop a range of options for management, as outlined in Chapter 11.

The caretakers will be responsible for developing the regional RHSs and Crown Frontage Management Plans, identifying the priorities for protection and restoration of riparian land, negotiating with other land managers to implement these priorities, negotiating ongoing management arrangements, and reporting on riparian condition as part of their general reporting on river health.

The riparian caretakers will be responsible for coordination and implementation of riparian restoration and protection programs and for reporting on riparian condition.

8.3.4 Mechanisms for the Protection and Restoration of Riparian Land

Protection

The ecological value and functions of riparian land depend on the quality of vegetation present. It is therefore important to protect native vegetation on riparian land where it exists and to prevent further losses.

A range of mechanisms is already in place to protect existing vegetation on riparian land. These include:

- management plans for land within Victoria's parks and reserves system where these include riparian land.
- Native Vegetation Retention controls implemented by local government through the State planning schemes. These control the removal or destruction of native vegetation. *Victoria's Draft Native Vegetation Management Framework – A Framework for Action* provides a framework for achieving a reversal in the decline of native vegetation across the landscape and includes a review of the current planning controls. Applications to clear native vegetation need to consider factors including proximity to streams.
- Victoria's *Flora and Fauna Guarantee Act 1988*, which prevents the taking of protected flora without authorisation.
- the *Code of Forest Practice for Timber Production 1996* (the Code) which provides for the protection of riparian zones in both State and private forests. Management conditions vary according to waterway size and permanence and land tenure.
- a comprehensive forest management plan framework, which includes Regional Forest Agreements and Forest Management Plans. This provides for the ecologically sustainable management of Victoria's forest resources.

In State and private forests, the Code provides protection for riparian vegetation through management of buffer and filter strips along rivers and around wetlands. Buffer and filter strips along waterways range from 10 to 40 m from the banks, depending on the permanence of the waterbody and the slope and erodibility of the soils.

These existing mechanisms should ensure that riparian land with high ecological or social values would be protected in reserves and on private land.

Native riparian vegetation will be protected through existing policy and statutory planning mechanisms.

In addition to this, riparian land can be at some risk where recreational pressure is high. Where the riparian land is of high value, recreational plans are needed. In some areas, recreational plans have already been developed. Where there are no plans, CMAs will facilitate their development by the key riparian land manager in consultation with key stakeholders. Arrangements for on-going management will be included in the plans.

CMAs will facilitate the development of Recreational Plans by the key riparian land manager in consultation with key stakeholders for riparian areas of high value with heavy recreational pressure.

Restoration

Restoration of riparian lands generally requires revegetation, weed management and, in most circumstances, fencing to control stock access to protect the new plants, the riverbed and banks, and water quality. In some cases, fencing may be all that is required to allow natural regeneration to occur. In other cases, riparian restoration will require more intensive management, including the management and replacement of exotic species such as willows, blackberries and other weeds, or the use of fire as a management tool.

Best management practice principles for the restoration of riparian land are outlined in Box 8.1. However, the standard of restoration to be achieved will depend on the values of the riparian land, the likely environmental benefits, the costs and the goodwill of the riparian land manager.

Box 8.1 Principles for Best Practice Riparian Restoration

In undertaking restoration of riparian land:

- maximise continuity of vegetated areas on both sides of river;
- in general, the wider the area for protection or restoration, the better (though there will be a point when there is more value in moving to a new area rather than continuing to extend);
- use only native, indigenous species from the local provenance - no planting of exotics;
- provide a 'natural' structure consistent with original condition, for example:
 - grass and herb layer,
 - understorey shrubs, and
 - overstorey trees;
- allow accumulation of woody debris on the ground;
- where possible, work out from areas in best condition that can act as a colonisation source;
- link remnants, including non-riparian remnants, where appropriate for the values being protected;
- establish conditions that allow natural regeneration;
- exclude stock; and
- remove exotics, and at the same time implement a program of revegetation and erosion management.

CMA's will negotiate with other public land managers to ensure that their riparian management is consistent with the priorities for protection and restoration of riparian lands identified in the regional RSHs.

CMA's may provide incentives (when funds are available) to encourage private riparian land managers to participate in the restoration of riparian land. Incentive schemes will reflect the priority of the area for riparian restoration, the level of environmental benefits provided and the long-term nature of the agreement. Provision of incentives will be on the basis of a land management agreement between the CMA and the land manager.

CMA's may provide incentives (when available) to encourage private riparian land managers to participate in the restoration of adjoining riparian land.

In addition, Whole Farm Plans will encourage inclusion of specific planning for frontage management.

A key disincentive to farmers who fence out riparian land is the loss of direct access to the stream for stock watering purposes. To overcome this, an arrangement is needed which encourages landholders to protect their riparian land and also accommodates the licensing requirements for management of diversions.

The CMA's will develop a protocol, in association with rural water authorities (RWAs), for issues associated with water diversion which arise as a result of fencing out river frontages. The protocol will include an evaluation of various options for cost sharing where landholders would require alternative sources of water for stock. Agreement over cost sharing arrangements will be reached between the CMA's and RWAs by June 2003.

CMA's will develop a protocol for issues which arise as a result of fencing out frontages, including options for cost sharing where licences are required for alternative stock watering sources.

A further concern is the management of pests and weeds in the fenced-off riparian zones. Riparian land managers often consider that occasional stock access to riparian zones with growing vegetation can assist in pest and weed management. Land management agreements will specify any conditions for stock access over the life of the agreement and the ongoing arrangements for pest and weed management. However, this is a key area where the impact of occasional or controlled grazing on the ecological health of riparian areas versus total exclusion is not clear. Similarly, in some cases fire may be an appropriate management tool, though the appropriate fire regime is not yet understood.

NRE in partnership with the CMAs will develop statewide guidelines for occasional or controlled grazing in riparian land.

Weed management is one of the most important restoration activities for riparian land. While use of biocides in riparian land can be a risk to environmental values, in many cases it is the only feasible means of controlling weeds. Spraying with biocides for weed management will be kept to a minimum in line with *SEPP (Waters of Victoria)* requirements and will be undertaken to best practice standards.

To effectively integrate the management and restoration of riparian land, the management of Crown water frontages needs to be included under the umbrella of the regional RHSs. This is particularly important for the management of those Crown water frontages outside Victoria's parks and reserves system, State forests and coastal and urban land. This would mean that Crown water frontage licensing could be used as one of the management tools to assist in the implementation of the regional RHSs. As a matter of principle, the responsibility for the management of Crown water frontages outside parks and forests reserves, and coastal and urban land should reside with CMAs. However, there are a number of practical and legislative issues to be resolved before this can be progressed.

In the interim, to facilitate an integrated approach, CMAs will consult with licensees where required in the implementation of the regional RHS and will provide advice to NRE on licence conditions and management. Any changes to licence conditions will only be made in consultation with licensees during the term of the licence or on the transfer or renewal of licences. As a general rule, new licences will be limited to grazing. Cultivation will only be permitted on the recommendation of the CMA.

As a matter of principle, the responsibility for the management of Crown water frontages outside parks and forests reserves, and coastal and urban land should reside with CMAs as caretakers of riparian land to facilitate an integrated approach to the management of riparian land.

NRE will work with CMAs to resolve the practical and legislative issues associated with the transfer to CMAs of responsibility for the management of Crown water frontages outside parks and forests reserves, and coastal and urban land.

Any changes to licence conditions will be based on the recommendations and priorities of Crown frontage reviews and will only be made in consultation with licensees or on licence transfer or renewal.

Use of exotic species

Whilst a lot of community effort is going into the protection and restoration of riparian land, it is also important that further degradation is prevented wherever possible. Degradation can occur through clearing native vegetation (addressed above), weed invasion and the deliberate planting of exotic species, including ash, elm, poplar and particularly willows. The use of willows was in the past considered to be beneficial for stabilising river banks and preventing bank erosion, and government funding was used to plant willows in many areas. It is now recognised that planting willows has resulted in a decline in the environmental value of riparian land and has also exacerbated flooding in many areas. Willow removal and replacement is now a major river restoration activity in many areas of Victoria. The potential damage that can be caused by willows has been recognised and they are listed as a Weed of National Significance (with the exception of weeping willow, pussy willow and sterile pussy willow). The *Weeds of National Significance - Willows (Salix taxa, excluding S. babylonica, S. calodendron and S. reichardtii) Strategic Plan* outlines a range of actions to stop further spread, manage existing areas of willows, prevent their importation and gain community support in management of willows.

Planting exotic species on riparian land will be actively discouraged and actions to contain or remove weed infestations will be implemented within the context of river restoration priorities.

Government funding will not be provided for planting any exotic species on riparian land.

Consistent with the National Weed Strategy and the *Victorian Pest Management – A Framework for Action*, NRE will identify new and emerging weed species that threaten riverine ecosystems.

8.3.5 Increasing Community Awareness

The protection and/or restoration of riparian land cannot be implemented without an active partnership between the community and Government. To encourage the development of this partnership, it is critical that the significance and functions of riparian land are well understood and appreciated by both riparian land managers and the general community, and that the issues raised by landholders are also understood.

CMA's will develop programs to increase awareness within the general community of the role of riparian land and to provide detailed information to riparian land managers with the aim of increasing participation and program 'ownership'.

8.4 FLOODPLAIN LINKAGES

Whilst all of the above material refers equally to floodplain and non-floodplain riparian land, it is worth especially highlighting the concept of enhancing floodplain-river linkages. This is because there is a separate planning framework available that is well suited to maximising floodplain values by addressing this issue.

Reduced linkages between river and floodplain are an outcome of water regulation and extraction which reduce flooding, of actions taken to protect property from flooding, mostly by building levees, and also of laser levelling on private land which infills floodways. There are myriad environmental consequences for both the floodplain system and the river, and there can also be social and economic consequences as the floodwaters are excluded from their natural floodplain and as a result can cause flooding in other, unprotected, areas.

The concept of defining the riparian zone to include the areas of floodplain is very new in river management. The integration of management of the river and this extent of riparian land will require a considerable shift in our thinking and practice over time. The aim is that in the longer term, rivers and the floodplains will be managed as an ecological entity with the floodplain providing organic inputs to the river and high quality habitat, and the river providing water, nutrients and sediment.

Whilst this is unlikely to be fully achieved in the short term, the management framework described above together with the Regional Floodplain Strategies that have already been developed by the CMAs should provide clear goals and objectives for riparian land, and should align the policies, statutory planning arrangements and implementation activities to facilitate this outcome.

The *Victoria Flood Management Strategy* provides a statewide framework for managing floods and a context for the development of regional Floodplain Management Strategies by CMAs and Melbourne Water. A key floodplain management objective is to maintain and enhance the inherent capacity of floodplains to convey and store floodwaters especially in floodway areas. This general principle of ensuring that floodplains are managed to fulfil their natural functions is carried through the other objectives of the Flood Management Strategy and is a clear message throughout the development of policies and guidelines.

The Regional Floodplain Strategies describe the region's floodplain assets and issues, and set in place objectives, priorities, targets and management programs. They carry throughout, the principle that floodplains should, wherever possible, be allowed to flood naturally and that statutory planning processes should not permit any buildings or development on the floodplain in areas which are incompatible with its principal purpose of conveyance of floodwaters, especially in floodway areas. They provide the mechanism for ensuring that the linkages between the floodplain and the river are protected or enhanced.

The water allocation processes outlined in Chapter 6 provide for protection of some form of the flooding regime, an essential step in maintaining linkages. The final piece of the puzzle is the identification by CMAs of areas of floodplains that are a high priority for restoration in order to provide the linkages for habitat and organic inputs to the river required in an ecologically healthy system. Identification of high value floodplains for restoration activities will be encapsulated in the regional RHSs, and priorities assessed along with other river health activities.

The riparian caretakers will protect existing floodplain-river linkages and will identify priority areas and management actions for the restoration of linkages within the context of waterway restoration priorities.

9. Management of the River Channel

9.1 IMPORTANCE OF THE RIVER CHANNEL

Rivers are dynamic systems that will, through time, change course through the processes of erosion, sedimentation and avulsion. These are natural processes. However, because of activities in the catchment, these processes may be occurring at an accelerated rate, and because of human settlement and use of the floodplain, their impact on regional communities can be significant. Floods can cause significant bed and bank erosion, which can often lead to loss of major public assets (e.g. roads and bridges) and of significant areas of private land. The damage to regional communities from these events can be devastating. For example, river-related damage to public and private assets in the 1998 East Gippsland floods was estimated at \$39.6 million and the regional community is still recovering from that event.

As a result of this high potential for damage, there has always been great community interest in the condition and management of the river channel. As a consequence, river management in the past focused mainly on controlling bed and bank erosion and reducing the occurrence of floods and flood damage. Thirty to forty years ago, sections of rivers were straightened and woody snags pulled out in the hope that this would increase the channel capacity, more effectively convey water and reduce flooding. The reality was that these activities often tended to increase bed and bank erosion, in some cases quite dramatically, and often resulted in major environmental damage.

Whilst there is still a major need to manage bed and bank erosion and to protect high value public infrastructure assets, there is also a much better understanding of the importance of the river channel, from an environmental perspective, in providing instream habitat. The components of the channel that are important in determining the quality of instream habitat are:

- substrate type and diversity, such as the presence of pools and riffles, cobbles, sand;
- channel shape, which influences aspects like water depth, velocity and quality as well as the presence of backwaters and undercut banks;
- presence of woody debris;
- presence of riparian vegetation; and
- connectivity – the degree to which there is access for biota, organic material and sediments to move both along the river and laterally into floodplains and wetlands.

Aquatic flora and fauna have fairly distinct physical habitat preferences within rivers which can generally be defined by a combination of these habitat features. Changes to the presence or amount of any component of physical habitat will influence the flora and fauna that survive there.

Issues or activities that can impact on the capacity of the channel to provide instream habitat include:

- **bed and bank erosion.** In addition to the potential loss of public and private assets, bed and bank erosion can cause loss of habitat and lead to sediment deposition. The overall effect will be to gradually widen the river and make it shallower.
- **mobilisation and deposition of sediment.** Increased sediment occurs in rivers mostly due to erosion of the bed and banks and within the catchment. Once in a stream, sediment will either settle out or be transported gradually downstream or onto floodplains. As this occurs, major habitat features like pools and riffles become covered and disappear over time. Sediment slugs up to 3 m in depth are moving slowly down many rivers in Victoria.
- **removal of instream woody debris.** The removal of woody debris (snags) or desnagging occurred to provide boat passage and to increase the channel capacity and reduce flooding. However, desnagging results in the complete absence of a highly valuable habitat, especially in large lowland rivers where snags can be the only stable substrate and instream source of nutrients. Snags provide physical habitat that may be crucial for individual species; for example, no snags means no Murray cod.
- **activities that physically disturb the substrate, such as dredging or bridge building.**

- **introduction of barriers.** Barriers within the river can prevent upstream and downstream movement of fish and other biota, and can interrupt transport of organic material and sediment. Barriers include weirs, on-stream dams, causeways, and even culverts if the drop is too great or the current is too fast or too shallow. The most obvious and dramatic impact is the direct exclusion of migratory fish moving to or from habitat essential for completion of their life cycle, such as spawning grounds in estuaries or headwaters.

Barriers can also be introduced which prevent lateral movement onto the floodplain and associated wetlands. These structures include flood levees, erosion control structures and regulators.

9.2 MANAGEMENT ISSUES

There are a number of issues associated with the management of the river channel. These include:

- making decisions on how much investment should be put into:
 - protection of assets from bed and bank erosion which requires decisions on:
 - the level of risk acceptable to the community, and
 - the quality of the work undertaken;
 - restoration of instream habitat and connectivity to protect and restore environmental values; and
 - relative importance of asset protection and restoration activities; and
- preventing damage to the channel and its capacity to provide instream habitat from other activities.

The final aspect of management within the river channel is the active management of fish resources which may be an asset and/or a threat to river health. This includes the management of non-indigenous fish, stocking and fishing. Recreational fishing in inland waters and recreational and commercial fishing in estuaries are both important activities, socially and economically, and need to be managed in a sustainable way.

9.3 MANAGEMENT OF THE RIVER CHANNEL

Solving the issues outlined above requires a management framework that has:

- clear management objectives and priorities for protection and restoration based on consideration of the value of the community assets and the level of acceptable risk;
- consistent guidelines governing the level and quality of protection and restoration activities; and
- clear policies, relating to the management of other activities, that are aimed at preventing damage to the channel.

9.3.1 Priorities for Protection and Restoration

Priorities for investment in channel works either for asset protection or for restoration will be set within the broader context of integrated waterway management provided by the regional RHSs described in Chapter 5. The regional RHS identifies the ecological, economic and cultural assets of all the major river reaches in a river system. These include public infrastructure assets. The regional RHS establishes where the current condition and/or management of the channel is a threat to these assets and where there may be major opportunities for habitat restoration. In doing this, the regional RHS establishes management objectives for major river reaches and sets priorities for:

- protection of public infrastructure assets;
- protection of other environmental and social assets; and
- restoration of instream habitat and connectivity.

Priorities for instream activities aimed at the protection of public infrastructure and/or restoration of instream habitat and connectivity will be established through the regional River Health Strategy planning process.

9.3.2 Protection of Assets

Where the protection of any assets, including public infrastructure, is considered to be a high priority within the regional RHS, the major issue to be considered is the level of protection to be provided.

This will be true for any high value asset associated with a river reach but is particularly relevant when the asset to be protected is public infrastructure.

A risk-based approach will be taken when determining the level of asset protection to be provided. This will include consideration of:

- the value of the asset;
- the consequences to the community if it is lost or damaged;
- the likelihood of loss or damage; and
- the costs of the protection work including both financial and environmental costs.

For example, a freeway bridge is a major public infrastructure asset that is of very high value to the community. Its loss or damage would result in major community disruption and high replacement or repair costs. A high level of protection (e.g. withstanding a 1 in 500-year flood event) may be warranted in this case in contrast to a situation such as the protection of a bicycle track, which may justify a much lower level of protection.

Whilst the level of asset protection provided will be determined within the regional RHS process, some statewide guidance is required to ensure consistency of approach across regions.

Where protection of assets is considered a priority within the regional RHS, the appropriate level of protection to be provided will be determined using a risk analysis approach.

NRE in partnership with the CMAs and MWC will develop a consistent statewide approach to determining appropriate levels of asset protection.

It should be noted that funding provided by Government for activities related to river protection and restoration will be directed primarily towards activities with public benefit. This is discussed further in Chapter 11.

9.3.3 Restoration Activities

Regional RHSs will indicate priorities for instream restoration. The types of activities that would be undertaken include:

- restoration of instream habitat, such as instream revegetation, resnagging and reconstruction of substrate diversity. The major issue to be considered here is the standard at which the work is undertaken. This is discussed in section 9.3.4;
- restoration of connectivity, generally by the provision of fish passage; and
- control of pest populations of aquatic flora or fauna.

Habitat restoration

Fish passage

One of the key within-channel restoration activities is the restoration of fish passage where a barrier has been constructed in the past. Barriers include any obstructions that are placed across the river. This includes obvious barriers such as dams and weirs but can also include smaller structures such as culverts and road crossings. In addition, fish passage can be inhibited by water quality problems, such as a stream of unnaturally cold water occurring as a result of dam releases.

Whilst, in general, priorities for restoration will be determined within the regional planning process, there are several areas where priority setting is initially undertaken at the State level with these priorities then being fed into the regional planning process. These include the determination of Heritage Rivers, sites of significance and the presence of rare or threatened species. The determination of priorities for restoration of fish passage is undertaken at the State level because it needs to consider inter-basin issues and the conservation status of fish species.

Criteria for determining priorities for the restoration of fish passage in Victoria were determined as a part of the State Fishway Program and are listed in Box 9.1. The State Fishway Program, a government funded partnership between NRE, Melbourne Water, CMAs and water authorities, was established to provide fish passage at priority barriers. To date, works at 58 fishway sites have been completed for a gain of at least 4500 km of riverine habitat. There are, however, many important remaining sites at which fish passage is necessary.

In determining how fish passage will be provided, consideration needs to be given to whether:

- the fish barrier should be removed;
- the barrier can be modified structurally/operationally; or
- a fishway should be built.

Where a barrier is considered to be a high priority for the provision of fish passage, a broad feasibility analysis will be conducted to consider the advantages of one management action versus another.

Box 9.1 Criteria for Establishing Priorities for Fish Passage across Victoria

Statewide priorities for fish passage are determined on consideration of:

- native fish species likely to benefit (high conservation status or migratory species will be highest priority);
- length of river and area of habitat made accessible to fish;
- quality of habitat made accessible to fish;
- proximity to the sea or River Murray (the number and diversity of native fish that would benefit is highest at the lower end of catchments);
- complementary restoration programs being undertaken within the basin;
- an assessment of adverse effects such as spread of noxious/predator species; and
- a feasibility analysis that accounts for issues such as total cost of works, availability of independent financial support, enhancement of recreational/commercial fisheries, drown-out weir frequency, and other management options such as modification or removal of the structure.

Priorities are set by a panel of fish biologists in consultation with the relevant water authorities and CMAs.

Priorities have been set across all the barriers listed in the current inventory of potential barriers to fish movement in Victoria (NRE 1999). This has identified 2438 potential barriers, with farm dams and weirs making up the largest proportion of instream barriers in the State. There are also a significant number of stream gauging sites (weirs specifically designed for streamflow monitoring and major water storages with a stream gauging function) which comprise about 30% of the total number of barriers. Large numbers of culverts and road crossings were not generally recorded, though these in many cases form an effective barrier to fish movement.

Removal of barriers

Removal of barriers may be performed for a number of economic or environmental reasons, though providing fish passage may be a key driver. Any decision to remove a barrier will only be made after a process aimed at determining whether the structure is redundant to the community. This process will examine the utility of the structure against:

- its original objectives (e.g. water supply);
- other social issues (e.g. community support, potential loss of recreation or amenity, safety);
- economic issues (e.g. cost of maintenance of present structure, liability); and
- environmental values (both positive and negative, such as protection of native fish populations from pest species).

NRE in partnership with CMAs and RWAs will undertake a scoping study of barriers across Victoria and will:

- **establish a register of potentially redundant weirs by December 2002;**
- **identify and prioritise them for further investigation; and**
- **develop best management practice and guidelines for existing weirs by December 2002.**

In addition, the ongoing need for structures will be examined by water authorities as part of their asset maintenance program.

When water regulating structures are due for major maintenance work, consideration will first be given to the need for the structure. Water authorities will conduct a community process to determine if the structure is required.

- **If there is no ongoing need, options for the removal of the structure will be considered.**
- **If an ongoing need is demonstrated, then refurbishment should be undertaken at the current best practice standards including environmental standards.**

Altering design and/or operation of structures

In some instances, altering the design or operating procedures at regulating structures can provide ecological benefits such as enhancing fish passage, increasing variability of flow downstream of large storages to enhance bank vegetation, providing backwaters for larval fish or invertebrates, promoting growth of bio-films and providing ecological triggers for fish movement. Design alterations include:

- lowering the height of structures to increase draw out;
- modifying structures to increase flow variability; and
- replacing a single large weir or regulating structure with several small structures which fish can pass. This may reduce the net impact on fish passage while still achieving the original purpose of the works.

Operational modifications include:

- increasing the frequency and duration of gate opening or weir pool draw down, especially when this is timed to coincide with periods of fish movements;
- flow regulation and controlled releases from upstream storages designed to inundate low level weirs to facilitate fish passage; and
- varying the size and rate of releases to meet ecosystem needs.

Where the operation or design of a structure has been identified as a priority issue, authorities will review the operation of their structures with the aim addressing the problem wherever feasible.

Installation of fishways

Where fish passage has been reduced or obstructed and removal or modification of the barrier is not possible, then the use of fishways will be considered. Where fishways are constructed, there is a need to monitor fish passage to assess effectiveness and refine designs.

The State Fishway Program will continue to be implemented and will provide for:

- the provision of fish passage at barriers which are considered a priority; and
- monitoring the effectiveness of fish passage works.

All relevant authorities will be encouraged to consider the need for fish passage and to provide fish passage across any of their structures.

9.3.4 Quality of Restoration/Protection Work to be Undertaken

Undertaking river restoration activities or providing an appropriate level of asset protection requires works to be undertaken within the river channel. This may involve a range of hard engineering works, particularly in the protection of public infrastructure, including alignment training (e.g. the construction of groynes or pile fields), bank protection (e.g. rip-rap), the introduction of rock chutes for gradient control or reinstatement of pool-riffles, or the provision of fish passage. Alternatively, it may involve soft engineering works such as resnagging rivers to provide fish habitat, revegetation or a combination of both. In recent times, there has been a move towards soft engineering works where these will achieve the objective of the restoration/protection works as they are considered to be more environmentally sensitive.

Any works within a river channel have the potential to cause further damage to the instream ecosystem. It is therefore very important that all works are carried out to best environmental standards. The way in which these works are planned and the standard to which they are undertaken will determine both their success at achieving their objectives and their environmental acceptability. The quality of these works depends on:

- **design based on understanding stream ecosystem and geomorphic processes and causal factors.** River works must be designed within the context of the geomorphology of the river system and an understanding of the ecological processes operating within the river otherwise they could fail or do further damage.
- **the environmental standard at which the works are implemented.** River works can have the potential to damage the stream environment depending on the way in which they are undertaken. Therefore, they need to be undertaken to current best environmental standards. These are described in the *Environmental Guidelines for River Management Works* (Standing Committee on Rivers and Catchments 1990) and the *SEPP (Waters of Victoria)*. Since publication of the *Environmental Guidelines for River Management Works*, there have been many advances in this area, particularly in development of techniques and approaches. Accordingly, these guidelines will be reviewed and updated to include recent advances in best environmental practice river restoration, and guidelines for installation of fishways will also be developed.
- **the technical standard at which the works are implemented.** Works clearly need to be undertaken at the highest standard of quality given the desired level of protection. Current best practice standards are described in the *Guidelines for Stabilising Waterways* (Standing Committee on Rivers and Catchments 1991). These guidelines were developed in 1991 and should be reviewed to include the most up-to-date information.
- **the need for riparian restoration as an integral part of the design.** The effectiveness of within-channel works can be greatly enhanced if complementary riparian works are undertaken at the same time. In many cases, they can fail to achieve their objectives if this is not included in the design.

The following principles will be adopted in the implementation of within-channel restoration works.

All protection/restoration works undertaken in the river channel must be:

- based on a good understanding of the stream processes operating within the river system and the causes of the problem;
- undertaken according to the best environmental standards;
- undertaken to the best technical standard given the desired level of protection; and
- designed with riparian restoration as an integral component of the work.

To assist in the implementation of these principles, NRE in partnership with MWC and the CMAs will update:

- the Environmental Guidelines for River Management Works; and
- the Guidelines for Stabilising Waterways,

to include recent advances in particular in the areas of river restoration using soft engineering techniques of resnagging and revegetation.

NRE in partnership with MWC and the CMAs will also develop guidelines for the installation of effective fishways, including monitoring.

In addition, NRE will from time to time conduct technical audits of river restoration works undertaken by CMAs.

9.3.5 Protection of the Channel against Degradation from Other Activities

There are a number of management activities that have in the past taken place within the channel of a river. A number of these can be detrimental either to the channel itself or to the instream habitat it provides. These activities include:

- removal of woody debris;
- undertaking works on waterways;
- building dams on waterways;
- mining;
- clearing heavy aquatic plant growth; and
- management of existing structures, such as flushing sediment from storages.

It is important to ensure that there is clear direction on how these activities should be undertaken to minimise any possible future degradation and to provide protection of assets within the channel.

Removal of woody debris

Large woody debris is a major habitat in rivers, providing shelter, food sources and breeding sites for a variety of instream biota. In the past, large amounts of woody debris were removed from rivers to provide for navigation and in the belief that this would increase channel capacity and reduce flooding. This was done without realising the damage that this removal would do to native species like the Murray cod.

The demand for navigation has reduced considerably since paddle steamers plied the River Murray and we now have a much better understanding of the importance of large woody debris. We also have a much better understanding of river hydraulics and it is now recognised that the effect on flooding of wood in rivers was grossly overstated.

Therefore, the following policy principle will be adopted.

Large woody debris shall not be removed from rivers unless it is demonstrated to be a serious threat to a high value asset or to human lives. Where this has been demonstrated, the option of realigning the snag will be investigated to retain as many of the ecological benefits as possible.

Undertaking works on waterways

There are a number of works and activities undertaken by public authorities and landowners that can impact on waterways. These include:

- road and bridge building;
- stream access crossings;
- bed and bank erosion control works;
- stormwater outlets;
- removal of invasive instream vegetation, such as Cumbungi;
- stream clearing;
- crossings of pipelines and other services across waterways;
- stream deviations; and
- dumping of rubbish.

In the non-metropolitan regions of the State, application must be made to the CMA for approval for any works on waterways. In the Port Phillip and Westernport CALP region, this function is shared between Melbourne Water and Southern Rural Water.

In granting approval for works on waterways, CMAs consider the:

- potential to destabilise stream bed and banks;
- potential to alter flood levels;
- impact on riparian vegetation;
- impact on instream habitat;
- potential to affect water quality;
- impact on cultural and heritage values; and
- impact on general stream environment.

CMAs, MWC and Southern Rural Water will only give approval for works on waterways where they maintain or improve the environmental value of the site and surrounds, and are unlikely to create problems for stream instability, adverse off-site impacts or flooding problems.

CMAs may exempt from individual works approvals some works by public authorities or major utility companies, subject to specified conditions.

Dams on waterways

The effect of dams on river flows is discussed in Chapter 6. Building dams on waterways also has the clear impact of creating a barrier to fish passage. Even small structures such as culverts and stream gauging stations can restrict essential fish movements. The cumulative effects of a number of small dams in a catchment can result in local extinctions of some fish species in that area. Provision for fish passage is therefore an essential consideration for planners and designers of works on waterways. In Victoria, legislation is now in place that requires that fish migrations not be impeded and that a planning and approval process be followed prior to commencement of works.

New dams on waterways that would be classified as watercourses or other waterways with high environmental values should only be considered for approval if there are unsuitable sites elsewhere and only if the stringent environmental requirements outlined in the draft 'Licensing Guidelines for New Irrigation or Commercial Dams' are met.

Any new structure, if required, will include adequate ongoing provision for fish passage.

Licensing authorities (RWAs and MWC) will refer any application for new dams to CMAs and NRE for advice on this issue.

Mining

Major mining activities in the river channel have the potential to totally change the bedform of the river. This will have major impacts on instream habitat and biota and may trigger significant erosion events. Major mining activities that take place in rivers include:

- eductor dredging, which has been banned in Victoria since 1990; and
- sand and gravel extraction.

It must be acknowledged that there are some cases where the extraction of sand or gravel from a river can provide benefits to the river, such as in the management of sand slugs caused by catchment erosion in the past. Given this, sand and gravel extraction may be undertaken in waterways where it is used by the CMA as a management tool for the protection of waterway assets.

All other existing mining controls will continue to apply.

Management of existing structures

The management regime of existing structures not only affects the environmental flow regime (see Chapter 6) but can also affect the channel downstream, causing bank erosion if not managed appropriately. In addition, storages are regularly flushed to stop the accumulation of sediment. This sediment is then washed downstream.

Water authorities holding BEs are required as a condition of the BE to develop an environmental management program to minimise the impact of storage operation on the downstream environment.

All BE holders will prepare an environmental management program which will include assessment and management of:

- the effects on the bed and banks of the waterway in the vicinity of the storage;
- the effects on aquatic biota in the waterway;
- operating practices to remove silt from the storage;
- operating practices to manage water quality, including temperature, in the storage and in the waterway;
- operating rules to control releases from the storage to the waterway; and
- operating rules for managing flood flows through the storage.

9.3.6 Management of Fish Resources

Recreational and commercial fisheries, while an asset in themselves, can include activities which may be detrimental to river health - such as fishing pressure, impact on native species or access routes along stream banks. These activities need to be considered within the broader framework of river health and managed appropriately. Non-indigenous species, whether introduced species of high recreational value (such as trout), native species stocked out of their normal range, or pest species (such as carp), can impact on river ecology.

Currently, stocking of fish species is controlled through a process involving regional consultation committees and a statewide specialist committee which overall consider river health impacts together with recreational interests in accordance with national and statewide policy.

NRE will finalise statewide policy consistent with national policy for management of live aquatic biota and aquatic pests in Victoria by December 2002.

However, it is intended that stocking will be dealt with increasingly through the development of Fisheries Management Plans. These plans focus on the sustainable use and allocation of fisheries resources in rivers, lakes and impoundments and recognise that the health of aquatic ecosystems is fundamental to the health of the fishery and also that activities associated with fishing can have adverse impacts on the aquatic environments if not managed sensitively. They will be developed by NRE in consultation with CMAs and other key stakeholders, for all systems which sustain inland fisheries. They will be developed within the context of the regional river health framework in consideration of the social, environmental and economic assets of the river system.

Fisheries Management Plans will be developed progressively for all systems which sustain inland fisheries, within the context of the regional river health framework.

Management of inland fishing is undertaken through a range of mechanisms, including bag limits, catch quotas, size limits, gear restrictions, and seasonal/area closures, with the aim of ensuring that they are ecologically sustainable.

One of the most difficult issues in the management of fish resources is the management of noxious species. Noxious fish, which include carp and gambusia, are listed under the *Fisheries Act 1995* and once listed there are many controls over their handling. Management of populations of exotic species currently entrenched in Victoria is a very difficult task, as with terrestrial pests and weeds. Investigations into carp ecology and means of control are underway in Victoria, and also at a national level by CSIRO. In some cases, where populations of exotic species are a major threat to high value native flora and fauna communities, specific intervention programs may be undertaken to protect these assets.

10. Linked Ecosystems

As discussed in Chapter 1, the scope of the VRHS reflects a river's functioning as an ecosystem:

A river, stream or natural waterway includes the channel, the riparian zone which takes in the regularly wetted floodplain, any associated floodplain wetlands and the estuary or terminal lake.

Whilst it is not intended that the VRHS cover all issues associated with management of estuaries, terminal lakes and floodplains, it does cover those aspects that either affect or are affected by river condition and are therefore associated with the health of the river system overall. This chapter summarises how the management framework and policies outlined in the VRHS provide for these linked ecosystems. It also indicates other relevant policies that direct other aspects of the management of these systems.

In general, the needs of these linked ecosystems are considered within the regional RHS framework by the identification of:

- environmental, economic and social assets – estuarine, floodplain or associated wetlands and terminal lakes of high environmental value are identified through this mechanism (see Box 5.1); and
- river management related threats to these systems and opportunities.

The identification of the assets and threats as outlined above will ensure that they are considered during the development of targets and work programs in the action plans.

Although there is an appropriate framework in place, the management of linked ecosystems is often limited by the lack of knowledge of the ecological functioning of these ecosystems.

Management arrangements for linked ecosystems are described in Table 10.1.

Linkages with broader catchment management programs

The management framework has been designed as a major sub-component of the RCS. Through this and the regional RHSs, the issues of land use and management as they affect the river are considered, and targets and work programs for these activities are established. These are described in more detail in Chapters 5, 7 and 8.

Table 10.1 Management arrangements for linked ecosystems

Linked Ecosystems	Relationship to River	Provisions within VRHS	Complementary Strategies
Estuaries	Affected by:		
	• Changes in flow regime	• estuarine needs included in environmental flow assessments (where known)	<i>Victorian Coastal Strategy</i> <i>SEPP (Waters of Victoria)</i>
	• Changes in water quality (e.g. increasing salinity and nutrients)	• high value estuaries included in water quality and salinity plans	Coastal Action Plans
	• Sedimentation	• general erosion control activities undertaken as a result of priorities established in regional RHSs	Management plans for specific estuaries
	• Barriers	• provisions for fish passage (estuarine barriers are generally of high priority because of the large increase in accessible area that result from their removal)	Ramsar Strategic Directions Statement
	• Premature opening of estuaries		Dealt with in specific regional processes
Floodplains and Associated Floodplain Wetlands	Affected by:		
	• Changes in flow regime	• the needs of floodplain wetlands included in environmental flow assessments (where known)	<i>Victoria Flood Management Strategy</i> <i>SEPP (Waters of Victoria)</i>
	• Disruption to river linkages	• the preservation and restoration of river–floodplain linkages considered in principles for the management of riparian land and in provisions for fish passage	<i>Victorian Biodiversity Strategy</i> Victorian Planning Provisions
	• Changes in water quality (e.g. increasing salinity and nutrients)	• included in water quality plans and salinity management plans (where this is an issue)	Ramsar Strategic Directions Statement
	• Sedimentation	• general erosion control activities undertaken as a result of priorities established in regional RHSs	Specific management plans
Terminal Lakes (In Western Victoria)	Affected by:		
	• Changes in flow regime	• needs included in environmental flow assessments (where known)	<i>SEPP (Waters of Victoria)</i> and Schedule for the Western District Lakes
	• Changes in water quality (including increasing salinity and nutrients)	• included in water quality plans and salinity management plans (where this is an issue)	
	• Barriers	• provisions for fish passage where a priority	Ramsar Strategic Directions Statement
	• Sedimentation	• general erosion control activities undertaken as a result of priorities established in regional RHSs	Specific management plans