

Water Resources Management Plan 2004

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1. Name of instrument

This instrument is the *Water Resources Management Plan 2004*.

2. Commencement

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DI1999-203 *Water Resources (Management Plan) Approval 1999*, notified on the legislation register on 27 August 1999 is revoked.

Jon Stanhope
Minister for the Environment

30 April 2004



ACT Government

***Think water,
act water***

**Water Resources
Management Plan 2004**



**building our city
building our community**
ACT Government

Think water, act water

Volume 1: Strategy for sustainable water resource management in the ACT

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Volume 2: Explanatory document

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Dedication to Gary Croston

Think water, act water is dedicated to the memory of Gary Croston, the key architect and driver behind the development of this Strategy. Gary passed away unexpectedly in January 2004.

Gary leaves behind a significant legacy for future generations through his contributions in the areas of forestry, urban parks, conservation, environment protection and water resources management, made over his twenty-eight years of public service.

Chief Minister's Foreword

The absolute necessity of effective water resource management in the ACT has never been clearer than it is now. We can no longer treat water in the way many of us have in the past. Even before the drought and the bushfires, the Government was looking to the future for water, through the development of The Canberra Plan, which provides a long-term strategic vision for the ACT.

The water resources strategy, ***Think water, act water*** and accompanying Implementation Plan, provides a framework for a partnership between the community and the government in managing, using and conserving the water resources of the region.

We face challenges in how we improve water resource management as well as how we fulfill our obligations beyond the boundaries of the ACT. We face challenges in our role as the National Capital.

We are an active participant on a national level in the development of the new National Water Initiative and strategies and approaches on water policy reform, improving water quality and ecologically sustainable development. Our water resource practices must minimise our local environmental impacts and support the achievement of other national objectives such as improving the health of the Murray–Darling River system.

Securing a sustainable future for Canberra and enhancing economic prosperity and environmental responsibility for the ACT and the surrounding region will depend on our ability to implement the best possible water resource management practices.

The challenge of providing long-term certainty will require many improvements to the way we use water. This will be influenced by how well we understand, and commit to, making changes in many areas as our knowledge of factors such as climate change, catchment management, environmental issues and water conservation and water use grows. Water sensitive urban design is a new concept for many of us—but we will need it to become part of our every day lives.

We will also need to consider the development of water trading markets and how we can work better with our neighbours as well as whether we have the right structure in our water management organisations.

The detailed policies we adopt now for the ACT will determine our ability to contribute to managing the water challenges of the future.

Think water, act water is a significant contribution to addressing these challenges. The implementation of this Strategy over the coming years will provide an opportunity for the Government to continue to work with the community and business to address the many issues that confront sustainable use of our water resources.

We all have a stake in making this Strategy become a reality.

Jon Stanhope MLA
Chief Minister and Minister for the Environment

The water future 50 years from now

What will people in Canberra and the region think when we talk about water in 50 years time? Will our thoughts be filled with concern about levels of water pollution or be as uncertain as they are now, in a time of drought and water restrictions? Or will we be proud that the ACT is seen as a leader in the way we manage our water and use our lakes and streams?

There is no doubt that water will continue to be seen as an important issue. Water is a limited and fragile resource in Australia and the future will always hold a mixture of views about our relationship with water.

But Canberra has a history of being able to look after the environment and our natural resources. We have the skills and capacity to develop the new ideas needed to care for our water resources if we work together.

So the future does look good.

In 2054, we should have plenty of drinking water—whatever our population. But each of us will be using much less mains water—for many it will be as little as one-quarter of what we use now. This will be achieved through using water more efficiently around the house. We will use rainwater, stormwater or reclaimed water for uses that do not require clean, pristine drinking water—such as in gardens or toilets. Toilets, washing machines, showers and other water-using appliances will be much more efficient.

Canberra will still have a reputation as a Garden City and Bush Capital but our gardens will be designed in a way that is more appropriate to our natural environment, taking advantage of the many plants which use little water but still provide the amenity values we seek.

The way we use water in our homes, gardens, workplaces and elsewhere will change so that everyone will think first about whether a task can be done without any water or, if water is needed, exactly how much.

In all of our neighbourhoods, not far from each of our homes, will be small wetlands containing a community of plants, insects, frogs and birdlife. Each wetland will collect and slowly release urban stormwater, which has been cleaned by the natural life cycle of the wetland.

And we will respect our place in the wider Murrumbidgee catchment. In 50 years, the quality of water leaving the ACT in the Murrumbidgee will be at least as good as the water entering. We will still enjoy swimming in a clean and healthy Murrumbidgee River. Our lakes will be busy with sailors, canoeists, swimmers and others enjoying the water. People will still enjoy a stroll around the edge of Lake Burley Griffin, admiring the reflection of public buildings in the clean lake waters.

Our water future—a clean, healthy outlook, but only if we act now.

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Executive summary

Think water, act water will provide long-term guidance for the management of ACT water resources. *Think water, act water* should be seen as a document that is able to incorporate the latest thinking and new ideas. The major objectives of the Strategy and the Government's commitments to meeting them are outlined below.

Increase the efficiency of water usage

Ensuring that the ACT has an adequate, secure water supply is a major objective of the Strategy. How water resources are managed into the future is dependent upon a range of issues such as population growth, the legacy of the 2003 bushfires in the Cotter catchment, climate change, and how the 'urban water cycle' is managed.

Water for future population growth can be obtained by increasing the water we obtain from our water supply reservoirs, or by reducing per capita mains water use, or a combination of both. Analysis undertaken for Canberra indicates that the most effective option, taking account of costs to the entire ACT community, is to implement water efficiency measures first. Accordingly the Government has set water targets of:

- a reduction in per capita consumption of mains water by 12 per cent by 2013 and 25 per cent reduction by 2023, through:
 - water efficiency measures
 - sustainable water recycling
 - use of stormwater and rainwater
- an increase in the use of reclaimed water from 5 per cent to 20 per cent by 2013.

Water efficiency will be achieved by:

- providing a rebate for AAA showerheads
- subsidising household water tune-ups
- subsidising household garden water tune-ups
- subsidising provision and fitting of a AAA 6/3 litre dual flush toilet in place of a single flush toilet
- providing a rainwater tank rebate scheme
- information and awareness programs that provide advice to householders and the business and government sectors
- supporting a national scheme for compulsory water efficiency labelling of appliances, and promoting agreement across Australian jurisdictions so that only water efficient appliances, such as AAA showerheads (by 2007) and AAAA washing machines (by 2010), are available for sale in the ACT and the rest of Australia

- a range of regulations to support more water efficient use of water in the home and garden.

Initiatives are also needed in the commercial and industrial sectors, and from government buildings, public land and public housing. A number of initiatives in areas such as irrigation of public land and water efficiency in schools and public housing are being implemented. In consultation with businesses in the ACT, a detailed water efficiency program across the commercial, industrial and public sectors will be developed and initiated during 2004–2005.

Water reuse is another way to help meet our water consumption reduction target. Within the ACT we currently use high quality drinking water for irrigation and other purposes for which we could potentially use some of the 35 GL of treated water discharged every year into the Molonglo River. We currently reuse only about 1.8 GL. The Government has set a target of increasing the use of reclaimed water to 20 per cent by 2013. This target will be challenging to meet and further research is needed to determine if and how this could be sustainably achieved. Reuse measures that will be pursued in the short term are:

- develop guidelines for use of domestic greywater and include information in community awareness programs
- reticulate reclaimed water from the Fyshwick treatment plant to irrigate ovals in North Canberra
- investigate the opportunities for sustainable reuse in greenfield and re-development areas
- ensure that any building the Government builds or procures for its use will incorporate features to maximise efficiency of water use and reduce the demand on mains water through alternative supplies, such as stormwater, rainwater and reclaimed water.

Provide a long-term, reliable source of water for the ACT and region

The ACT Government is committed to applying thorough scientific and systematic analysis of the state and future of the ACT's water supplies to ensure they are managed in a sustainable, equitable and participative manner.

A range of water supply options for the future will continue to be considered in case water use efficiency measures are not able to save enough water to avoid the need to construct further water supply infrastructure. This planning process is being developed in a strategic manner to ensure there is no risk to the long-term security of water supplies for the ACT.

ACTEW has undertaken an initial assessment into possible infrastructure options to augment supply. Three major options have been identified for detailed evaluation. They are:

- building a new dam near Mount Tennent, south of Tharwa in the ACT
- enlarging the existing Cotter Dam
- transferring water from Tantangara Dam in New South Wales to the ACT's Cotter catchment.

The ACT Government will work in partnership with ACTEW and the community to further investigate the full range of issues, including consideration of hydrological, economic, environmental and social factors. It is envisaged that a detailed cost-benefit, environmental and social analysis will be completed by March 2005.

It is important to undertake this type of planning for the future because there are many uncertainties, including predictions about population growth, possible significant climate changes and likely reduction in water yield from our fire affected Cotter catchments.

In the wider region, the ACT has agreed to participate in the cap on water diversions as a commitment to its role in looking after the Murray–Darling Basin. The ACT is currently in the process of developing an appropriate cap level in consultation with other members of the Murray–Darling Basin Commission.

The Government will aim to complete a Memorandum of Understanding with the New South Wales Government and the Commonwealth Government that will include provision for a water cap by the end of 2005.

Promote development and implementation of an integrated regional approach to ACT/New South Wales cross-border water supply and management

Development of a cross-border water supply strategy based on sustainability principles, and that ensures water supply security for the ACT is seen as a priority. Work has already begun on this. It will be consistent with, and supportive of the approaches promoted by *Think water, act water* and consistent with The Canberra Plan (including its component plans).

Protect the water quality in ACT rivers, lakes and aquifers, to maintain and enhance environmental, amenity, recreational and designated use values and to protect the health of people in the ACT and down river

The ACT is Australia's largest inland population centre and with our position in the Murray–Darling Basin, the impact of our activities on water quality needs to be carefully considered. The Government acknowledges this responsibility both in the ACT and to waters downstream and will meet this responsibility through:

- continuing environmental and health water quality protection programs to meet the aim of the same or better quality for water leaving the ACT as that entering
- reviewing the Environmental Flow Guidelines in 2004 using new scientific knowledge gained since 1999
- reviewing water resource monitoring to identify clear objectives for monitoring programs, and facilitate synergies between programs
- requiring that management of riparian zones in the ACT be consistent with the Riparian Zone Management Plan in Volume 2 of *Think water, act water*
- using adaptive management to ensure best practice management of the ACT's water resources.

Facilitate the incorporation of water sensitive urban design principles into urban, commercial and industrial development

When we build our cities and towns, we significantly modify the natural water cycle. We import water from our water supply catchments, and we discharge highly treated water via the sewerage system back into our rivers. Urban areas also cause a dramatic increase in stormwater run-off and associated pollutants, causing serious degradation of our natural river systems. There is now much attention on how we might better manage all these components of the water cycle in our urban environments. Such an approach is known as Water Sensitive Urban Design (WSUD).

WSUD approaches seek to facilitate sustainable urban development by reducing use of mains water, reducing treated effluent discharge and stormwater run-off and reducing water quality impacts on urban waterways, particularly the urban lakes. In addition to these water-focused outcomes, WSUD aims to protect or enhance other social, amenity and design values traditionally accommodated in the planning process.

- In consultation with industry, the Government will require that best practice, cost effective WSUD measures be used in the construction of all new greenfield developments, large scale redevelopments and capital works projects. WSUD guidelines to direct development and re-development will be completed in 2005.
- The Government will set up a scheme so that developers can meet their WSUD obligations by contributing to more beneficial WSUD measures off site.
- The Government will seek opportunities to retrofit WSUD measures into developed areas where such measures currently do not exist.

If Canberra is to benefit from the increased urban and rural amenity arising from good water management, innovative new systems and products will need to be developed.

- By the end of 2004, the Government will investigate the feasibility of a fund to encourage innovation in water management.

Promote and provide for community involvement and partnership in the management of the ACT Water Resources Strategy

Meeting the Strategy's objectives cannot be achieved without the involvement of the entire community.

- The ACT Government will implement an Information and Awareness Program to help meet the ACT's water resources management Goal and Objectives, particularly to improve the efficiency of urban water use. The aim of the program is to achieve continual, long-term savings in the community.

Community groups have indicated that they are ready and willing to engage in activities to educate and involve the community in community-based projects around sustainable water use and management. This will be supported by:

- development of a community-oriented learning and action package which can be tailored by various groups, based on what is relevant for their needs

- working with the community to develop initiatives that will support groups to undertake development and delivery of community water learning projects.

Implementation and review

Water resource management is a complex process. The Strategy will undergo regular review every five years to ensure it remains current. The implementation plan included will be reviewed every year to ensure its objectives are being achieved.

The ACT Water Report will report annually on the effectiveness of implementation.

1 Introduction

Think water, act water is the ACT's water resources strategy. It is a long-term strategy, setting directions for water resource management until 2050. It also includes an Implementation Plan setting out a range of actions.

Water does not recognise Territory and State boundaries, consequently **Think water, act water** not only seeks to set the direction for future water resource management in the ACT but also considers how our actions in the ACT affect water availability and management across the region and downstream of the ACT.

The direction of the strategy **Think water, act water** comes from the ACT Government's draft policy, *Water ACT: a draft policy for sustainable water resource management*. **Think water, act water** confirms the goal for water resource management identified in *Water ACT*, namely:

“The ACT Government is committed to the sustainable use and management of ACT water resources, and will implement best practice water resource management strategies.”

1.1 Navigating the strategy

There are three parts to **Think water, act water**:

Volume 1

Think water, act water (this document) being the overall strategy and an implementation plan (see Appendix A).

Volume 2

Explanatory document, which provides more detailed information and explanation.

Volume 3

The state of the ACT's water resources and catchments, which describes the water sub-catchments in which the ACT has an interest, the flows, allocations and provision for future allocation for sub-catchments.

2 The ACT's water policy framework

Water resources management in the ACT is guided by:

- international agreements to which Australia is a signatory
- national policies agreed by some or all jurisdictions including the ACT
- federal and ACT policies, agreements and legislation.

Legislation that impacts on ACT water resource management is enacted at two levels, federal and ACT. The policy and legislative details are included in Volume 2.

Of importance, the Council of Australian Governments (COAG) agreed to develop a National Water Initiative (NWI) to refresh and realign the water reform agenda to more fully realise the benefits intended by 1994 COAG water initiatives. While the NWI has not yet been finalised, its objectives are clear and include 'encouraging water conservation in our cities, including better use of stormwater and recycled water'.

The ACT Government's approach to sustainability, outlined in the document *People, Place, Prosperity* describes the sustainability principles that the ACT Government will incorporate into its systems and operations. It commits the ACT Government to:

- embedding sustainability within its decision-making processes
- promoting sustainability to the wider community
- developing partnerships for sustainability with the ACT community
- developing indicators and reporting regularly on progress.

While it is expressed in many different ways, the concept of sustainability has three key components:

- recognition of the interdependence of social, economic and environmental well-being
- a focus on equity and fairness, and that we need to take account of the effect of our actions on others in an interdependent world
- recognition that meeting today's needs must not be at the expense of future generations being able to meet their own needs.

2.1 Water Resources Act 1998

The objectives of the *Water Resources Act 1998* are to:

- ensure that the use and management of the water resources of the Territory sustain the physical, economic and social well being of the people of the ACT while protecting the ecosystems that depend on those resources
- protect waterways and aquifers from damage and, where practicable, to reverse damage that has already occurred

- ensure that the water resources are able to meet the reasonably foreseeable needs of future generations.

Protection of environmental flows as a first priority is an important principle of the *Water Resources Act*. Environmental flows for all ACT-controlled waterbodies were set in 1999 in the *Environmental Flow Guidelines*. In the ACT, water can only be used for other purposes once environmental flow requirements have been met.

The Act also requires a *Water Resources Management Plan* to be prepared. It must include a description of the Territory's water resources, proposed water allocations for the next 10 years, water allocations to be created, and action to be taken to manage water resources. ***Think water, act water*** will be tabled in the Legislative Assembly as the *Water Resources Management Plan*.

2.2 ACT Legislative Assembly direction

The importance of sustainable water management was recognised by the Legislative Assembly on World Environment Day 2002, when it passed a motion that gives clear direction to water management policies. It was agreed that:

- as far as possible the building of further water supply dams in the ACT should be avoided
- the water leaving the ACT via the Murrumbidgee River should be of no less quality than the water flowing into the ACT
- adequate flows should be maintained in the ACT's waterways to maintain their environmental values.

Think water, act water, is the vehicle for implementing this direction.

2.3 Challenges and objectives

Water ACT: a draft policy for sustainable water resource management was released in July 2003. It identified challenges and objectives for water resource management in the ACT. ***Think water, act water*** re-iterates those challenges and sets out how the Government intends to achieve the objectives. Our challenges are to:

- ensure the ACT and region has a secure and reliable supply of water for current and future needs
- continue to protect the ecological and social values of our waterways for our needs and the needs of future generations
- take account of climate change, including scientific predictions for higher temperatures and lower and variable rainfall, in assessing the future sustainability of our resources
- improve urban, housing and landscape design to fit with emerging water resource constraints

- integrate an holistic approach to water cycle management with economic, spatial and infrastructure planning
- ensure water supply and management practices are consistent with protecting public health.

Think water, act water also confirms specific targets for the Canberra community to achieve over the next 20 years (see Section 4), such as a 25 per cent reduction in water use over 20 years.

The targets focus our attention. They will require each of us to change our water consumption patterns. Without action by each of us, the ACT will be forced to look at costly and less sustainable water supply options in the near future. Whereas, achieving the targets will bring multiple benefits, not just for our water supply requirements, but also for:

- improved urban amenity
- improved recreational opportunities
- water quality protection
- enhanced ecological values of urban waterways.

3 Water planning variables

There are a number of variables that must be taken into account in managing water resources into the future. The main ones are:

- population growth
- the aftermath of the 2003 bushfires in the Cotter catchment
- long-term climate change
- the extent to which we change the way we manage the 'urban water cycle'.

3.1 Population growth

Human population is a significant factor in determining water requirements of a region. Future population growth is subject to a degree of uncertainty, and thus predictions for the ACT region over the next 50 years vary considerably. The planning scenarios developed for **Think water, act water** use different population projections, and as such the figures quoted will vary. The two common population projections are the median level and upper-level projections.

ACT and region median level population projections: To estimate the potential future demand for water, we used the median population of Canberra and the Australian Bureau of Statistics' Statistical Local Areas of Yass, Yarrowlumla Part A and Queanbeyan. This reflects the most likely scenario of future regional growth, and will serve to avoid over-investment in supply infrastructure with resultant costs of service delivery minimised. **Think water, act water** also used advice from the ACT Demographer, which predicts that the most likely population for the Canberra, Queanbeyan and the adjacent region will be 460,000 by 2050.

ACT and region upper-level population projections: Upper-range population projections, such as outlined in the Canberra Spatial Plan, are used for contingency planning, where planning needs to accommodate higher-than-expected population growth, should this eventuate. The Canberra Spatial Plan has adopted a Canberra/Queanbeyan population of 500,000 by 2032, if a range of factors comes into play. Such factors include growth pressure from Sydney, the impact of economic growth and diversification of business and industry in the Territory, and improved transport linkages within the region. It is important that **Think water, act water** plans for, and has the capacity to deal with, such potential growth shock factors. Work being done to predict when new water supply infrastructure will be needed will therefore be using these higher growth projections for contingency planning to ensure that, if increased water supply is needed, necessary planning and design will be done well in advance of the need to begin construction.

If we achieve our target of reducing mains water use, it is possible that we can meet the requirements for a population of 460,000 without constructing further water supply infrastructure. Bushfire, climate change impacts and other factors may mean this is not feasible, but more efficient water use should be put in place first, given its lower cost.

The ACT already supplies water across the border to Queanbeyan. A further factor affecting the size of the ACT population our water supplies will serve is the extent of cross-border supply. This issue is further discussed in section 4.3.

3.2 Bushfire damage

On 18 January 2003, the ACT experienced an unprecedented fire disaster which, amongst other things, has major long-term consequences for the ACT's water resources. The report of the Government-appointed Bushfire Taskforce *Shaping our Territory, Final Report: Opportunities for Non-Urban ACT (November 2003)*, should be read in conjunction with this Strategy.

In summary, the bushfires:

- burnt the vast majority of the Cotter water catchment (fire severity ranging from low to very high)
- scorched or destroyed 78 per cent of the canopy in the Bendora sub-catchment (fire damage ranging from high to very high)
- damaged 42 per cent of the canopy in the Corin sub-catchment.

There are significant consequences for:

Water run-off: While preliminary investigations into the behaviour of the catchment over the past year have indicated there has been little change in the run-off patterns in the catchment, the future response of the catchments to the bushfires is still extremely uncertain. Further research is being carried out.

The reason for the expected decrease in run-off over the next 16 or so years relates to the vigorous regrowth of vegetation.

- **Water quality:** After the bushfires, the washing of soil, ash and other fire debris into the Cotter River caused the turbidity in all three Cotter River reservoirs to exceed drinking water guidelines. Until the vegetation recovers, which will take several years, the risk of this happening will remain, but with the risk reducing as the ground cover increases. To a large degree the catchments will recover naturally over the long term. In the short term, appropriate actions can be taken to accelerate recovery of the catchment.

Actions:

Continue research and analysis to gain a more accurate understanding of the likely impact of bushfires on water supply.

Stabilise and rehabilitate the fire-affected sections of the Cotter catchments where appropriate.

Complete installation of treatment facilities at the Mount Stromlo Water Treatment Plant, which will greatly reduce the risk of Cotter catchment water supplies being unavailable for use due to water quality problems.

3.3 Long-term climate change

The CSIRO has conducted some analysis into climate change projections for the ACT region based on global climate models. There are some uncertainties in projections and new

information continues to give us a better understanding of the possible impacts of climate change. The CSIRO's key findings into climate change were:

- **Temperature change:** Projections indicate that the mean annual temperature could increase by 0.4°C to 1.5°C by 2030 and about 1.0°C to 4.8°C by 2070. Increases in temperature will lead to changes in the frequency of extreme temperatures in the ACT region.
- **Rainfall change:** By 2030, projections for average annual rainfall range from an increase of 2% to a decrease of 9%, and by 2070 from an increase of 7% to a decrease of 29%. Models also indicate an increase in the frequency and intensity of extreme rainfall under climate change conditions.
- **Evaporation change:** By 2030, annual evaporation is projected to increase by 1.4% to 9.1%.
- **Temporal shift:** In the 1970s a sudden shift in climate saw run-off from water supply catchments in the southwest of Western Australia reduce significantly. It is possible that the climate in the ACT region could shift in a short period to a new state; also producing reduced run-off from our catchments.

These climate changes are inter-related. Increases in temperatures are likely to result in increased evaporation, meaning more water use. Even during wet years, the amount of run-off would be lower than expected as a result of higher evaporation associated with higher temperatures. Under these circumstances a 10 per cent reduction in rainfall and changing rainfall patterns could result in a reduction of run-off of up to 20 per cent into the dams. Monitoring of changes in run-off will continue into the future to assist water supply planning.

Action:

Planning for the ACT's water resources will continue to take account of future climate change predictions for the ACT.

3.4 The urban water cycle and water sensitive urban design

Many communities are now looking to only use water 'fit for purpose'. This is part of a concept called water sensitive urban design (WSUD), which can mean, for example, that a lower grade of water might be supplied for outdoor garden use or toilet flushing.

But WSUD is more than just water 'fit for purpose'—it is about managing the water cycle as a whole. WSUD involves designing and managing our mains water, sewer, stormwater and urban water bodies to imitate as closely as possible water behavior which existed before urban development. Among other things, this means encouraging stormwater to soak into the soil, using rainwater and stormwater in preference to mains water where suitable, using water as efficiently as possible, retaining run-off in the landscape as long as possible so it does not collect pollutants, and using wetlands to treat urban run-off which has become polluted. The more we adopt WSUD the less impact our urban living will have on our water resources, providing improved amenity and recreational opportunities. The WSUD concept is discussed in more detail in section 4.5.2.

Ultimately our success as water managers will be judged by how well we embrace the new,

smart management ideas in WSUD.

4 Water strategy objectives

Objectives for water resource management for the ACT are:

1. Provide a long-term, reliable source of water for the ACT and region
2. Increase the efficiency of water usage
3. Promote development and implementation of an integrated regional approach to ACT/New South Wales cross-border water supply and management
4. Protect the water quality in ACT rivers, lakes and aquifers, to maintain and enhance environmental, amenity, recreational and designated use values and to protect the health of people in the ACT and down river
5. Facilitate incorporation of water sensitive urban design (WSUD) principles into urban, commercial and industrial development
6. Promote and provide for community involvement and partnership in managing the ACT Water Resources Strategy.

The issues and challenges associated with these objectives are complex. So too are the options.

One of the biggest certainties at this point is that providing the ACT with a secure, reliable source of water for the long-term will require the active involvement of all sectors of the community, and personal responsibility, particularly by those of us who live in detached dwellings.

The options available are not just about more or different supplies of water, but also about being smarter, more resourceful and more conscious of how and when we use water. Thus innovative, educated approaches are essential, as is broad community understanding that water is not an infinite resource at the end of a tap.

Quite simply, our challenge is to put in place community-wide practices that deliver sustainable water resource management. We must change the way we manage water and design our cities, and we must also change how we, as a community, use this valuable resource.

How well we manage this change will determine our success as best practice water managers. Our success will be at least partly measured by whether we can make changes without harming the values we hold for Canberra as a Garden City and Bush Capital.

With no time to waste, certain targets have been set already. They have been set with the knowledge and experience of the community reducing mains water usage by 20 per cent per capita over the past 10 years. We have shown we can do it.

The targets

- A 12 per cent reduction in mains water usage per capita by 2013, and a 25 per cent reduction by 2023 (compared with 2003), achieved through water efficiency, sustainable water recycling and use of stormwater and rainwater.
- By 2013 increase the use of treated wastewater (reclaimed water) from 5 per cent to 20 per cent.
- The level of nutrients and sediments entering ACT waterways is no greater than from a well-managed rural landscape.
- Reduce the peak flow and volume of urban stormwater flows so the run-off event that occurs, on average once every 3 months, is no larger than it was prior to development.

Setting targets is the easy part.

So, how do we get there? What is the current situation? What are the issues, and the options?

There are a number of actions that will help us meet these targets; summarised at Appendix A. The Implementation Plan will be reviewed annually and revised as better ways to achieve the objectives are identified.

As 2013 approaches, more information will be available to decide how the longer-term target of a 25 per cent reduction on per capita water use by 2023 can be reached.

Whatever the future path chosen, it will require innovative approaches to catchment management, water supply and water use.

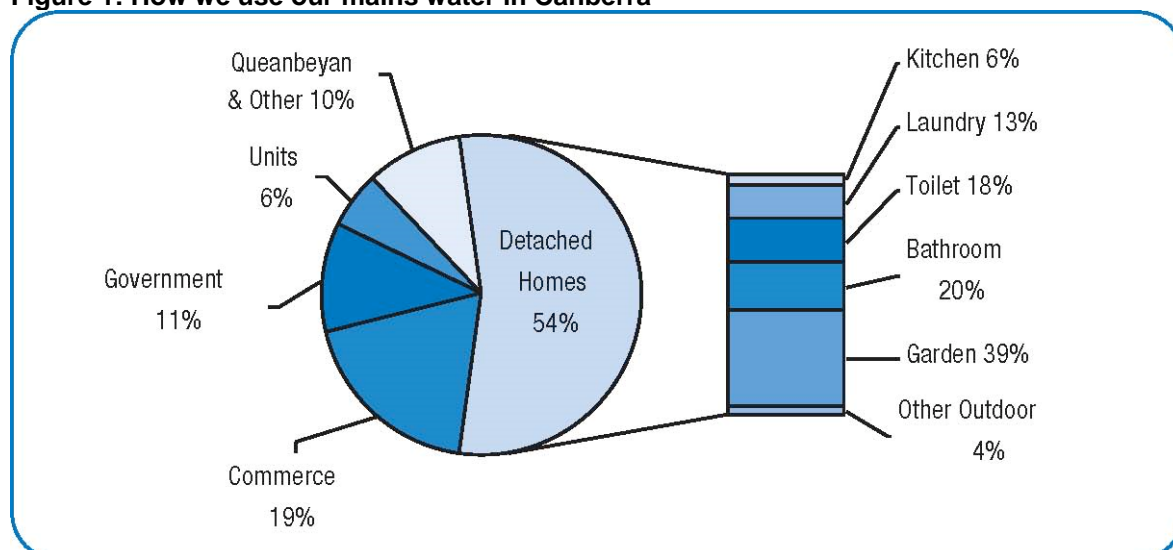
4.1 Provide a long-term, reliable source of water for the ACT and region

4.1.1 The current situation

Currently the ACT uses about 65 gigalitres (GL) of water a year. A gigalitre is 1 billion litres or 1,000 megalitres (an Olympic sized pool with an even depth of 2 metres contains 2 megalitres). This usage is out of approximately 494 GL of ACT-controlled water resources, 269 GL of which is dedicated to environmental flows.

Residents in detached houses use more than half of that amount. The use made by commercial users is mostly for workplaces but also for golf course watering and other irrigation. Of the water used by government users, nearly one third is used for irrigation of parks, playing fields and school grounds. Queanbeyan uses about 5 GL of the water in the 'Other' group in Figure 1.

Figure 1: How we use our mains water in Canberra



Source: Data from ACTEW

At this current level of use, combined with population forecasts and climate-change issues, the ACT's water supply will come under increasing pressure. The issues around water supply have been worsened by the severity of the recent drought and the January 2003 bushfires in the water catchments. Climate change may also result in reductions to dam inflows. While any reductions in water use—by either water efficiency measures, or by substituting mains use with other sources of water—will certainly help reduce the reliance on water supply, their overall effectiveness will need close monitoring.

If no action is taken now, based on the current population projections and per capita consumption, existing water supply infrastructure is expected to meet demand until we reach a population of about 405,000 people, anticipated around 2017. However, this expectation does not take uncertainties, such as reduced rainfall, reduced catchment yields as a result of bushfires, unexpected population growth, or any future decision to extend cross-border water supply, into account.

If (or when) we need an additional supply will depend on a combination of factors, in particular:

- how potential impacts (discussed in this section) affect the existing supply
- how well we implement water conservation measures (including use of reclaimed water).

Analysis of the likely combination of these effects will need to continue over the life of this Strategy.

No matter what the future holds, the ACT Government is committed to ensuring that all mains water users (government, commercial, institutional and residential) contribute equitably to the targets in ***Think water, act water.***

4.1.2 Water cap

The ACT has agreed to participate in the Murray–Darling Basin cap on water diversions. The underlying intention of the water cap is to limit the amount of water that can be taken from the rivers of the Murray–Darling Basin to the 1993–1994 level of development.

The ACT has indicated to other Basin jurisdictions that it will not agree to a cap based on historical use, such as those of New South Wales and Victoria. Instead, the ACT will seek agreement to a cap that recognises Canberra’s existing water rights while providing an appropriate level of protection for the Murray–Darling River system.

Action:

By December 2005: Aim to complete a Memorandum of Understanding with the New South Wales Government and the Commonwealth Government that will include provision for a water cap.

4.1.3 Water supply options for the future

Canberra’s per capita water consumption is 20 per cent less than it was in the early 1990s following changes to pricing, and education campaigns. While this reduction was being achieved, investigations had to continue into the options for major additional water supply. We are in a similar situation now. No matter what savings we achieve and what decisions we ultimately make about providing for a long-term, secure water supply for the ACT, studies need to be made into all forms of additional supply. This is, in part, because projects to analyse the merits of large-scale water supply options are so long-term and often complex. This requires substantial cost-benefit analysis and consultation—the cost of increasing the supply of water to the Territory is expected to be very high.

The section below addresses possible additional sources of supply. In examining options for the next major supply source, previously investigated schemes have been re-assessed and, along with some new options, each considered in the light of modern Canberra.

A three-stage approach was used.

- Stage 1: Preliminary investigation of nearly 30 possible options.
- Stage 2: Eleven options based on four water sources underwent more detailed analysis.
- Stage 3: Options identified for detailed evaluation. These are:
- building a new dam near Mount Tennent, south of Tharwa in the ACT
 - enlarging the existing Cotter Dam
 - transferring water from Tantangara Dam in New South Wales to Canberra via the Cotter catchment.
 - a range of smaller scale options, or options which focus on enhancing the operation of existing infrastructure. For example, use of the existing Cotter Dam once treatment facilities become available at Mount Stromlo.

The ACT Government, in partnership with ACTEW, will be undertaking a more detailed analysis of the relative merits of each option against the estimated supply requirements. This will include comprehensive analysis of the full social, environmental, economic and inter-jurisdictional implications of each option.

It is important to take account of uncertainties, such as climate change, bushfire impacts, higher population growth and the impact of water efficiency and reuse measures, so we better understand future supply needs and choose the best option at the right time.

While not pre-empting the outcome, there may also be potential for the review of environmental flows to lead to an enhanced supply capacity.

Option 1 Construction of a new dam at Mt Tennent

The Tennent Dam site is in the Naas valley on the Gudgenby River just south of Mount Tennent. It is identified in the National Capital Plan as a site for a future reservoir for water supply and associated recreation.

The dam would be constructed of an earth and rock fill embankment 76 metres high providing a water storage with a top water level of 655 metres and a storage capacity of 152 Gigalitres. It is anticipated that water from Tennent Dam would require full treatment as a result of the agricultural use of the catchment.

There are two ways to deliver Tennent water to consumers. One alternative involves a pump station at Tharwa, a balancing storage on the hill behind Banks, and a new water treatment plant on the hill behind Theodore.

To avoid the new treatment plant, a second alternative involves a 29 kilometre pipeline and a pumping station to connect the dam with the Mount Stromlo treatment facility.

Option 2 Enlarging existing Cotter Dam

The Cotter Dam could be enlarged in a variety of ways. One option that has been examined is building a roller-compacted concrete, gravity dam incorporating the old dam. It would have a height of 88 metres and a storage capacity of 76 Gigalitres.

The spillway for the new dam would be over the dam wall, in the same manner as the existing dam. The top water level of the stored water would be 550 metres, which is some 167 metres below the balance tank at Mount Stromlo. Water would be pumped from the new dam to Stromlo Water Treatment Plant in the same way it is now.

Some refurbishment of the Cotter pump station would be needed to meet the increased demand. A new pipe would be needed from the dam to the Cotter pump station but no new delivery lines would be needed from there to the Stromlo Water Treatment Plant. The water would need treatment at the new Stromlo filtration plant.

The National Capital Plan currently provides for the Lower Cotter sub-catchment to maintain water quality to at least existing conditions in the short term, with further consideration to be given to longer-term use.

Option 3 Transferring water from Tantangara Dam

The Tantangara option involves taking water from Tantangara Dam, in New South Wales, by tunnel and/or pipeline to the Cotter catchment.

Since the ACT does not currently hold rights or entitlements to water in Tantangara's catchment, it would be necessary to purchase entitlements held by water users in New South Wales, Victoria or South Australia.

The Tantangara option would involve purchasing the right to up to about 50 Gigalitres of water under the Murray–Darling Basin cap on water diversions. The following four alternatives to get Tantangara water into the Cotter catchment have been developed:

Alternative 1—water pumped through two pump stations and 30 km of pipeline across the Bimberi Range at Murray's Gap to discharge into the Cotter River upstream of Corin Dam.

Alternative 2—water flows down the Murrumbidgee River to a diversion weir, through a tunnel and discharges into Porcupine Creek, then into the Cotter River.

Alternative 3—water flows down the Murrumbidgee River to a diversion weir in the Yaouk Valley from where it is pumped up the valley, through a short tunnel and into Porcupine Creek. **Alternative 3a** is the alternative of pumping all the way to Corin Dam. This option has been costed as an alternative in all cases.

Alternative 4—using the same Yaouk Valley pipeline route as alternative 3, however this option also has a pipeline down the Murrumbidgee River, which would allow water to flow by gravity from Tantangara to Porcupine Creek.

In developing these options the following assumptions were made about the purchase and supply of water from Tantangara:

- The ACT would purchase a licence for 25 Gigalitres in 2017, and an additional 25 Gigalitres 25 years later at a 2003 price of \$1.5 million per Gigalitre. These volumes were selected to make them comparable to the volumes available in the other options.
- The ACT would pay use charges at \$28 per Megalitre each time it was required and would pay \$60 per Megalitre for foregone revenue in generating electricity. Any opportunities to sell water entitlement in years when it was not required for the ACT have not been costed.
- Significant inter-jurisdictional issues would need to be addressed, including New South Wales planning, cross-border water trading and construction of pipelines on New South Wales public and private lands.

Option 4 Smaller scale options including increased use of existing Cotter Dam

There are also some small scale options that could increase the water supply capacity, or alternative ways of using existing infrastructure, which can provide a valuable augmentation of our water supply. One example is use of the existing Cotter Dam with the completion of the Stromlo treatment plant. ACTEW is currently developing operating scenarios to incorporate the Cotter Dam into its supply network once the treatment facilities are available.

The raising of the Cotter Dam could be staged so that at a lower cost, there can be a smaller increase in the overall supply rather than building a larger dam at one time. Similarly, for the Tennent dam option, a weir could be constructed on the Gudgenby River in the first instance and water pumped in to the existing treatment plant, and then a smaller dam constructed with the final larger dam only being constructed when and if the need arose for the ultimate supply capacity. The economics of these dam staging options will need to be considered and compared to the cost of not staging.

Another option that could be considered is raising the Googong spillway with a “fuse plug”. This technique allows the reservoir storage to be increased without compromising the safety of the dam. Options also exist for a small increase in the height of Bendora dam. These options will generally be low cost, but deliver a very marginal gain in long term yield.

Actions:

By December 2004: A range of planning scenarios will be developed on the basis of information on climate change, bushfire impacts and population growth which will identify if and when a new water supply source would be needed and the demand to be supplied.

By December 2004: Provide recommendations on the more efficient use of the existing infrastructure, including the option to use Lower Cotter when the new water treatment is commissioned.

By March 2005: Provide recommendations on the options for a new water source for the ACT including the smaller scale options.

4.1.4 Groundwater

Groundwater resources in the ACT are small by comparison with other parts of Australia.

Groundwater use is allocated up to conservative limits for each sub-catchment included in the *Water Resources Management Plan* under the *Water Resources Act 1998*. No further allocations are made beyond the sub-catchment limits unless specific studies on a particular catchment show that allocations can be increased without environmental harm or impact on other users.

While there are circumstances where groundwater has replaced use from the urban water supply network and there may be scope for additional use in some areas, the quantity available is so small in relation to total demand that it cannot be considered as an alternative urban water supply source.

4.1.5 Stormwater reuse

Traditional urban stormwater systems have been designed to encourage rapid run-off and quick removal of run-off through pipes and concrete drains to lakes and ponds. Water is not allowed to pool on urban surfaces, there is less infiltration into the soil and evaporation is substantially reduced.

This means more water reaches rivers from urban catchments than would have under previous rural or natural conditions. In Canberra’s case, urban areas are thought to produce, on average, about 13 GL more run-off than the previous largely rural environment—a

significant impact. Additionally, stormwater contains a high level of pollutants, with nitrogen and phosphorus, salinity, and bacteria levels normally elevated in it.

Turning stormwater into a resource would not only reduce the impact of stormwater on downstream waters but also supplement mains water supply. This approach is integral to water sensitive urban design (see Section 4.5).

4.2 Increase the efficiency of water usage

Water use efficiency measures are the most effective means of extending the water supply to serve our population. The low relative cost of these measures is explained in more detail in Volume 2. To decide which water efficiency option to choose, we need to understand the cost effectiveness and other benefits and drawbacks of the options. As the Strategy is implemented, the ACT community will need to continue to examine the cost and benefits of these options to decide the priority of water efficiency, water reclamation and obtaining new water sources.

Actions:

The Government will implement Water Efficiency programs to improve the efficiency of water use in the house and garden. The programs will take account of those offered in New South Wales where savings of up to 10 per cent per household have been achieved. They will be reviewed and revised as necessary, but at least once per year.

The Government will establish a team to implement actions as part of **Think water, act water**. This team will administer water efficiency programs and communication and awareness programs, coordinate other strategy implementation activities, and provide advice to householders, industry and government.

4.2.1 Minimum performance standards and labelling

Australia is to develop a compulsory water efficiency labelling scheme. Australia's Environment Ministers agreed to this in May 2003 and expect the scheme to commence in mid to late 2005.

The proposals of the Water Services Association of Australia will be used as the basis for the scheme. It will allow the community to become aware of which appliances have poor water efficiency, based on the A to AAAAA rating system (triple AAA 'a high level of water efficiency' is considered the minimum ideal level). Compulsory labelling will also provide the opportunity to make regulations limiting the manufacture and sale of appliances of an inappropriately low level of water efficiency.

In the longer term, the ACT will promote agreement across Australian jurisdictions so that only efficient appliances, such as AAA showerheads and AAAA washing machines, are available for sale in the ACT and the rest of Australia. This type of approach recognises the need for a broad range of initiatives, so any savings generated from the **Think water, act water** strategy are maintained for the long term.

Actions:

The Government will support a national scheme for compulsory water efficient labeling of appliances.

The Government will provide information on water efficient appliances and their water saving benefits.

The Government will promote agreement across Australian jurisdictions so only water efficient appliances, such as AAA showerheads (by 2007) and AAAA washing machines (by 2010), are available for sale in the ACT and the rest of Australia.

4.2.2 Pricing to increase water use efficiency

The Independent Competition and Regulatory Commission (ICRC) recently reviewed ACTEW's pricing for water. The ACT Government encouraged the Independent Competition and Regulatory Commission to consider water pricing as a water use efficiency measure. The final report and price direction was released in March 2004.

In setting the new water pricing structure, the ICRC recognised two general types of demand for water. First, there is demand for cooking, cleaning, drinking and general hygiene. These activities have a number of wider public benefits, including those associated with the lower health costs arising from access to clean drinking water. Demand for this indoor use of water is generally considered to be non-discretionary, in that every person requires a certain amount of water irrespective of any external factor, including price. The second type of water demand is that used for recreational and business purposes. This includes water used to cultivate gardens, wash cars, fill swimming pools, and water golf courses. Demand for this water is generally considered discretionary.

The new pricing structure, which comes into effect on 1 July 2004, includes a fixed water supply charge and a three tier charging structure for water consumption. The fixed charge will be \$75.00 per annum. Water will cost \$0.50 per kilolitre for the first 100 kilolitres consumed, \$1.00 per kilolitre for the next 200 kilolitres, and \$1.35 per kilolitre for consumption above 300 kilolitres. The ICRC's three tier structure will result in a stronger incentive for Canberrans to reduce discretionary consumption in the top tier while at the same time not overly disadvantaging non-discretionary water use. This new structure provides a greater incentive to reduce water use, and gives customers greater control over their water bills. The tariff structure strengthens price signals to Canberrans and is consistent with general community expectations regarding price signals, water usage and the environment.

The ICRC is expecting that the change in the pricing structure will result in a decrease of between 5.2 percent and 9.4 percent in the amount of water consumed above 300 kilolitres per customer per annum. This results in potential savings over the medium term of 3.74 percent of total water consumed in the ACT. This will assist the Government move towards its target of 25 percent reduction by 2023. The ICRC's work has indicated there is a limit to the effectiveness of pricing as a demand management tool. In addition, significant price increases are not equitable and risk jurisdictional challenge as an unconstitutional excise duty.

4.2.3 Water efficiency in homes and businesses

Research, locally and elsewhere in Australia, revealed a variety of measures that could be put in place in homes and businesses throughout Canberra to help reduce consumption of water.

For residences, it is proposed that a range of measures be used to help meet the target water usage savings. Initially, our targets can best be met by an effective information and awareness program, suitable pricing of water and regulation that supports efficient water use. Another measure would be to provide subsidies on the following household water saving items:

- AAA showerheads
- water tune-ups
- dual flush toilets
- rainwater tanks
- watering equipment for garden use.

In 2003-04, experience with Stage 3 restrictions demonstrated that substantial savings can be achieved by changing practices outdoors—savings of up to 40 per cent are possible. An outdoor program will be developed taking into account experiences gathered from the Stage 3 restrictions.

Actions:

From 2004–05 the Government will offer a number of incentives to households, including:

- a rebate for AAA showerheads
- an incentive for a household indoor water tune-up, providing written advice on water efficiency, and the fitting of an AAA showerhead, up to two tap valves or flow regulators and up to two tap washers
- subsidising the cost to the household towards supply and fitting of an AAA rated 6/3 litre dual flush toilet in place of a single flush toilet
- an incentive for a garden tune-up, providing written advice on garden water efficiency and provision of products to save water
- a revised rainwater tank rebate program, which will include waiving development and plumbing approval fees to encourage installation of larger tanks; a scaled subsidy program for a greater range of tank sizes; and an additional subsidy for connection to a toilet or to a washing machine cold water tap.

The Government will investigate bulk buying arrangements to ensure that Canberrans can purchase rainwater tanks at the lowest price possible.

The Government will evaluate rebate programs annually and continue to investigate opportunities to redistribute rebate program funding to more beneficial programs in the future, as water efficient technologies evolve.

4.2.4 Government sector initiatives

The ACT Government will work closely with individual government sector water users to help them decide how to make the most effective savings. However, likely measures include installing water efficient appliances in public housing and other government owned buildings, more efficient irrigation of public open space, and changed procurement guidelines to ensure all government rented facilities are water efficient in the future.

Already underway is an ACT Government schools program that involves changing to water efficient toilets and taps. Plans are being developed for more efficient, multiple use of irrigated sports grounds and pools. CSIRO has done a preliminary study to determine if the software that operates our already highly efficient computerised irrigation systems can be better used.

The Commonwealth Government is a significant water user in Canberra and the ACT Government will seek the Commonwealth Government's cooperation to initiate similar programs to achieve the 12 per cent water savings target in the federal sector.

The ACT Government is a sizeable housing owner in the ACT, with 9 per cent of housing stock. It will put in place a program to make public housing as water efficient as possible.

Action:

In 2004–05: Programs will be developed by the Water Efficiency team working with government water users. The proposed programs will initially focus on:

- updating government procurement practices to encourage greater water efficiency
- continuing development of the schools program
- improving irrigation practices used for sports and recreation facilities.

4.2.5 Commercial and institutional sector initiatives

The ACT Government will be working closely with the commercial sector in Canberra to identify savings and to help ensure this sector obtains best practice.

This sector has expended considerable effort to identify water savings needed for the current restrictions. This includes internal efficiency measures and external water reduction, such as improving automatic sprinkler efficiency, reducing external building and window washing and capturing irrigation run-off for reuse. However, there are still opportunities for long-term savings from more intensive water use efficiency initiatives.

The ACT Government will assess the options for water efficiency programs and related funding requirements in the commercial and institutional sector over the next year in order to provide a detailed strategy for water use reduction.

4.2.6 High water users

The top 150 commercial, government and institutional users in the ACT use about 8 GL of water each year (just less than half of the use for these sectors). Initial efforts to reduce water use will concentrate on working closely with these high volume users to identify possible water efficiencies. In future years, the Government will ask other water users in these sectors to identify where they can make savings and will encourage them to put in place best practice

management as soon as is practicable to help achieve the efficiencies needed.

In the residential sector it is also possible to identify high water users that are potentially using water inefficiently and to use this information in conjunction with self-nomination when selecting candidates for water tune-ups.

Action:

In 2004–05: The Water Efficiency team will work with commercial and institutional water users to develop water saving programs. Programs will focus on large institutional and commercial premises, such as hospitals, universities and shopping centers. Increasing water efficiency in office buildings will also be important.

4.2.7 Regulations

In addition to these water saving measures, consideration needs to be given to regulations that support long-term water conservation without undue restriction. Experience from other regions, for example Geelong in Victoria, together with research of ACT water consumers and input from the ACT Water Summit (2003), indicates that opportunities exist to put in place more effective water use practices at all times of the year. It may also be appropriate to modify aspects of the plumbing code to ensure that opportunities for rainwater use and greywater use are available.

The Government will initiate changes to regulations and plumbing practice notes to ensure efficient water use around our homes.

Actions:

In 2004: After further community consultation, permanent water conservation measures will be introduced to:

- restrict the watering of lawns and gardens to morning and evening hours
- ban hosing of hard surfaces including driveways and windows
- control the use of sprinklers for dust suppression
- introduce compulsory use of trigger hoses for car washing.

In 2004: New plumbing practice notes will be introduced to:

- require separation, in new houses, of washing machine and bathroom drainage from the remainder of the wastewater system to enable future reuse
- require separation, in new houses, of the water supply to toilets and washing machines to enable future rainwater use.

4.2.8 Sustainable use of reclaimed water

Reclaimed water includes effluent that has passed through a treatment process and has been reticulated to users, and domestic greywater used for garden irrigation or other purposes. The ACT has the target of increasing the use of reclaimed water to 20 per cent by 2013. Achieving this reuse target will also help achieve the water reduction targets and bring a range of other

benefits, such as:

- protecting public assets (for example, sports grounds and parks) during droughts as reclaimed water would not normally be subject to restrictions
- reducing pollutant impacts by reducing effluent discharges to rivers
- reducing flow related impacts of effluent discharges
- reducing the impact of unforeseen system failures by developing a more diversified water supply system
- savings on household water bills where simple on-site use of reclaimed water replaces potable water use
- promotion of water efficiency in other areas through education and awareness.

The average volume of sewage collected in the ACT (from Canberra and Queanbeyan) potentially available for reuse is 35 GL per year. Current reuse in the ACT is around 1.85 GL per year (5.6 per cent of total volume of effluent discharged). While increasing reuse to the target of 20 per cent in only 9 years is recognised as very challenging, the target will provide impetus for development of sustainable solutions.

There is a range of options that can be considered for reclaimed water reuse, including small-scale initiatives of individual residents, recovery of water in industry and commercial developments, and development of water reuse infrastructure in new and existing urban areas. Certain initiatives are already planned. For instance, an existing scheme in North Canberra is to be expanded in 2004. This will increase water reclaimed to just over 7 per cent. Further expansion of the North Canberra scheme into South Canberra, particularly the Parliamentary Triangle is also being considered, but the cost is high, estimated to be at least \$23 million for an additional 500 ML per year of reclaimed water.

On-site water reuse can also contribute to the water consumption reduction target. Household surveys have indicated that up to 40 per cent of households reuse greywater during the 2003 summer period. With an increased awareness of reuse benefits combined with emerging technologies, domestic reuse may make a significant contribution to our water consumption reduction target in the future. Appropriate controls are needed which foster reuse without compromising public health. ACT Health is currently undertaking a health risk assessment of greywater systems. The outcome of this work will determine policy development on this issue and ultimately inform longer-term approaches to greywater reuse in the ACT.

There is a need for more detailed analysis and understanding of the use of reclaimed water when designing and developing new areas of urban settlement and in redeveloping existing areas of the city. The *Spatial Plan* identifies development of the Molonglo valley. Innovative solutions will be needed to take advantage of reclaimed water from the nearby Lower Molonglo Water Quality Control Centre. Any form of reuse would require extensive consultation with affected communities. It is known that some schemes have not come to realisation due to lack of community acceptance. The broad-scale opportunities for using reclaimed water can be very costly and require individual proposal assessment. Existing water pricing arrangements do not take account of water reuse opportunities or reflect capital investment requirements.

Preliminary work indicates that further research will be needed to find more innovative and less expensive ways to meet the reuse target. In striving for this challenging target, the Government recognises it will need to carefully consider the cost effectiveness, health and environmental implications of reuse proposals. There will need to be full support for innovative recycling methods from local industry and commerce, and the Commonwealth Government, as a major landholder and water user. There could be opportunities for on-site recycling schemes at individual offices and major employment nodes.

Actions:

By September 2004: The Government will develop guidelines for use of domestic greywater and include information in community awareness programs.

The Government will undertake an investigation of the potential for sustainable use of reclaimed water, taking into consideration cost-effectiveness, environmental, social and health issues. The analysis will take into account the Government's commitment to the water efficiency and reuse targets, to water sensitive urban design and to protection of water quality downstream of the ACT. Outcomes from this investigation may be adopted through such mechanisms as changes to urban design or modification to licensing of discharges from point sources.

By April 2004: Progress implementation of Stage 2 of the North Canberra Effluent Reuse Scheme as appropriate.

The Government will require any building the Government builds or procures for its use to incorporate features to maximise efficiency of water use and to reduce the demand on mains water through use of alternative supplies such as stormwater, rainwater and reclaimed water.

The Government will support some of Australia's leading Canberra-based research organisations in working with the ACT community to find cost effective, innovative, sustainable solutions for reclaimed water use while protecting public health.

4.2.9 Reducing water use by 2023

For the longer-term target, much will be dependent on what water use efficiencies can be achieved over the next 10 years. The program of measures will be reviewed annually and revised if better ways to achieve efficiencies are identified.

As the end of the 10-year period approaches, more information will be available to decide how to meet the longer-term 25 per cent target.

4.3 Promote development and implementation of an integrated regional approach to ACT/New South Wales cross-border water supply and management

4.3.1 The current situation

Water was one of the key determinants for the siting of the National Capital. The agreement, and corresponding legislation, between the Commonwealth and New South Wales governments that established the ACT, set in law the Commonwealth's paramount rights to the waters of the Queanbeyan and Molonglo rivers for all the purposes of the ACT. The ACT now exercises this right on behalf of the Commonwealth in regard to the water which flows

into Googong Dam on the Queanbeyan River. This provides the ACT with significant control over much of the water resources for urban water supply in the region, and an interest in a number of sub-catchments that straddle the ACT border. Part of this role involves the ACT supplying Queanbeyan City Council with high quality water for the residents of Queanbeyan. Commonwealth–New South Wales Government agreements restrict this supply to the existing Queanbeyan developments and the adjacent Yarrowlumla estates of Ridgeway and Weetalabah. In total, the ACT now supplies water for approximately 35,000 people in Queanbeyan and Yarrowlumla. Proposals exist for significant developments at Googong and Tralee, which are near the Queanbeyan/Yarrowlumla border. New South Wales local government boundaries have also been changed recently which has resulted in the expansion of Queanbeyan boundaries. It is timely to consider if and on what basis the ACT would provide water supplies to support new developments in New South Wales (including Queanbeyan).

4.3.2 Integrated water supply strategy

The ACT Government is committed to working with NSW and the Commonwealth in developing the integrated water supply strategy (IWSS)—a strategy for provision of ACT water to surrounding regions in NSW undergoing development. The IWSS will be consistent with The Canberra Plan, and developed in consultation with Commonwealth, NSW and relevant local authorities. The IWSS is based on:

- sustainability principles as expressed in the ACT sustainability policy—*People, Place, Prosperity*
- an agreed regional settlement strategy that includes a best practice approach to water quality protection and provision of environmental flows
- the 1994–95 Council of Australian Governments' water reforms discussed in Volume 2
- an agreed ACT water cap
- full-cost user pays pricing, including provision for infrastructure and environmental costs
- protecting and securing the yield from water supply catchments and flows in regional streams
- agreed targets for water use efficiency and reuse.
- best practice demand management and water restrictions
- ACT water supply security, with ACT residents not being disadvantaged in comparison with New South Wales residents.

Development of the IWSS is seen as a necessity before water from the ACT water supply catchments can be supplied to any additional areas outside the ACT. The strategy will deal with how we share our water resources across the border and be consistent with the approaches promoted by **Think water, act water**, particularly in regard to security of supply and catchment management issues.

Action:

The Government will take a lead role in developing the integrated water supply strategy. Government expects to negotiate this strategy with the NSW and Commonwealth Governments before the end of 2004.

4.3.3 Catchment management

Risk management in the Cotter and Googong water supply catchments is more important than ever—this has been brought home most strongly given the combination of severe drought and the January 2003 bushfires.

Before the bushfires, the Cotter catchment provided high quality drinking water requiring minimal treatment. However, ash and sediment has washed into the dams, necessitating new infrastructure for water filtration and treatment. Further erosion of waterways, limitation of knowledge of the impact on water storage bogs, regrowth and the changing nature of vegetation all add to unprecedented uncertainty and the need for more careful attention to catchment management. Reliance upon Googong catchment as the ACT's principal water supply catchment has also focused attention on land management practices in the New South Wales catchment. There is concern as to whether climate change, rural residential developments and catchment management practices have affected water quality and reduced the yield of the Googong catchment.

Different catchment management issues occur in other cross-border catchments, such as Molonglo and Jerrabomberra. Differing standards on each side of the border and differences in management systems are just two of the issues that may impact on these catchments. Catchments wholly within the ACT are affected by sub-optimal coordination and the need to balance different management responsibilities. Improved catchment management needs to be a condition of water supply to Queanbeyan. The Government has started discussions with the NSW Government on catchment management and agreement on catchment protection will be an important part of the negotiation of an Integrated Water Supply Strategy with NSW and the Commonwealth.

Catchment management can be improved by clarifying management objectives and the role of the various land managers, and by ensuring that agreed management activities are planned, undertaken and evaluated. This coordination role will be even more important with the challenges that arise from the impacts of the bushfires.

Three important principles need to be part of any solution:

- any arrangement should have a statutory base
- a formal and detailed catchment management framework is needed to guide activity on each different type of catchment
- a formal, transparent review process is needed to ensure performance.

The ACT Government will meet these new challenges by formalising catchment management arrangements to achieve the highest level of coordinated outcomes.

Action:

By 2004: The Government will formalise catchment management arrangements to ensure better directed, more coordinated outcomes and to better protect our water supplies.

4.3.4 Local area catchment management

Significant gains for the environment have been obtained through teamwork and partnership by local communities at the sub-catchment level. Examples of this include catchment-wide willow removal in the Ginninderra catchment and the wetland project in Sullivan's Creek. Both succeeded through a combination of community effort and ownership, supported by government resources.

Similar sub-catchment management plans are seen as essential for coordinating natural resource management throughout the ACT. The plans are a way to bring together community groups that may have previously been working in isolation or focusing on a single issue, and coordinating their efforts with that of government. Community groups and government work together on a shared goal for their local sub-catchment. Issues are prioritised and there is more efficient use of resources and on-the-ground action. Although the community owns the plans, they are developed in association with government.

Action:

The Government will recognise the role of sub-catchment plans by formalising a process to use the plans as input into the Government's Capital Works Program and management decisions.

4.4 Protect water quality in ACT rivers, lakes and aquifers, to maintain and enhance environmental, amenity, recreational and designated use values and to protect the health of people in the ACT and down river

4.4.1 ACT water quality

The ACT does not have heavy industry or many of the other activities that impact on water quality in other places in Australia. On the other hand, as Australia's largest inland population centre, and with our position in the Murray–Darling Basin, we need to carefully consider the impact of our activities on water quality.

In the ACT, potential impacts on water quality include erosion from building and development, urban stormwater pollution, effluent discharges, hydrocarbon pollution, erosion from agriculture and forestry, and pollution from poor management of pesticides and other chemicals.

The current approach taken to protect ACT waters has drawn on the framework established by the National Water Quality Management Strategy 1992. This framework provides the basis for catchment specific management policies to achieve agreed environmental and social outcomes.

Components of the ACT water quality framework are:

- identification of ecologically sustainable development (ESD) based management principles

- a clearly stated set of environmental values for water resources
- understanding of the links between human activity and environmental quality
- unambiguous goals for management, such as the water quality standards specified in the Environment Protection Regulations (1997)
- effective management policies including cooperative, regulatory, feedback and auditing mechanisms.

This strategy is one of the reasons the ACT's water quality is generally good. The water quality of the Murrumbidgee entering the ACT at Angle Crossing and leaving at Halls Crossing both meets the standards, we still have some way to go before we can say we have no effect on water quality.

Another key component of our system for maintenance of water quality in our streams, rivers and lakes is the riparian zone. This is a strip of vegetation along the margins of all our water bodies that protects stream banks, filters water running into the stream and is important wildlife habitat. Riparian zones in the ACT need to be protected and rehabilitated in a more coordinated manner to assist achievement of the water quality objectives.

Actions:

The Government will continue environmental and health water quality protection programs, working with the community to meet the aim of the same or better quality for water leaving the ACT as that entering.

The Government will require that management of riparian zones in the ACT be consistent with the Riparian Zone Management Plan in Volume 2 of ***Think water, act water***.

4.4.2 Environmental flow

The *Environmental Flow Guidelines* under the *Water Resources Act 1998* are the basis for calculating environmental flows in ACT controlled waters. Up to about 41 GL, or 23 per cent of total flow, is passed through our water supply dams as environmental flows. These flows are important for the health of aquatic ecosystems downstream of the dams.

For non water supply sub-catchments an average of about 82 per cent of flows are set aside for environmental flows. This is because there is less need to store this water for our use and we can take a more precautionary approach.

The current level of environmental flows was determined in 1999 by a panel of scientific experts, using information available at the time, to decide how to balance the needs of humans as water users with the needs of the environment. The Cooperative Research Centre for Freshwater Ecology is currently undertaking a significant scientific study in the Cotter catchment. The results of this study and other relevant information will form the basis for a review of the *Environmental Flow Guidelines*.

Action

In 2004: Using the new scientific knowledge gained since 1999, the Government will review the *Environmental Flow Guidelines*.

4.4.3 Resource management framework

The ACT's water resource management goal is to implement best practice water resource management strategies. In many ways our regional neighbours share this desire. Impacts on water resources do not stop at borders and it is important that the goal of best practice management is shared across the ACT region or it will never be realised.

Action:

The Government will seek the agreement of the New South Wales Government and regional local councils to adopt best practice principles as the basis for water resource management generally.

4.4.4 Adaptive management and monitoring

We need to manage our water resources in an environment of changing physical conditions, information, active community participation, and often incomplete knowledge of the systems. Adaptive management techniques have been evolved for resource management in such a situation. It can be defined as '*a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs*'. These techniques are being used to effectively manage the ACT's water resources.

A key component in the effective management of our water resources is information on their condition and on the factors impacting on that condition. Adaptive management can then follow an iterative process in which we improve the way we manage water resources based on additional monitoring information.

Actions:

The Government will undertake a review of water resource monitoring to:

- identify and communicate clear objectives for each monitoring program
- identify common data interests and objectives of monitoring programs to facilitate synergies
- ensure the monitoring objectives are the basis for design of monitoring programs
- undertake the review as a collaboration between agencies and the community.

The Government recognises the importance of continuous reassessment and improvement in the sustainable management of water resources for the future. It will also use adaptive management to ensure best practice management of the ACT's water resources.

4.5 Facilitate incorporation of water sensitive urban design principles into urban, commercial and industrial development

4.5.1 Looking to the future

A major aim of this Strategy is to include the wider ACT community in its development and subsequent implementation.

There are two major, direct ways that the community can take a lead:

- through water sensitive urban design (WSUD) initiatives that can start in the home, local communities and local businesses
- through a range of other actions, assist people to be more widely informed about the issues the Territory is facing with water as a resource.

These two areas of direct community involvement are closely related—people need to understand the benefits through information and awareness, in order to make the kind of changes that water sensitive urban design is based upon. The response of the community will be fundamental to the long-term success of ***Think water, act water.***

4.5.2 Water sensitive urban design

When we build and expand our cities and towns, we significantly modify the natural water cycle. There is a dramatic increase in stormwater run-off and associated pollutants, causing serious degradation of our natural river systems. We import water from our water supply catchments and we discharge wastewater through the sewerage system back into our rivers. There is now much attention on how we might better manage water in our urban environments. Such an approach is known as water sensitive urban design (WSUD). WSUD seeks to provide a more sustainable approach to the management of the total water cycle within the urban environment and has the three main objectives of:

- reducing reliance on the town water supply system
- optimising opportunities for reuse of water (treated sewage effluent and greywater) and stormwater
- reducing the export of stormwater run-off and associated pollutants to pre-development levels.

In addition to these water-focused outcomes, WSUD aims to protect or enhance other social, amenity and design values traditionally accommodated in the planning process.

Benefits of applying WSUD include:

- more efficient use of available water resources
- reduced changes to the natural hydrological cycle
- improved water quality
- improved visual and landscape amenity
- more effective use of built and open landscapes
- improved ecological outcomes, including riparian quality and wildlife habitat protection (both on-site and downstream)
- more marketable urban developments.

In the 1970s, Canberra pioneered introduction of water quality measures into the stormwater drainage system. This resulted in the successful network of lakes, ponds, wetlands, gross

pollutant traps and, more recently, retention of natural streams which now form an integral part of the Canberra urban drainage system, protecting the quality of flows to the Murrumbidgee River. This work placed Canberra at the forefront of world best practice in terms of urban stormwater management. This approach not only achieves water quality objectives, but also treats water and waterways as valuable assets, enhancing the local environment and providing passive recreation opportunities. The practice of installing ponds and wetlands to intercept flows from all new urban development continues as standard practice in the ACT. The only areas of Canberra that currently do not have water quality ponds or lakes to intercept stormwater run-off are Woden, Weston Creek and the western areas of Belconnen.

As part of its commitment to applying sustainable urban development, the ACT Government will implement WSUD, building on the achievements to date in stormwater management. WSUD principles will also be applied within sub-catchments and will be broadened to encompass management of the total urban water cycle. This will include application of WSUD both within the public realm and within individual leases.

WSUD can be applied in greenfield developments and within established areas, although the range of techniques that can be used in established areas is limited by the higher cost of retrofitting or other constraints, such as the space available.

One of the significant impacts of urban development is a dramatic increase in the level of stormwater run-off. The two main reasons for this are:

- roofs and other impervious areas, such as roads and paths, prevent rainwater from infiltrating into the underlying soil
- the stormwater system, consisting of underground pipes and lined channels, collects and discharges stormwater far more quickly than it would have been discharged from an undeveloped catchment.

The increased rate of run-off results in greater mobilisation of sediment and pollutants, causing deterioration in downstream water quality. The increased frequency of flow pulses also means the natural biota in our river systems have less chance to recover between flushes. The increase in run-off is more pronounced for the smaller more frequent storms than it is for the larger less frequent storms. Due to the frequency of smaller storms, they collectively represent the highest proportion of the total volume of run-off. By implementing measures to reduce the run-off from a one-in-three-month storm to pre-development levels, there will be a significant reduction in the deleterious effects of stormwater run-off.

City scale

There are opportunities for WSUD initiatives in public space that enable reuse of water, reduction in mains water use and improvement in the quality of stormwater run-off. Already there are examples of such initiatives locally. They include treating sewage in small plants closer to the city, as at Southwell Park, so reclaimed water can be used more readily; and reticulation of reclaimed water from sewage plants to irrigate public space (such as, Duntroon's use of reclaimed water from Fyshwick Sewage Treatment Plant, which is currently being extended through North Canberra); or back to individual houses for garden use.

Neighbourhood scale

At the neighbourhood level there is potential for different design layouts that facilitate local use of stormwater and reclaimed water. Within streets, swale drains (shallow grassed channels) can be used in place of roadside kerb and gutter. These techniques are beginning to be used in Canberra, for example near the Gungahlin Town Centre. Wetlands, such as at David Street in O'Connor, can be constructed to intercept and treat polluted stormwater through natural processes.

Block scale

On house blocks there are many opportunities to apply WSUD. Some of the more appropriate measures for adoption in Canberra are the in-house water use efficiency measures (such as water-efficient shower heads and washing machines), gardens that provide amenity with minimum water use and use rainwater tanks to reduce the stormwater run-off and demand on mains water. Ideas for water efficient gardens can be seen at ActewAGL's Xeriscape Garden in Weston. The size of impervious areas like driveways and patios can be reduced to increase water seepage into the soil. Detention trenches can be used to detain stormwater that slowly flows into the stormwater system or infiltrates into the soil.

Implementation of water sensitive urban design

Implementing WSUD will involve all sectors of our community. It will change the way our suburbs look. Stormwater, mains water supply, and sewerage systems will all need to operate differently. It will affect the way our houses and workplaces are built and how we use water in them. Information will need to be provided across the community.

At the heart of these changes will be the way we plan, design and build our city for the future. For a successful adoption, WSUD principles need to be integrated with other planning requirements across all spatial scales: block, neighbourhood and city.

Implementation of WSUD will be achieved by:

- incorporating measures to improve stormwater run-off quality in all new developments and significant redevelopments
- incorporating measures to reduce consumption of mains water in all new developments and significant redevelopments
- seeking opportunities to incorporate effluent reuse schemes into new development areas
- providing guidance to designers and developers on appropriate approaches to incorporating WSUD
- seeking opportunities to incorporate WSUD into existing developments, through community, industry and government partnerships
- providing guidance to builders and homeowners on appropriate approaches to WSUD within individual leases (for example, rainwater tanks, greywater reuse, landscaping measures and water efficient fixtures and appliances).

Action:

The Government will seek the advice of the ACT Planning and Land Council on best practice implementation of WSUD.

Voluntary developer contributions to water sensitive urban design

Reducing a new development's contribution to stormwater flows is a requirement of the development approval system. For some developments, particularly multi-dwelling developments, this is achieved by construction of a stormwater retention tank, usually underground. This is costly and the outcome only meets this objective without gaining added benefit, such as reusing the water for irrigation as is possible on larger sites.

On such sites it would be sensible to permit the developer to volunteer to contribute the cost of the stormwater retention tank to a different project that would deliver the added benefits. This could be an urban wetland in the same sub-catchment as the development. Approving off-site works to achieve WSUD should not be needed routinely. It should only be made available for large developments on small sites where there is limited space to implement on-site measures.

Action:

The Government will develop a scheme so that, in some circumstances, developers can contribute to off-site works to meet their WSUD obligations.

Water sensitive urban design on greenfield sites and large-scale redevelopments

New water management measures are more easily implemented on greenfield development sites and large-scale redevelopments. They do not share the problem for other sites where existing infrastructure needs to be replaced or modified to put new water management measures in place. It is reasonable to expect that such developments will have water-efficient appliances, more use of alternative water sources, water-efficient landscaping and other measures.

Actions:

In consultation with industry, the Government will require that best practice cost effective WSUD measures are used in the construction of all new greenfield developments, large-scale redevelopments and capital works projects.

By June 2005: The Government will develop guidelines for applying WSUD.

Water sensitive urban design in existing suburbs and small scale redevelopment

Where redevelopment projects occur, particularly on a larger scale, there is an opportunity to incorporate significant WSUD measures. Multi-dwelling sites, in particular, offer an opportunity to apply WSUD stormwater control measures. There are also many opportunities to install WSUD measures in existing homes. Within the home, water-efficient fixtures and appliances, such as low-flow showerheads and dual flush toilet units, can be installed. Where sufficient space is available, rainwater tanks can be installed. Rainwater tanks not only provide an alternative water source, but also help reduce the level of stormwater run-off, thereby reducing the negative impact on downstream waterways. Gardens can be redesigned to reduce lawn areas, to use mulch and introduce drought tolerant plants.

Actions:

In consultation with industry, the Government will require best practice WSUD cost effective measures to be used in construction of all residential redevelopments and dual occupancies.

The Government will develop advisory material to provide practical advice to builders and homeowners on appropriate approaches to WSUD with individual leases (for example, rainwater tanks, greywater reuse, landscaping measures, use of water-efficient fixtures and appliances).

The Government will seek opportunities to retrofit WSUD measures into developed areas where such measures currently do not exist.

4.5.3 Encouraging innovation

If Canberra aspires to again set the standard, and to benefit from the increased urban and rural amenity that results from good water management, we will need to be innovative and develop new systems and products.

Government, industry, and the education and scientific communities in the ACT will need to work together as partners to improve efficient use of water in existing suburbs and develop water sensitive urban design in new subdivisions. As an example, the ACT Government is a partner with the Cooperative Research Centre for Freshwater Ecology and is currently working with that group on WSUD and environmental flows research.

Our history as an urban water management leader suggests that, if we work together, we have the skills and capacity to develop the new ideas needed. History has also demonstrated that being recognised as a leader in water management creates opportunities for Canberra businesses.

A strong innovation and research program will be needed which extends the work already done to establish Canberra's lake, pond and floodway system as a standard copied around the world. Extending this work to other aspects of water management will be an important element in building our capacity to perform as a water resource management leader. To be effective this will require the demonstration of innovative ideas as part of new development, redevelopment and day-to-day living.

Action:

By the end of 2004: The Government will investigate the feasibility of establishing a fund to encourage innovation in water management. Complementary funding from the Commonwealth Government's Natural Heritage Trust and National Action Plan on Salinity and Water Quality and private industry partners will be sought.

4.6 Promote and provide for community involvement and partnership in the management of the ACT Water Resources Strategy

4.6.1 Community consultation during development of the strategy

During development of this Strategy a variety of approaches were used to involve and inform people including:

- a Community Reference Group (ACT Council of Social Services, Communities at

Work, ACT Multicultural Council, Minister's Youth Council, Conservation Council of South East Region and Canberra, Rural Lessees Association, and the Property Council of Australia) which provided access to their networks

- focus groups
- presentations at community, business and industry group meetings
- a community summit on water
- displays about water issues at public events
- web site access to information about the Strategy
- email access to help the community submit views about what should be addressed in the Strategy
- the Urban Services' Quarterly Community Survey sought community views on water issues.

The Draft Strategy ***Think water, act water*** was circulated for public comment from 21 November 2003 until 16 February 2004. During this period, two community meetings were held to provide opportunities for the public to discuss the draft strategy.

4.6.2 Information, awareness and community involvement programs

The drought and water restrictions have demonstrated the level of community interest in obtaining information about water resources. If this interest can be maintained, the behavioural change needed from the general community, business, industry and government to meet the targets in this Strategy is possible. Without a partnership with the community, these targets will be unachievable.

An effective community partnership program will include a multi-faceted education and awareness campaign, providing information, tools, skills and participatory learning opportunities through programs for:

- the general community
- schools
- business and industry
- government and institutions.

Everyone can make significant contributions to water conservation programs as a result of their previous experiences. Therefore, it will be important that people from different cultural backgrounds have an opportunity to be involved. Information and awareness programs will need to communicate with people for whom English is not their first language.

Heightened awareness of the need for water saving measures will be essential. Evidence shows that awareness raising programs, if undertaken with sufficient resources and emphasis can deliver water savings of about 5 per cent over a period of several years. An effective

education and awareness program will need to incorporate:

- a media campaign incorporating seasonal newspaper features, television advertisements, a bus-back campaign, and radio advertisements
- a range of informational resources such as new brochures and fact sheets
- displays at nurseries, hardware stores, and community events
- participatory programs including demonstration site visits, hands-on workshops (e.g. water wise garden design; water audit), water conservation kits and community projects
- programs, such as 'water wise' Schools (leading to a Sustainable Schools program), incorporating teacher resources, professional development and an awards program
- business- and government-specific programs such as, water wise accreditation and water wise awards
- promotional products, such as posters, fridge magnets, mirror/shower stickers, water bottles
- an effective program for the Indigenous community and people from non-English speaking backgrounds
- a separate water web site with more extensive information, interactive tools such as an audit kit and water use calculators, online surveys, and competitions.

Action:

From 2004–05: The Government will implement an Information and Awareness Program to help meet the ACT's water resources management Goal and Objectives, particularly to improve the efficiency of urban water use. The aim of the program is to achieve continual, long-term savings in the community and the effectiveness of the program will be reviewed annually.

Community groups have indicated they are ready and willing to engage in activities to educate and involve the community in community-based projects around sustainable water use and management.

Actions:

The Government will support community involvement and partnerships by:

- developing a community oriented learning and action package which can be tailored by various groups, based on what is relevant for their needs
- working with the community to develop initiatives that will support groups to undertake development and delivery of community water learning projects.

5 Implementation and review process

Water resource management is a complex process with continuously developing knowledge. This means that a robust review process will be as important as the existence and implementation of an agreed policy.

Think water, act water establishes the framework by which we can manage water resources into the future, but external factors, such as actual population growth patterns and climate change, will almost certainly mean some specific elements of the Strategy will need to be changed within a decade. Likewise, developments within the science of water resource management (for example, more accurate flow monitoring or better information about how consumers react to water efficiency incentive programs) will also make refinements necessary.

Implementation of **Think water, act water** will need to be a continuing process involving policy review, refinement in the light of new or better knowledge, and assessment of management effectiveness.

The impetus will need to be maintained over time, with performance and directions subject to review. The ACT community also needs to be aware of progress, issues and achievements.

Environment ACT publishes a report on the state of ACT water resources called the *ACT Water Report*. This report will be expanded to incorporate a reporting mechanism on implementation of the water resources strategy.

Action:

Annually: To provide an independent check on the effectiveness of the implementation of **Think water, act water**, progress will be reported in the *ACT Water Report*.

6 APPENDIX A *Think water, act water* implementation plan

What	Action	Principal Policy Responsibility	See Section
Water planning variables			
Bushfire impacts	Continue research and analysis to gain a more accurate understanding of the likely impact of bushfires on water supply.	ACTEW	3.2
	Complete the installation of treatment facilities at the Mount Stromlo Water Treatment Plant.		
	Stabilise and rehabilitate the fire-affected sections of the Cotter catchments where appropriate.	DUS	3.2
Climate change	Planning for the ACT's water resources will continue to take account of future climate change predictions for the ACT.	ACTEW	3.3
Objective 1: Provide a long-term, reliable source of water for the ACT and region.			
Water cap	By December 2005, aim to complete an MOU with the NSW and the Commonwealth governments that will include provision for a water cap.	CMD	4.1.2
Water supply augmentation	By December 2004, a range of planning scenarios will be developed on the basis of information on climate change, bushfire impacts and population growth which will help identify when a new water supply source would be needed and the demand to be supplied.	CMD/ACTEW	4.1.3
	By December 2004: Provide recommendations on the more efficient use of the existing infrastructure, including the option to use Lower Cotter when the new water treatment is commissioned.		
	By March 2005, provide recommendations on the options for a new water source for the ACT including the smaller scale options.		
Objective 2: Increase the efficiency of water usage			
Mandatory labelling	The Government will support a national scheme for compulsory water efficient labelling of appliances.	DUS	4.2.1
	The Government will provide information on water efficient appliances and their water saving benefits		
Minimum performance standards	The Government will promote agreement across Australian jurisdictions so that only water efficient appliances, such as AAA showerheads (by 2007) and AAAA washing machines (by 2010) are available for sale in the ACT and the rest of Australia.	DUS	4.2.1
Water efficiency team	The Government will establish a team to implement actions as part of <i>Think water, act water</i> . This team will administer water efficiency programs, communication and awareness programs, coordinate other strategy implementation activities, and provide advice to householders, industry and government.	DUS	4.2

What	Action	Principal Policy Responsibility	See Section
Water efficiency house and garden program	Implement the following Water Efficiency programs to improve the efficiency of water use in the house and garden. These programs will be reviewed and revised as necessary but at least once per year.	DUS	
Showerhead rebate	Provide a rebate for AAA showerheads commencing in 2004–05.	DUS	
Subsidised indoor water tune-up	Provide a subsidised indoor water tune-up program for households, which provides written advice on water efficiency, and fitting of an AAA showerhead, up to two tap valves or flow regulators, and up to two tap washers commencing in 2004–05.	DUS	
Subsidised installation of AAA toilet	Subsidise the supply and fitting of an AAA rated 6/3 litre dual flush toilet to replace a single flush toilet commencing in 2004–05.	DUS	
Subsidised garden water tune-up	Provide a subsidised garden water tune-up program for households, which provides written advice on garden water efficiency and products to save water commencing in 2004–05.	DUS	
Encourage the installation of rainwater tanks	Commencing in 2004–05, revise the rainwater tank rebate program to: <ul style="list-style-type: none"> • waive development and plumbing approval fees to encourage the installation of larger tanks • include a scaled subsidy program for a greater range of tank sizes, and an additional subsidy for connection to a toilet or washing machine cold water tap. 	DUS	4.2.3
	Investigate bulk buying arrangements to ensure that Canberrans can purchase rainwater tanks at the lowest price possible.		
Rebate scheme	The Government will evaluate rebate programs annually and continue to investigate opportunities to redistribute rebate program funding to more beneficial programs in the future as water efficient technologies evolve.	DUS	
Government water savings	Commencing in 2004–05, develop and implement water efficiency programs with government users.	DUS	4.2.4
Commercial water savings	Commencing in 2004–05, develop water efficiency programs with commercial and institutional users, focusing on large commercial and institutional premises.	DUS	4.2.6

What	Action	Principal Policy Responsibility	See Section
Regulations	<p>In 2004, after further community consultation, permanent water conservation measures will be introduced to:</p> <ul style="list-style-type: none"> • restrict the watering of lawns and gardens to morning and evening hours • ban hosing of hard surfaces including driveways and windows • control the use of sprinklers for dust suppression • introduce compulsory use of trigger hoses for car washing. <p>In 2004, new plumbing practice notes will be introduced to:</p> <ul style="list-style-type: none"> • require separation of washing machine and bathroom drainage in new houses from the remainder of the wastewater system to enable future reuse • require separation of the water supply to toilets and washing machines in new houses to enable future rainwater use. 	DUS/ACTPLA/ ACTEW	4.2.7
Water reuse	By September 2004, develop guidelines for use of domestic greywater and include information in community awareness programs.	DUS/Health	4.2.8
	Investigate the potential for sustainable use of reclaimed water, taking into consideration cost-effectiveness, environmental, social and health issues. The analysis will take into account the Government's commitment to water efficiency and reuse targets, to water sensitive urban design and to protection of water quality downstream of the ACT. Outcomes from this investigation may be adopted through such mechanisms as changes to urban design or modification to licensing of discharges from point sources.	DUS	
	By April 2004, progress implementation of Stage 2 of the North Canberra Effluent Reuse Scheme as appropriate.	ACTEW	
	The Government will require any building it builds or procures for its use to incorporate features to maximise efficiency of water use and to reduce demand on mains water through use of alternative supplies, such as stormwater, rainwater and reclaimed water.	DUS	
	The Government will support some of Australia's leading, Canberra-based research organisations in working with the ACT community to find cost effective, innovative, sustainable solutions for reclaimed water use while protecting public health.	DUS	
Objective 3: Promote development and implementation of an integrated regional approach to ACT/NSW cross-border water supply and management			
Integrated water supply strategy	The Government will take a lead role in developing the integrated water supply strategy. The Government expects to negotiate this strategy with the NSW and Commonwealth Governments before the end of 2004.	CMD	4.3.2
Catchment management	The Government will formalise catchment management arrangements to ensure better directed, more coordinated outcomes and to better protect our water supplies.	DUS	4.3.3

What	Action	Principal Policy Responsibility	See Section
Sub-catchment management plans	Formalise a process to use sub-catchment plans as input into the Government's Capital Works Program and management decisions.	DUS	4.3.4
Resource management framework	The ACT Government will seek the agreement of the NSW Government and regional local councils to adopt best practice principles as the basis for water resource management generally.	DUS	4.4.3
Objective 4: Protect the water quality in ACT rivers, lakes and aquifers, to maintain and enhance environmental, amenity, recreational and designated use values and to protect the health of people in the ACT and down river.			
Water quality	The Government will continue environmental and health water quality protection programs, working with the community to meet the aim of the same or better quality for water leaving the ACT as that entering.	DUS	4.4.1
Riparian zone management plan	The Government will require that management of riparian zones in the ACT be consistent with the Riparian Zone Management Plan in Volume 2 of <i>Think water, act water</i> .	DUS	4.4.4
Environmental flow review	Using the new scientific knowledge gained since 1999, the Government will review the <i>Environmental Flow Guidelines</i> in 2004.	DUS	4.4.2
Water monitoring	Undertake a review of water resource monitoring to: <ul style="list-style-type: none"> • identify and communicate clear objectives for each monitoring program • identify common data interests and objectives of monitoring programs to facilitate synergies • ensure monitoring objectives are the basis for design of monitoring programs • undertake the review as a collaboration between agencies and the community. 	DUS	Volume 2
Adaptive management	The Government will recognise the importance of continuous reassessment and improvement in the sustainable management of water resources and use adaptive management to ensure best practice management of the ACT's water resources.	DUS	4.4.4
Objective 5: Facilitate incorporation of water sensitive urban design (WSUD) principles into urban, commercial and industrial development			
WSUD planning	The Government will seek the advice of the ACT Planning and Land Council on best practice implementation of WSUD.	ACTPLA	4.5.2
Developer contributions to WSUD measures	The Government will develop a scheme so that, in some circumstances, developers can contribute to off-site works to meet their WSUD obligations.	ACTPLA/DUS	4.5.2
Greenfield development	In consultation with industry, the Government will require that best practice, cost effective WSUD measures are used in the construction of all new greenfield developments, large-scale redevelopments and capital works projects. By June 2005, the Government will develop guidelines for the application of WSUD.	ACTPLA	4.5.2

What	Action	Principal Policy Responsibility	See Section
WSUD in developed areas	The Government will seek opportunities to retrofit WSUD measures into developed areas where such measures currently do not exist.	ACTPLA	
	In consultation with industry, the Government will require best practice WSUD measures to be used in construction of all residential redevelopments and dual occupancies.	ACTPLA	
Advisory material	The Government will develop advisory material to provide practical advice to builders and home owners on appropriate approaches to WSUD (e.g. rainwater tanks, greywater reuse, landscaping measures, use of water efficient fixtures and appliances).	ACTPLA	
Innovation fund	By December 2004, investigate the feasibility of establishing of a fund to encourage innovation in water management.	CMD/Treasury	4.5.3
Objective 6: Promote and provide for community involvement and partnership in management of the ACT Water Resources Strategy			
Information and awareness	Commencing in July 2004, implementation of an Information and Awareness Program to help meet the ACT's water resources management Goal and Objectives, particularly to improve the efficiency of urban water use.	DUS	4.6.2
	The Government will support community involvement and partnerships by: <ul style="list-style-type: none"> developing a community-oriented learning and action package which can be tailored by various groups, based on what is relevant for their needs working with the community to develop initiatives that will support groups to undertake development and delivery of community water learning projects. 	DUS	4.6.2
Reporting on progress	Progress on implementation of <i>Think water, act water</i> will be reported annually in the <i>ACT Water Report</i> .	DUS	5

7 Glossary

ACTEW	ACTEW Corporation Limited (ACTEW) is a government-owned holding company with responsibility for providing water to the people of the ACT. It contracts ActewAGL to handle all operations.
ActewAGL	A private company owned by ACTEW and AGL and contracted by ACTEW to provide water services.
Basin	An area drained by a given stream and its tributaries.
Catchment	An area of land draining rainfall into a river or reservoir.
Catchment yield	The annual average volume of run-off from a catchment.
Demand management	An approach that is used to reduce the consumption of water (called water conservation).
Environmental flow	The streamflow needed downstream of a water storage to maintain appropriate environmental conditions in a waterway.
Gigalitre (GL)	1,000,000,000 Litres or 1,000 Megalitres.
Greywater	Wastewater from the laundry, bathroom and kitchen that does not contain faecal matter.
Kilolitre (kL)	1,000 Litres or 1 cubic metre.
Mains water	Water supplied by ACTEW through the urban water supply system.
Megalitre (ML)	1,000,000 Litres or 1,000 Kilolitres.
Per capita	Per person.
Reclaimed water	Effluent that has passed through a treatment process and has been reticulated to users, or domestic greywater used for garden irrigation or other purposes.
Regulation	A rule set by government requiring or prohibiting a specific action or outcome (for example, installation of dual flush toilets, restriction on water uses during drought periods).
Run-off	That part of precipitation (rainfall) that flows from a catchment area into streams, lakes, rivers or reservoirs.
Sewage	The waterborne wastes from our homes, workplaces and other buildings.
Sewerage system	The pipes and plant for collection, removal and treatment of sewage.
Streamflow	The flow in a stream or river.
Sub-catchment	The management unit used by the ACT for water resource management. Catchments in which ACT has an interest are divided into 32 sub-catchments.
Treated effluent	The treated water discharged from a sewage treatment plant.
Urban stormwater	Rainfall run-off from urban areas.

Volume	Kilolitre (kL) = 1,000 Litres or 1 cubic metre Megalitre (ML) = 1,000,000 Litres or 1,000 Kilolitres Gigalitre (GL) = 1,000,000,000 Litres or 1,000 Megalitres.
Water ACT	ACT's draft policy for sustainable water resource management released in July 2003 by the ACT Government.
Water cap	Cap on water diversions from the Murray–Darling River system set by the Murray–Darling Basin Ministerial Council to stop further deterioration of river health by limiting water use to 1994 levels of development.
Water conservation	See Demand management.
Water mining	Abstraction of a quantity of water from a sewer for reuse without full treatment of the sewage.
Water use efficiency	A measure of whether activities are being undertaken with the minimum amount of water needed and/or whether the water used is more pristine for the purpose than needed.

Think water, act water

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1 Navigating the strategy

Volume 1 of '*Think water, act water—the strategy*' sets out the strategies and contains an implementation plan of actions needed to manage our water resources in the future.

This document, Volume 2, '*Think water, act water—explanatory document*' provides further information and explanation of the strategies and implementation plan.

Volume 3, '*The state of the ACT's water resources and catchments*' describes water sub-catchments in which the ACT has an interest and the flows, allocations and provision for future allocation for sub-catchments.

2 The ACT's water policy framework

2.1 Polices and agreements

2.1.1 International

The United Nations (UN) reports that the world will face a water crisis in a few decades as population growth, pollution and climate change impact water resources.

According to the UN, by 2050 between 2 billion and 7 billion people will be faced with a scarcity of fresh water. There are about 12,000 cubic kilometres of polluted fresh water in the world and, if trends are not slowed or reversed, the total will reach 18,000 cubic kilometres by 2050, nearly nine times the total amount currently used for irrigation.

United Nations Commission on Sustainable Development

Australia is a signatory to the United Nations Commission on Sustainable Development (UNCSD) Framework Convention on Climate Change, Convention on Biological Diversity; Agenda 21, Rio Declaration and Forest Principles.

The Agenda 21 concept was developed to empower local government and communities to implement ecologically sustainable development. UNCSD held its sixth session in New York in April 1998 and made important recommendations on the principles that underpin an effective approach to water resources management. The essence of these principles is that water resources should be developed, used, managed and protected in an integrated manner; management plans as part of Agenda 21 are required; and better information and data is needed.

International treaties

There are a number of international treaties that relate to sustainable management of wetlands and water resources. The most significant is the *Convention on Wetlands of International Importance especially as Waterfowl Habitat* also known as the Ramsar Convention. Ginini Flats Wetlands has been placed on the convention's List of Wetlands of International Importance. The Japan–Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA) provide for cooperation to protect shared migratory birds and their habitats.

2.1.2 National

National Council of Australian Governments Water Reform Framework

In February 1994, the Council of Australian Governments (COAG) agreed to a strategic framework for the efficient and sustainable reform of the Australian water industry. COAG subsequently linked the reform framework to the National Competition Policy Agreement. Water reform is now a central focus of the National Competition Council. The COAG water reforms contained in the National Competition Policy Agreements establish a number of principles in relation to water resource management in Australia, which bind the States and Territories. These principles can be summarised as follows:

- that full-cost pricing regimes without cross-subsidies be adopted
- full disclosure of community service obligations
- adoption of two-part charging arrangements for urban water use
- that publicly-owned utilities aim to earn real rates of return on their assets
- charging on a volumetric basis for metropolitan bulk-water supplies
- investment in new schemes or extensions to existing schemes be undertaken only where it is sustainable
- where trading in water could occur across state borders, pricing and asset valuation arrangements be consistent
- setting aside of funds for future asset refurbishment and/or upgrading of infrastructure
- implementation of water allocations which are separate from land title
- that trading be set up so water is used to maximise its contribution to national income and welfare, within sustainability constraints
- that each jurisdiction develop trading arrangements to facilitate cross-border sales
- that governments develop and adopt integrated catchment management approaches to water resource management
- that consultation processes and public education programs be used to support water reform
- that governments support the National Water Quality Management Strategy
- that governments support the research necessary to progress implementation of the strategic framework.

In 2003, COAG agreed to develop a National Water Initiative (NWI) to refresh and realign the water reform agenda to more fully realise the benefits intended by 1994 COAG water initiatives. While the NWI has not yet been finalised its objectives are clear and include *'encouraging water conservation in our cities, including better use of stormwater and recycled*

water'. The ACT has committed support to the NWI and **Think water act water** will allow the ACT to implement this aspect of the NWI and remain at the forefront of urban water management in Australia. The ACT agreed to \$5 million over five years to assist in meeting this objective.

National Action Plan for Salinity and Water Quality

The National Action Plan for Salinity and Water Quality was endorsed by COAG in November 2000. The Commonwealth Government is seeking to implement the National Action Plan Inter-Governmental Agreements with each State and Territory setting out the commitment and obligations of jurisdictions. Negotiations are currently underway with the Commonwealth Government about a Bilateral Agreement for delivering of the National Action Plan in the ACT. It is expected that this Agreement will be in place by June 2004.

The goal of the Action Plan is to motivate and enable regional communities to use coordinated and targeted action to:

- prevent, stabilise and start to reverse trends in dryland salinity affecting the sustainability of production, the conservation of biological diversity and the viability of our infrastructure
- improve water quality and secure reliable allocations for human uses, industry and the environment.

National Strategy for Ecologically Sustainable Development

In response to Agenda 21, COAG endorsed a national strategy for ecologically sustainable development (ESD) in December 1992. This strategy sets out principles and objectives for achieving ESD in Australia. It defined ESD as *'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'*. ESD is about meeting the needs of people today, while conserving our ecosystems for future generations. ESD requires that we look in an integrated and long-term way at the social, economic and environmental implications of resource use and development decisions.

The Precautionary Principle is part of the National Strategy for Ecologically Sustainable Development and states that, where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The principles and objectives of this strategy are the basis upon which natural resources are managed in ACT and are enshrined in the *Water Resources Act 1998* and the *Environment Protection Act 1997*.

National Strategy for the Conservation of Australia's Biological Diversity

In 1996, all States and Territories endorsed the national strategy for conservation of Australia's biological diversity. The strategy sets out principles that underpin objectives and actions that are needed to protect Australia's biological heritage. Included in the strategy are actions needed in relation to the impacts of water management on biodiversity.

National Water Quality Management Strategy

Ministerial Councils that preceded the Natural Resource Management Ministerial Council (NRMMC) and the Environment Protection and Heritage Ministerial Council (EPHMC) formally endorsed the National Water Quality Management Strategy (NWQMS) in 1992. It is now widely recognised as the basis for water quality policy development throughout Australia.

In the ACT, the NWQMS provides the basis for water quality standards under *the Environment Protection Act 1997*.

National principles for the provision of water for ecosystems

Predecessor councils to NRMMC and EPHMC jointly developed the national principles for the provision of water for ecosystems in July 1996. These 12 principles help guide jurisdictions in providing water for ecosystems within the broader context of water allocation.

Other policies

A number of subordinate strategies and principles have been agreed across Australian jurisdictions as part of the COAG Water Reforms. They are helping States and Territories with implementation by developing national policies for various water issues. Relevant examples for the ACT are *A National Framework for Improved Groundwater Management in Australia* and *A National Framework for Improved Wastewater Reuse and Stormwater Management in Australia*.

2.1.3 Intergovernmental arrangements

Murray–Darling Basin initiative

Collaborative arrangements between the Commonwealth Government and the New South Wales, Victorian and South Australian Governments for regulating and sharing water within the Murray–Darling Basin have existed since 1914 when the first *River Murray Waters Agreement* was signed. In 1988 the partnership, which has become known as the *Murray–Darling Basin Initiative*, was expanded to cover the whole of the Murray–Darling Basin and the issues of water quality and environmental management were addressed. Queensland joined the Initiative in 1996 and the ACT joined in 1998.

The Murray–Darling Basin Ministerial Council (MDBMC) determines major policy issues of common interest to the partner governments concerning the sustainable use of the water, land and other natural resources of the Murray–Darling Basin. The MDBMC has endorsed a number of important strategies, including those for salinity and drainage, fish management, algal management, floodplain wetlands, communication, facilitation of interstate trade and caps on diversions.

Water trading

One of the objectives of the 1994 COAG Water Reforms was development of a water trading market. Trade in permanent water rights is well established within particular states but operates only in a limited manner between states. Most trading is also limited to within particular reaches of the river system. Interstate temporary trade also occurs on a wider scale.

The Murray–Darling Basin Commission began a pilot interstate water-trading project in the Mallee Region of New South Wales, Victoria and South Australia in 1998. The varying forms

of water property rights have hindered the expansion of permanent trading rights over water in each state and resulted in disagreements between states about management of traded water.

The *Water Resources Act 1998* makes provision for trade both within the ACT and with other jurisdictions. But interstate trading would need the agreement of all jurisdictions on the terms and conditions of trade.

Cap on water diversions

Caps on diversions for New South Wales, Victoria and South Australia have been in place since 1997 and were based on rapidly growing water use, which had already exceeded safe levels in their streams by 1994. As a result, the Murray–Darling Basin Ministerial Council decided to set a cap on water diversions at the level of development in 1994 so further deterioration would not occur. The ACT Government has made a commitment to participate in the cap and is currently investigating what it might be.

The Queensland Government has also not finalised its cap on water diversions.

2.1.4 ACT policies

ACT Nature Conservation Strategy

The ACT's water resources must be managed in a way that is sympathetic to the goal of the *ACT Nature Conservation Strategy*, which is to protect biological diversity and maintain ecological processes and systems.

The *Nature Conservation Act 1980* requires the Conservator of Flora and Fauna to prepare an Action Plan in response to each declaration of a threatened species or ecological community.

An Action Plan outlines conservation and protection proposals for the species or community concerned. The primary objective is to maintain long-term, viable, wild populations of each species (or elements of the ecological community) as components of the indigenous biological resources of the ACT. Action Plans have been finalised for the following aquatic species: Macquarie Perch, Murray River Crayfish, Northern Corroboree Frog, Silver Perch, Trout Cod, and Two-spined Blackfish.

Integrated catchment management

Integrated Catchment Management (ICM) can be defined as *'the coordinated and sustainable management of land, water, vegetation and other natural resources, on a water catchment basis, to balance resource use and conservation'*.

An *Integrated Catchment Management Framework for the ACT* is a statement of the ACT Government's commitment to ICM. It is reflected in sub-catchment plans, which are prepared in consultation with the community, take a holistic view, and seek to draw together statutory and policy responsibilities.

This approach has been embraced in planning the management of water resources in the ACT. Adoption of a catchment approach facilitates achievement of a balance between water use and conservation. Water allocation is managed at a sub-catchment level and will take into account the various factors that contribute to catchment processes.

Environment protection policies

Environment Protection Policies (EPP) are designed to help people understand and apply the *Environment Protection Act 1997* and the *Environment Protection Regulations 1997*. There are general offences in the Act that carry substantial penalties. Environment Protection Policies provide guidance on meeting these legislative requirements.

The Water Pollution Environment Protection Policy offers practical advice to people at home and in business on how their actions can affect water quality in the ACT and the need to adopt the general environmental duty, as specified in the Act to minimise environmental harm. The Water Pollution EPP also explains the strategy and procedures the Environment Protection Authority will use to protect and enhance water quality and quantity within the ACT.

The ACT Wastewater Reuse for Irrigation EPP sets out health and planning requirements for use of reclaimed water to help developers and operators of reuse systems with these requirements. In addition, this EPP explains the levels of environment protection and general performance the Environment Protection Authority will use to determine if users of reclaimed water have adopted their general environmental duty.

2.2 Legislation

There is a range of federal and ACT legislation relating to managing water resources in the ACT along with a number of statutory instruments prepared under this legislation. The relevance of the various pieces of legislation and instruments to water resources is set out below.

2.2.1 Federal

The ***Seat of Government Acceptance Act 1909*** gives the Commonwealth Government the land (and water) of the Australian Capital Territory as well as the paramount right to the use and control of the New South Wales' waters of the Queanbeyan and Molonglo Rivers and their tributaries for all purposes of the Territory.

The ***Canberra Water Supply (Googong Dam) Act 1974*** enabled the Commonwealth Government to exercise its 'paramount right' to the waters of the Queanbeyan River for the purposes of the ACT, through construction of Googong Dam, and for the Territory to manage the waters of the Googong Dam area for use in the ACT on the government's behalf.

The ***Australian Capital Territory (Self-Government) Act 1988*** gives the Territory Executive responsibility for water resources in the Territory.

The ***Australian Capital Territory (Planning and Land Management) Act 1988*** provides for preparation of the National Capital Plan, and declaration of declared national land (which includes Lake Burley Griffin and a small section of the Molonglo River).

The ***National Capital Plan***. Under the Constitutional provision, the Commonwealth Government remains the owner of land in the Territory, even after the granting of self-government. *The Planning and Land Management Act 1988* provides that land used by or on behalf of the Commonwealth may be declared National Land, and managed by the Commonwealth. The remaining lands of the Territory are Territory Land. These lands are managed by the ACT Government on behalf of the Commonwealth.

The *Planning and Land Management Act* requires development of the National Capital Plan, which controls the use and development of Designated and National Land within the ACT and provides overall direction for management of other land.

The Act also requires that the ACT prepare a Territory Plan, which is consistent with the National Capital Plan.

The ***Lakes Ordinance 1976*** enables the National Capital Authority to control and license taking water from Lake Burley Griffin.

The ***Commonwealth Environment Protection and Biodiversity Conservation Act 1999*** provides that Commonwealth approval must be gained for any action that may have a significant impact on a matter of national environmental significance, including nationally-listed threatened species (flora and fauna), listed migratory species and Ramsar wetlands.

2.2.2 Territory

The ***Land (Planning and Environment) Act 1991*** provides for preparation of the Territory Plan that identifies water use and catchment policies, consistent with the requirements of the National Capital Plan.

The ***Territory Plan*** sets out the principles and policies that guide development of the ACT. Amongst the goals of the Territory Plan are:

- to conserve and enhance valued features of the Territory's natural environment
- to promote ecologically sustainable development, protect biodiversity, and provide for high standards of environmental amenity and landscape.

The *Water Use and Catchment Policies* of the Territory Plan recognise the competing and often conflicting demands made on the Territory's water resources. They protect the waters and catchments of the ACT by specifying permitted uses and environmental values for each water body. They have been divided into three types of Water Use Catchments according to the predominant water use or environmental value within that catchment. These are:

- conservation of aquatic habitat
- provision of domestic water supply
- provision of drainage and open space.

Specific objectives are set for each category of use, along with a number of policies that are designed to facilitate meeting those objectives.

Secondary uses are also permitted for individual waterways, as long as they do not compromise maintenance of the standards required to meet primary environmental value.

Protection and conservation of the water quality of the groundwater resources of the ACT is a policy objective for all types of Water Use Catchment.

The ***Environment Protection Act 1997*** provides protection for the environment from pollution and other forms of environmental harm, and includes integration of environmental,

economic and social considerations in decision-making processes. It sets water quality standards and establishes the Environment Protection Authority.

The objective of the **Public Health Act 1997** is protection of the public from public health risks. It provides for the framework to regulate drinking water quality including the ACT Drinking Water Quality Code of Practice 2000. It also includes broad-ranging powers to control unsanitary conditions, which are relevant in the control of reuse of reclaimed water.

The **Water Resources Act 1998** provides for management and use of the Territory's water resources in a way that sustains the physical, economic and social well being of the people of the Territory while protecting the ecosystems that depend on those resources.

The **Environmental Flow Guidelines** is a statutory instrument under *the Water Resources Act*, which sets the environmental flow requirements for all waterbodies in the ACT, including groundwater.

The **Water Resources Management Plan** is a statutory instrument under the *Water Resources Act* that describes Territory water resources, proposed allocations, water allocations for various uses, and action to be taken to manage water resources.

The **Utilities Act 2000** establishes a complex regulatory framework of industry participation, pricing, technical standards, regulations, customer service standards and quality of service.

The **Water and Sewerage Act 2000** makes provision in relation to supply of plumbing or sanitary drainage services; controls the certification, approval and inspection of water and sewer installations; and provides regulations specifying detailed technical requirements.

3 Water planning variables—detailed information

3.1 Population growth

Think water, act water uses population projections prepared by the ACT Demographer.

The basis of the projections for the ACT is contained in the report, *Australian Capital Territory Population Projections 2002–2032 and beyond*, which is available on the internet at: http://www.cmd.act.gov.au/demography/2002to2032/ACT_pop_proj_02_32.pdf. Using these projections, a regional population (Canberra, Queanbeyan, Yass and Yarrowlumla Part A) of 460,000 by 2050 can be derived. This median population projection reflects the most likely growth scenario and is used as a basis for *Think water act water*.

Where decisions based on population growth may need to be taken many years in advance, for example planning for a new water supply or urban development, it is also important to plan for possible higher population growth. The Spatial Plan identifies a high growth scenario that would lead to a population of 500,000 for Canberra and Queanbeyan by 2032. Planning for possible new water supply infrastructure, in particular, will take account of such projections.

3.1.1 Long-term climate change

Climate change projections for the ACT region have been developed using simulations from 13 climate change models. There are uncertainties in projections, particularly variations in climate due to local topography.

3.1.2 Temperature change

The latest climate change projections for the ACT region indicate an annual increase of 0.4°C to 1.6°C in mean temperature by 2030 and of 1.0°C to 4.8°C by 2070. There are slight variations among the seasons. The ranges of projected annual and seasonal average temperature changes for the ACT region for both 2030 and 2070 are shown in Table 1. Projected changes in temperature can be applied to both daily maximum and minimum temperatures.

Table 1: Temperature change (°C) for the ACT by 2030 and 2070, relative to 1990

Season/Year	2030	2070
Annual	0.4 to 1.6	1.0 to 4.8
Summer	0.4 to 1.8	1.0 to 5.6
Autumn	0.4 to 1.5	1.0 to 4.6
Winter	0.3 to 1.3	0.9 to 4.1
Spring	0.4 to 1.7	1.1 to 5.3

Source: Climate change projections and the effects on water yield and water demand for the Australian Capital Territory. CSIRO Land and Water, CSIRO Atmospheric Research, CSIRO Sustainable Ecosystems

Increases in temperature will lead to changes in the frequency of extreme temperatures in the ACT region.

3.1.3 Rainfall change

The seasonal and annual ranges of projected average percentage rainfall for the ACT for both 2030 and 2070 are shown in Table 2. The simulated direction of rainfall changes is not clear during summer and autumn, but decreases predominate in winter and spring.

Table 2. Rainfall change (%) for the ACT by 2030 and 2070, relative to 1990

Season/Year	2030	2070
Annual	-9 to 2	-29 to 7
Summer	-9 to 12	-28 to 36
Autumn	-5 to 5	-17 to 15
Winter	-11 to 2	-34 to 6
Spring	-11 to 0	-34 to -1

Source: Climate change projections and the effects on water yield and water demand for the Australian Capital Territory. CSIRO Land and Water, CSIRO Atmospheric Research, CSIRO Sustainable Ecosystems

Changes in rainfall under climate change conditions are expected to have a significant affect on the frequency of extreme dry and wet years. Even during wet years, run-off would be reduced as a result of the higher evaporation associated with higher temperatures. Models also indicate an increase in the frequency and intensity of extreme rainfall under climate change conditions.

3.1.4 Evaporation change

The changes in annual evaporation for the ACT for 2030 and 2070 are shown in Table 3. Projected annual and seasonal evaporation values have been taken from nine climate models. Greater increase in potential evaporation is expected as a result of increased temperature.

Table 3: Projected evaporation for the ACT for 2030 and 2070, relative to 1990

Season/Year	Present (mm)	2030 (%)	2070 (%)
Annual	1575	+1.4 to +9.1	+3.8 to +28.0
Summer	626	+0.5 to +11.0	+1.5 to +33.8
Autumn	329	+0.8 to +10.8	+2.2 to +33.3
Winter	184	+2.2 to +12.8	+5.9 to +39.4
Spring	436	+2.1 to +12.0	+5.8 to +36.8

Source: Climate change projections and the effects on water yield and water demand for the Australian Capital Territory. CSIRO Land and Water, CSIRO Atmospheric Research, CSIRO Sustainable Ecosystems

3.1.5 Temporal shift

Historical rainfall in the Murrumbidgee catchment has shown considerable temporal variability. There is evidence of shifts in the last 20 years, with several locations (except Michelago) near Canberra showing a small decline in rainfall and a decrease in inter-annual variability after the mid to late 1980s. A similar shift has been well documented in the southwest of Western Australia. It is possible that the climate will shift in a short period to a new state, rather than show a smooth progression. Global climate change models do not pick up such shifts.

Projected global climate change scenarios show that for the period 2035 to 2065, rainfall occurrence is expected to decrease by about 6 per cent and annual rainfall amounts to decrease by about 8 per cent. These scenarios suggest there will be a decrease in the run-off into ACT storages. Additionally, increases in temperatures are likely to result in an increase in water use by ACT residents.

The hydrological modelling results, based upon the above rainfall projections, show decreases of annual run-off in the ACT region of up to 20 per cent by 2030 and up to 50 per cent by 2070. The modelling results also indicate changes in summer/autumn run-off by about +5% to -20% and +10% to -50% by 2030 and 2070 respectively, relative to 1990, and winter/spring run-off by about -5% to -20% and -10% to -50% by 2030 and 2070 respectively. In general, the percentage changes in run-off are higher in the drier Queanbeyan River catchment than the wetter Cotter River catchment.

Analysis of the potential climate change impacts is continuing as new information becomes available.

4 Meeting the objectives—background information

4.1 Provide a long-term, reliable source of water for the ACT and region

4.1.1 Water supply options

Augmentation of the ACT's water supply may or may not be needed, but work is being done to identify the best available option in case it is.

Major factors in determining the effectiveness of our current or any future water supply storages are the capacity, the inflow and variability of inflow. Variability of inflow is particularly important as this varies significantly between our water supply storages and determines their reliability. Corin and Bendora reservoirs are our most reliable.

Preliminary investigations have been conducted on about 30 water source options. So far no attempt has been made to quantify the environmental, social and broader economic costs of each option. There are also inter-jurisdictional issues to be considered. This initial analysis has identified preferred major supply options for more detailed analysis. A comprehensive analysis of environmental, social, economic and inter-jurisdictional impacts is needed, along with further assessment of likely supply requirements, before a decision on a future supply source is made.

Details of the supply options that will be examined in more detail are given in Volume 1 section 4.1.3.

4.2 Increase the efficiency of water usage

How will we know if we are using 12 per cent less water in 2013?

Weather is a predominant driver of the ACT's water consumption, so when comparing consumption over time it is necessary to correct for changes in climate. To calculate current average usage it is necessary to adjust for consumption over wet and dry years. Table 4 includes data for the 10 years prior to the onset of the current drought as has been used to calculate current climate corrected water usage.

Table 4: Annual per capita mains water consumption

Year	Total Consumption (GL)	Total population served ('000)	Use (KL/person)
1992	60.0	329.7	182.1
1993	50.2	334.9	149.8
1994	59.4	337.2	176.1
1995	60.6	340.9	177.7
1996	53.3	345.1	154.3
1997	61.8	347.5	177.9
1998	73.1	346.5	211.0
1999	59.4	347.7	170.9
2000	58.0	350.1	165.7
2001	63.0	352.6	178.7
Average			174.4

Source: Data from ACTEW and ACT demographer.

Average consumption across all sectors over the period 1992–2001 is 174 kilolitres per person per year. To determine whether we have met the mains water target in 2013, a

climate-adjusted model is needed to correct for climate effects on usage in 2013. To meet this target in 2013, climate-adjusted consumption will need to be 153 kilolitres per person per year.

4.2.1 Valuing water as a scarce resource

Since 1999, water users in the ACT have paid a Water Abstraction Charge (WAC). At 10 cents per kilolitre, this charge was set to place a value on water as a resource. The ACT is the only jurisdiction in Australia that values water this way. In the 2003–04 Budget, the ACT Government announced its intention to increase the WAC to 20 cents per kilolitre on 1 January 2004 and to 25 cents per kilolitre on 1 July 2005.

In May 2003, the Government sought advice from the Independent Competition and Regulatory Commission on the appropriate level for the WAC. The Commission released its advice in October 2003 confirming that the WAC could be set at 20 cents per kilolitre in January 2004.

4.2.2 Water efficiency measures

Cost effectiveness

One consideration in determining what water use efficiency measures to consider for Canberra is comparative cost.

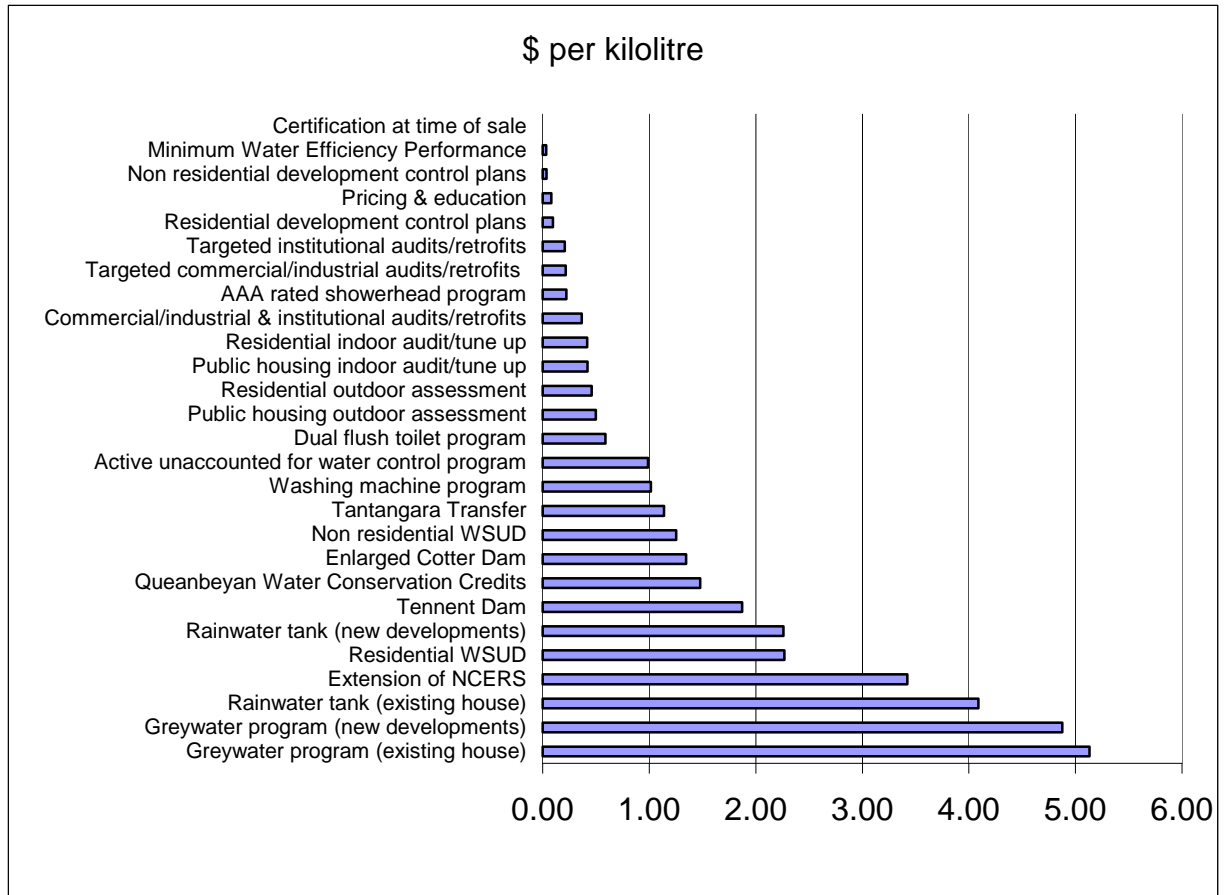
Work has been done for Canberra that compares the relative total costs for a variety of measures. The work ensures the measures are compared on the same basis by calculating the average cost per unit of extra water generated over a period by the measure, taking into account all expenditure by the Government, water supplier, customers or others to achieve the measure.

Typical comparative cost to the community for a range of measures is shown in Figure 1. The costs of three water supply options and of effluent reuse have been included for comparative purposes.

The measures considered include such components as water efficient household appliances, education, pricing, and regulation. Full details on the individual measures are provided in the Institute of Sustainable Futures report *Preliminary demand management and least cost planning assessment* available at <http://www.thinkwater.act.gov.au>

Whether these measures are introduced by regulation or incentive does not change these values, as the total cost to the community remains the same. Of course, any cost comparison method is only capable of comparing the costs that can be described in dollars. Further analysis is being carried out to assess environmental, lifestyle, convenience and other impacts of these measures. This information will be used to further evaluate the best efficiency measures to be introduced but is also necessary when comparing the water efficiency measures to supply options and source substitution options such as use of reclaimed water and stormwater.

Figure 1: Water efficiency measure cost comparison



Source: Data from Institute of Sustainable Futures, University of Technology, Sydney.

Minimum performance standards and labelling

Australia is to develop a compulsory water efficiency labelling scheme such as that shown in Figure 2. Australia’s Environment Ministers agreed to this in May 2003 and expect the scheme to commence in mid to late 2005.

Figure 2: Water Services Association of Australia’s Water Efficiency Labelling Scheme



A moderate level of water efficiency A good level of water efficiency A high level of water efficiency A very high level of water efficiency An excellent level of water efficiency

The Water Services Association of Australia administers the existing voluntary water efficiency product rating and labelling scheme, the National Water Conservation Rating and Labelling Scheme. It is based on Australian Standard 6400:2003, *Water efficient products—rating and labelling*. The rating specifications are shown in Table 5.

Table 5: AS 6400:2003 rating specifications

Product		Rating Unit	Rating				
			1A	2A	3A	4A	5A
Showerheads		Litres (L)/min	>12 but not >15	>9 but not >12	>7.5 but not >9	>6 but not >7.5	not >6
Dishwashers		L/place setting	>2 but not >2.8	>1.5 but not >2	>1 but not >1.5	>0.8 but not >1	not >0.8
Clothes washers		L/kg of dry load	>28 but not >34	>22 but not >28	>15 but not >22	>9 but not >15	not >9
Taps & flow regulators	Hand basins	L/min	>6 but not >7.5	>4.5 but not >6	>3 but not >4.5	>2 but not >3	not >2 with automatic shut off
	Kitchen & laundry sinks	L/min	>12 but not >15	>9 but not >12	>7.5 but not >9	>6 but not >7.5	not >6
Toilet suites		L (avg flush volume)	>5.5 but not >6.5	>4 but not >5.5	>3.5 but not >4	>2.5 but not >3.5	not >2.5

Source: Standards Australia

AAA showerheads

Data obtained from interstate studies on water savings show AAA showerheads that cost about \$30 each have an average payback period of less than one year on water costs alone. Even the more elaborate models, which cost \$150 to \$200 each, have a payback period of between three and four years on water costs alone. There are also economic savings from the use of less energy to heat the water.

Inefficient showerheads use up to 24 litres of water per minute. AAA rated showerheads (the best rating) use as little as 7.5 litres per minute, a saving of about 17 kL per year on average in Canberra. In 2001, 32 per cent of Canberra homes had water efficient showerheads.

AAA showerheads are the most cost effective appliance to achieve water savings. Their cost compared with other water efficiency measures is 22 cents per kilolitre. AAA showerheads suffer from their association with old style low flow showerheads that, it was commonly felt, provided an unsatisfactory shower. Modern water efficient showerheads which meet the AAA standard are required to meet performance standards which produce much more satisfactory results.

The ACT Government ran a showerhead subsidy program for three weeks in December 2002 and January 2003, which resulted in rebates of up to \$30 being provided for nearly 3,900 showerheads. A survey conducted later showed that over 70 per cent of those who got the showerheads thought they gave a shower that was as good or better than their old showerhead. A further 25 per cent thought the new showerhead was only slightly worse than their old one. The survey also showed that the 3,900 showerheads are saving 81 ML of water per year or 21 kL each. The final point to highlight from the survey is the recommendation that, for any future subsidy program, a rebate of \$20 be considered to promote installation of

more water efficient showerheads.

AAA showerheads have a payback period of less than one year, based only on the value of water and not including energy savings. The 3,900 showerheads in the ACT's subsidy program also reduce greenhouse emissions by almost 2,000 tonnes of carbon dioxide equivalent each year.

There are advantages to be gained by subsidising the fitting of AAA showerheads in combination with a water tune-up program, which provides advice to the community about other demand management issues on their properties. Subsidised showerheads can attract some in the community to participate in a water tune-up, while there are others interested in a water tune-up who can be informed through the tune-up about the merits of an AAA showerhead.

Implementation of a compulsory water efficiency labelling scheme (as discussed above) provides the opportunity to require that showerheads with ratings of less than AAA not be allowed to be sold. Such a regulatory approach would be effective if implemented widely across Australia.

Showerheads are the most effective water efficiency measure to subsidise. The Government has decided to reintroduce a subsidy to encourage maximum take up of showerheads.

Water tune-up programs

Water tune-ups can be used to obtain clear pictures of water usage in individual homes, businesses and other places. These tune-ups promote water use efficiency by encouraging installation of low water use appliances and plumbing fittings, and through introduction of water saving practices.

Water tune-ups can be a personalised marketing approach to provide information and advice on water use efficiency. The objective of such a program is to reduce personal water consumption by providing interested property holders with specific water efficiency information relating directly to their individual situations.

As previously discussed, there are advantages in combining a tune-up program with a showerhead replacement program.

Further synergies may be possible by combining water tune-ups with similar tune-up programs in relation to energy and waste generation, although careful thought is needed before combining tune-ups across such a broad range of expertise. Inside water auditors will require plumbing skills while outside auditors will need gardening knowledge to provide advice to Canberrans on water efficiency. It would be very difficult to equip auditors with the skills needed to provide information to consumers on all aspects of a combined tune-up on water, energy and waste.

In addition, tune-ups should be offered first to consumers who are least efficient in the field being audited. High water users might not necessarily be high waste producers. In the case of water, information is available from ACTEW's billing system to identify high water users who can be approached first for tune-ups. Tune-up priority for energy and waste should be based on more appropriate criteria than high water use.

Dual flush toilets

An Australian Bureau of Statistics survey in March 2001 showed that about 58 per cent of Canberrans have a dual flush toilet in their residence. Apart from New South Wales, this is the lowest proportion in Australia with over 70 per cent of Victorians, South Australians and West Australians having dual flush. Existing regulations mean that within two to three decades the vast majority will be changed over as old ones become unserviceable or are replaced as part of redevelopments.

A dual flush toilet cuts water use by 18 kL per year and is a good demand measure because once installed it continues to deliver water savings for many years with little concern about the behaviour of those using it.

Regulations could be changed so that, when a cistern over an older pan requires replacement, the entire toilet unit must be replaced with a 6/3 litre unit. Currently the cistern can be replaced with a 9/4.5 cistern and the older pan left in place. Unilaterally making such a change to regulations in Canberra, which is not done in other states, is not recommended given the ease of circumventing such a regulation by purchasing a cistern in New South Wales.

Retrofitting dual flush toilets has a payback period of around 15 years, depending on the actual value of water savings. A fully subsidised replacement program for older toilets is not justified for Canberra given the high relative cost of retrofitting dual flush toilets compared with other demand measures and the existing regulatory controls which will ultimately see all toilets changed.

AAAA Washing machines

In Canberra, about 15 per cent of washing machines are AAA rated or better, a proportion that is increasing by 1 per cent per year. For an average household, water savings with an AAA or AAAA rated washing machine are estimated at 15 kL per year. Front-loading machines are typically about 50 per cent more expensive per kilogram of capacity. This will reduce as their market penetration increases.

Studies indicate that the average life of a washing machine is 18 years and front-loading washing machines have a payback period of around five years, based on the value of water, energy and detergent savings. An incentive program would help to ensure consumers purchase more water efficient machines.

It has already been mentioned that a compulsory National Water Efficiency Labelling Scheme will soon be in place across Australia. The presence of these labels will provide encouragement for consumers to purchase water efficient models.

It will also be possible, with agreement across Australia, to require manufacturers to produce washing machines that meet a certain standard and/or to ban the sale of less efficient models. It would seem opportune to seek such an agreement now, as many jurisdictions are currently facing water security issues similar to ours.

No subsidy for washing machines is supported at this stage—on the basis of cost effectiveness.

Regulations

A range of activities can be controlled through the passage of regulations. At present there is an Environment Protection regulation that requires vehicles to be washed on pervious surfaces where such a surface is available. Further regulations have been considered which will contribute to reduced consumption, and best practice behaviour and serve as a constant reminder of the need to conserve water.

The Government has considered a range of possible regulations and has decided not to proceed, at this stage, with the following regulations that either impose undue expense on the community and/or do not produce adequate water savings.

The Government **will not** introduce regulations that:

- permanently restrict sprinkler use, based on the current odds and evens house numbering system
- limit daily watering times to between 7 p.m. and 8 a.m.
- require swimming pools to be covered, while not in use, to reduce evaporation losses.

Experience gained from water restrictions, and the difficulty of retrofitting existing properties to use reclaimed water, support introduction of regulations to reduce some of the water wasted during outdoor activities, and to spend more on new and redeveloped properties to make water reuse feasible.

The Government **will**, therefore, introduce permanent water conservation measures to:

- restrict watering of lawns and gardens to morning and evening hours
- ban hosing of hard surfaces, including driveways and windows
- control the use of sprinklers for dust suppression
- introduce compulsory use of trigger hoses for car washing.

New plumbing practice notes will be introduced to:

- require separation, in new houses, of washing machine and bathroom drainage from the remainder of the wastewater system to enable future reuse
- require separation, in new houses, of the water supply to toilets and washing machines to enable future rainwater use.

Rainwater tanks

Surveys of Canberra households indicate that 6% of households (approximately 6,000) have rainwater tanks. Enquiries received by the ACT Government indicate that the number of tanks installed would probably be higher if the approval and subsidy systems were not so complex.

When assessed solely as a source of water, rainwater tanks are not as cost effective as other water efficiency measures. However, they serve two additional functions in urban water management. Firstly, rainwater tanks reduce the run-off from urban areas so fewer pollutants

are transported to our lakes and streams, protecting the environmental values in those water bodies. Secondly, rainwater tanks in developed areas reduce the size of the peak storm flow, delaying the need for augmentation of stormwater infrastructure in suburbs with significant residential infill.

In addition, the cost of installing a rainwater tank can vary widely depending on whether the householder carries out some of the work, and whether a pump and plumbing work is required. In calculating the levelised cost of a rainwater tank, a number of assumptions about the system were made. It was assumed the house is 200 square metres in area and the entire roof is connected to the tank. It was also assumed that the system is installed professionally, includes a pump and is plumbed into the toilet and laundry. With a simpler set-up, installed by the householder, the levelised cost of a rainwater tank could be lower.

There is a range of actions that could improve the success of a rainwater tank subsidy program. Firstly, consideration needs to be given to waiving development and plumbing approval fees to encourage installation of larger tanks that might otherwise not go ahead because these fees add too much to the cost. Secondly, consideration needs to be given to the structure of the ACT's rainwater tank subsidy scheme to encourage the installation of tanks of between 2,000 and 4,000 litres that are often the only size that can be fitted, and to encourage connection of tanks to a washing machine cold water tap or a toilet. Finally, arrangements should be made, through manufacturers and local suppliers, for the supply of rainwater tanks at the lowest cost possible based on bulk purchase.

Greywater systems

Greywater fittings such as diversion valves, hoses from washing machines to the garden and buckets carried from the laundry are popular ways to recycle greywater during the drought.

Greywater treatment systems remove nutrients and other particles, and disinfect the water so it can be used for purposes that require higher quality water or so it can be stored for periods longer than one day. Victoria is the only jurisdiction in Australia that subsidises greywater systems, providing \$500 for systems that cost over \$1,500.

No subsidy is recommended for greywater treatment systems at this stage—on the basis of cost effectiveness.

4.2.3 Residential water use efficiency

Water use efficiency program

Canberra's experience with reducing water demand is relatively limited compared with other cities in Australia. We have some experience with short-term demand reduction during water restrictions that shows that Canberrans can easily exceed restriction targets—with savings of 25 per cent last summer and savings of 40 per cent during Stage 3 restrictions, when other water authorities would have expected much less in their cities.

We have some experience with a short but successful showerhead replacement program last summer and with a poorly subscribed rainwater tank subsidy program that has run for a number of years. We have not had an extended awareness campaign in Canberra that provides people with information on how to be more water efficient and upon which to base their decisions. The hardest factor to predict is how well Canberrans will respond to subsidies and education programs aimed to encourage a particular behaviour.

Table 6: Initial water efficiency incentive program

Residential	First Year Incentive	Subsequent Years
AAA showerhead rebate	Provide showerhead rebate	To be reviewed
Indoor water tune-up program	Subsidise cost to householder	Subsidise cost to householder
Dual flush toilets	Subsidise supply and fitting 6/3 dual flush toilet to replace single flush toilet	Subsidise supply and fitting 6/3 dual flush toilet to replace single flush toilet
Rainwater storage systems	Provide rebates for rainwater tanks in the following categories: 2,000-3,999 L, 4,000-9,000 L, and larger tanks, and for connection to toilet or washing machine	To be reviewed
Pricing—Water abstraction Charge component	Increased to 20c per kilolitre in January 2004	Increased to 25c per kilolitre in July 2005
Garden water tune-up program	Subsidise cost to householder	Subsidise cost to householder

The design of a water use efficiency program for Canberra will rely, in the first instance, on interstate experience and be modified over time as local experience indicates the need.

The program in Table 6, based on relative effectiveness and past experience in the ACT and elsewhere, is a good model to begin a water efficiency campaign. As experience is gained through managing the program it can be modified. The program will be reviewed annually and modified if necessary. The program is a significant commitment by Government to ensure water is used more efficiently in the ACT.

4.2.4 Non-residential water use

It is estimated that the top 150 non-residential water users consume more than 50 per cent of the total water used in the sector. This includes government, commercial and institutional users. To ensure a cost-effective approach to the non-residential sector obtaining water savings, the Government will be working closely with this high water use group in the first instance to identify if water efficiencies can be made. Other users in this sector will be approached in the longer term to obtain additional savings, but we will be encouraging them to put in place best practice management as soon as is practicable to help achieve the efficiencies needed.

4.2.5 Government water use efficiency

The Commonwealth and ACT Governments are significant users of mains water in Canberra. The ACT Government is committed to ensuring all mains water users (whether government, commercial, institutional or residential) make an equitable contribution to the ACT's water targets.

According to ACTEW data, the Commonwealth and ACT Governments use an average of 11 per cent of the mains water supplied by ACTEW or about 7,000 megalitres (million litres) per year. Some of this water is used to water grass in parks, playing fields and school grounds. With about 70,000 people in government employment in Canberra, water use in offices and other workplaces is also significant.

In the early 1990s, the ACT Government achieved a 30 per cent reduction in its use of mains water to irrigate grass through a program of reducing areas needing watering, fitting of more efficient watering systems and computerisation of larger water systems. These savings in water use have been maintained over the last decade.

The ACT Government has continued to seek ways to reduce water use. In 2001, sports ground pavilions and toilets across Canberra were equipped with water and energy saving fittings. Fitting low-flow showerheads, aerated flow control valves on sinks, reconditioning taps, modifying cisterns to reduce water use and other measures resulted in water savings at these facilities of over 30 per cent.

At ACT Government schools, reviews of water use have resulted in a reduction in the number of toilets. A replacement program to change high water use toilets and taps to more water efficient models has begun.

The ACT Government has also been involved in a research project with CSIRO to determine whether there is some capacity to refine the software that operates its already highly efficient computerised irrigation systems, with a view to reducing water usage. There are early indications that improvements of 10 to 20 per cent may be possible.

In a move aimed at more efficient use of facilities that use water, multiple uses of irrigated sports grounds and pools are being promoted as an objective in the draft Plan of Management for Enclosed Sports grounds and Public Pools for which public comment recently closed.

These and other cost effective water efficiency measures need to be encouraged across government so this sector can meet its obligation to contribute to the water savings target.

What about Parliament House and the Parliamentary Triangle?

ACTEW has been working with the Commonwealth agencies that manage Parliament House and the Parliamentary Triangle, both in the short term to reduce water use during the drought and in the longer term to help these water users contribute to overall water saving measures.

The watered grass on top of Parliament House is actually an important structural part of the building, acting like a roof, ensuring that soil erosion does not expose the rubber membrane covering the structure that protects the building from water leaks. Essential as it is, the roof uses a lot of water and the Joint House Department is investigating the use of reclaimed water on its landscape so mains water use can be dramatically decreased.

The National Capital Authority, which is responsible for much of the water use elsewhere in the Parliamentary Triangle, is also studying the possible use of reclaimed water to irrigate landscaped areas and is investigating opportunities to increase the use of water from Lake Burley Griffin in place of mains water.

Public housing

Nine per cent of Canberra's housing stock is government owned and consumes about 8 per cent of the mains water used in residences. As these properties are constructed, refurbished or as showerheads become unserviceable, water efficient showerheads are fitted. In addition, tap aerators are fitted wherever practical during refurbishments.

The ACT Government used to pass the full cost of water on to its tenants. Since 1995, public housing tenants have not paid for water.

A program, specifically aimed at reducing mains water use in public housing, could be put in place. Such a program would seek to replace water inefficient appliances that become part of the property, and provide information to tenants. A voluntary tune-up and showerhead replacement program has been used with success elsewhere for tenanted properties.

ACT Government sports grounds and parks

The ACT Government has been working with ACTEW over the last couple of years on a scheme—the North Canberra Effluent Reuse Scheme (NCERS)—to use reclaimed water from the Fyshwick Sewage Treatment Plant to irrigate parks and sports grounds in North Canberra (see Section 4.2.6). All pipes have been installed and the final phase of the project has been an upgrade of the treatment plant to meet health requirements for water quality. The scheme is expected to be operational early in 2004, enabling substitution of mains water with reclaimed water to irrigate about 62 hectares of turf, including about 15 hectares of ACT Government sports grounds (approximately 5 per cent of total sports ground area). This will result in the saving of 280 megalitres each year of irrigation water, when the treatment plant is fully operational. In a drought year, this amount could rise to 800 megalitres.

Northbourne Avenue median strip

One of the sights that is often mentioned when Canberrans are being asked to save water is the watering of the Northbourne Avenue median strip from Dickson to Civic.

The Commonwealth Government requires the ACT Government to maintain the watered grass median along Northbourne Avenue from Dickson to Civic. Even if the National Capital Plan did not require the grass to be irrigated, the trees on the median strip need watering. They are *Eucalyptus elata* or river peppermints, which grow naturally along the New South Wales south coast and in eastern Victoria in narrow belts along watercourses and small valleys. Their natural habitat is in higher rainfall areas than Canberra and they would not grow well here without watering.

While changing the management of the Northbourne Avenue median strip will take some time, as it requires a change to the National Capital Plan, the ACT Government has begun exploring options to change the landscape there. Of course any landscape change would have to maintain the high quality standard appropriate for the main entry into Canberra.

The idea of a native landscape similar to the Anzac Parade verge behind the memorials is

being discussed with the National Capital Authority. This would involve replacing the watered grass and river peppermints. Such a landscape would be expensive to establish but ultimately would not require watering and maintenance costs would be lower.

Water efficient ACT Government office buildings

The ACT Government owns only six of the office buildings it occupies around Canberra. Some water saving devices, such as tap flow regulators, have been fitted to these buildings. No specific action has been taken to ensure that the offices that the Government leases are water efficient.

The Government will determine how to modify these buildings to make them best practice water efficient. With a large number of leased office buildings, the Government will develop policies about the minimum standard of water efficiency it will accept in buildings it leases. This standard will be set at best practice levels.

Commonwealth Government contribution

The Commonwealth Government is a major water user in Canberra and the community expects it to achieve its share of water savings. The large areas of public open space irrigated by the Commonwealth provide a good opportunity to expand the use of reclaimed water for irrigation.

Water efficiency in the commercial sector

The commercial sector comprises users such as hotels and motels, irrigators, shopping centres, golf courses, office blocks, clubs and sport grounds, caravan parks, and commercial buildings.

The ACT Government will be working closely with the commercial sector to identify a range of savings to ensure this sector obtains best practice. The Government will initiate a program to identify where the likely savings would be obtained to reduce the commercial sector's use of mains water by 12 per cent in 2013.

An audit program will be developed for the commercial sector to help identify where the most cost effective savings could be made. Programs will be developed for particular industries such as golf courses, institutions, hotels and motels etc. It likely that savings will be achieved in areas such as more efficient irrigation practices; water efficient appliances such as toilets, washing machines, urinals and showers; monitoring cooling tower use; rectifying water leakage; and improved management practices including understanding water usage and cleaning regimes.

4.2.6 Sustainable use of reclaimed water

Achieving the 20 per cent reclaimed water use target will help meet the target for reduction in mains water use. Increased reuse will also accrue a number of other benefits including:

- protecting public assets (for example, sports grounds and parks) during droughts as reclaimed water would not normally be subject to restrictions
- reducing pollutant impacts by reducing effluent discharges to rivers
- reducing flow related impacts of effluent discharges

- reducing the impact of unforeseen system failures by developing a more diversified water supply system
- achieving savings on household water bills where simple on-site use of reclaimed water replaces mains water use
- promoting water efficiency in other areas through education and awareness.

The average sewage volume in the ACT (includes Queanbeyan, which discharges sewage in the ACT) is estimated at 38.1GL per year. It is estimated that the current reclaimed water use in the ACT is around 1.85GL per year. Both sewage inflows and reclaimed water volumes vary from year to year depending on climate.

Four approaches for increasing reuse are described below, ranging from large-scale infrastructure intensive programs to simple domestic options.

North Canberra effluent reuse scheme

The Fyshwick Sewage Treatment Plant provides reclaimed water for the North Canberra Effluent Reuse Scheme (NCERS). Stage 1 of the scheme serves 21.7 hectares of grassland at Australian Defence Force Academy—Duntroon; and stage 2 of the scheme, will serve an additional 40 hectares of ovals in North Canberra, with potential to increase the irrigated area without additional capital expenditure for infrastructure. Stage 2 is due for completion in early 2004, and will increase the amount of reclaimed water used by the NCERS to 0.5GL per year.

The NCERS scheme could be further expanded to 30 major customers in North and South Canberra. Preliminary estimates indicate a capital cost of \$23 million, with the scheme potentially capable of supplying 1.1GL to all major irrigators in North and South Canberra.

Dual reticulation systems

Dual reticulation systems provide domestic customers with two types of water, high quality water for drinking and washing, and reclaimed water for garden watering and possibly toilet flushing. Such systems have not been used in Canberra but have been trialled elsewhere in Australia. Dual reticulation systems are normally only considered for greenfield developments as the cost of installation in developed areas is high.

Dual reticulation systems also have the potential to be accidentally cross-connected, putting reclaimed water into the mains water network. This has happened with some existing systems. Care will need to be taken to protect public health with water reclamation schemes.

Distributed treatment

The distributed treatment option considers the construction of water mining plants (similar to that already installed at Southwell Park) located near major playing fields. For a typical playing field of around 1.6 hectares, a treatment and storage facility would cost around \$1.8 million.

Twenty hectares of ovals in Gungahlin and Belconnen that could be appropriate for such a scheme have been identified. In an average year these sites would reuse 0.12 GL. The capital cost would be around \$8 million.

Domestic greywater reuse

Greywater can be reused effectively at the individual household scale by diverting it to the garden.. Use of domestic greywater for garden irrigation is one of the most cost effective water efficiency measures. As an example, the use of domestic greywater for garden watering over the summer period could save 27KL in mains water per household per year. This would amount to a total annual saving of mains water of 3GL if adopted across the residential sector. Alternatively, greywater can be treated and stored until needed, although domestic greywater treatment systems typically cost several thousand dollars per household.

Further analysis, including the environmental, economic and social costs and benefits of increasing the use of reclaimed water will be carried out and compared to similar analysis for the ACT Government's water efficiency program and the options to develop a new water source for the ACT. This will provide a better understanding of the societal costs and benefits of increasing the use of reclaimed water to help reduce water use in the ACT.

4.3 Protect water quality in ACT rivers, lakes and aquifers, to maintain and enhance environmental, amenity, recreational and designated use values and to protect the health of people in the ACT and down river

4.3.1 Land use planning

Land use is an important determinant of the pattern and quantity of run-off, as well as the nature of the material transported by that run-off. A change in land use from rural to urban may have significant impacts on the pattern of streamflow and water quality of local waters. Canberra's expansion has led to large areas of land being modified for urban development and to increasing demands on limited water resources, including more water for domestic use, irrigation and more water-based recreation. There are also community pressures to preserve the scenic and ecological values of the waterways.

Planning systems in the ACT

The ACT has a unique land tenure system due to its role as the National Capital. The Commonwealth has a major interest and involvement in land management and ownership, including Designated and National Land defined in the National Capital Plan administered by the National Capital Authority. The ACT Planning and Land Authority administers the Territory Plan that controls land use planning and development of Territory Land.

Land use planning in practice

Planning in relation to water is underpinned by a set of planning principles:

- water resources in the ACT fulfill multiple uses, and planning should recognise these uses
- an integrated catchment management approach is required for achievement of water quality objectives
- a total water cycle perspective is required as there are fundamental interactions between different water components.

A range of planning approaches is used to achieve water resource outcomes. Within the

urban context a number of measures are applied to minimise impacts on water resources. Construction is limited by the land capability, development is restricted in creeks and river corridors, and appropriate landscaping is required to intercept run-off. Finally, infrastructure measures, such as ponds and retardation basins, are used to restore the quality of water impacted by urban activities.

Best management practices needed for urban land include implementation of state-of-the-art stormwater controls and changes to individual house block management. Effluent from sewage treatment plants is recognised as a problem requiring either higher discharge quality or reclaiming for further use. Best management practice requires that only sites with appropriate land capability are used for rural residential estates, and that more rigorous attention is given to design and management of effluent disposal systems.

Additionally, recent urban design changes have led to a trend of smaller house blocks and larger houses. Together these have resulted in much smaller gardens than previously, resulting in significant reduction in external water use in newer suburbs.

4.3.2 Environmental flow review

When they were published in 1999, the *Environmental Flow Guidelines* contained an undertaking that they would be reviewed in 2004. The current level of environmental flows was determined in 1999 by a panel of scientific experts using the information available at the time. The Cooperative Research Centre for Freshwater Ecology is currently undertaking a significant scientific study in the Cotter catchment. The results of this study and other relevant information will form the basis of the review of the *Environmental Flow Guidelines*.

4.3.3 Water resource monitoring

A key component in the effective management of our water resources is information on their status, their condition and on the factors impacting on that condition.

Following identification of clear objectives, a monitoring program can be designed to achieve those objectives. Monitoring is expensive and needs to be tailored to address key objectives. Monitoring may take the form of a single study examining a particular issue, or ongoing monitoring to detect trends in resource status or condition.

Information on river and lake condition is presented in a range of places, including the *ACT Water Report* and technical reports on biota produced by Environment ACT, the annual report on Lake Burley Griffin produced by the National Capital Authority, and the State of the Environment Report produced by the Commissioner for the Environment.

What components of our water resources should we monitor?

The condition or health of our water resources is ultimately reflected in their ecological integrity. Aquatic biota are a key indicator for assessment of ecological integrity, and the ability of waterbodies to provide the range of environmental values we expect. Impacts to biota are usually the final point of environmental degradation and pollution.

In addition to aquatic biota it is important to monitor the hierarchy of components that affect ecological condition—habitat and hydrological characteristics operate at larger scales, and water quality and biological interactions influence ecological condition at smaller scales. Assessment of these components requires information on hydrology, habitat features, water

quality, and aquatic biota.

Water resource assessment requires information on streamflow, groundwater, rainfall and other meteorological parameters.

What monitoring has been done?

A range of agencies or groups is responsible for water resource monitoring in the ACT. Monitoring effort can be classed into four broad categories—agency monitoring conducted across the entire ACT (for example, water quality monitoring conducted by Environment ACT), agency monitoring of a particular area (for example, National Capital Authority monitoring of Lake Burley Griffin), community monitoring across the entire ACT, and monitoring required in relation to a licence or authorisation.

How well does the ACT monitoring meet our information needs?

The ACT has a reasonable monitoring program that meets many of our needs. A range of monitoring objectives is listed in Appendix A. These objectives are relevant for the ACT and are the basis for the monitoring effort across the Territory. As examples, water quality monitoring conducted by Environment ACT provides a measure of the condition of streams affected by urban development and other activities. ACT Health monitors the suitability of ACT waters for body contact recreation.

However, not all the current monitoring has clear, explicit objectives. Consequently it is not possible to establish if these monitoring programs are well designed to meet their objectives. We need to clarify our objectives so that we can provide a more effective program.

Another area which needs consideration is the adequacy of monitoring to test the effectiveness of some of the more recent water management activities implemented and proposed, such as water sensitive urban design, including wetlands, gross pollutant traps, swales, etc; and the effects of demand management on water consumption within the home (long-term and seasonal).

Consideration must also be given to whether groups collecting the data are appropriately trained and accredited under National Standards.

A more detailed discussion of monitoring is presented in Appendix A.

4.3.4 Riparian zone management

The ACT's system of land use planning means that some riparian zones such as the Murrumbidgee and Lower Molonglo River corridors are well managed, with statutory protection, plans of management and status as nature reserves. Other areas, such as parts of Jerrabomberra Creek, have passive management with no particular objectives.

Riparian zones are a vitally important part of aquatic systems, filling roles ranging from pollutant filters and nesting sites to wildlife movement corridors.

The issue of riparian management is discussed in detail in Appendix B.

One problem in managing these areas has been to define what 'riparian zone' means. It is suggested that the following definition be used:

'The riparian zone is that region along lakeshores, streams and rivers where the existing or original emergent vegetation has distinctly different structure and/or floristics from that of adjacent terrestrial areas.'

Riparian zones for individual waterbodies are still difficult to identify and it is suggested that fixed-width riparian management zones be specified which will include the actual riparian zone.

Appendix B goes on to suggest that:

- a range of riparian zone values be identified
- values be assigned to each waterbody or stream reach
- management responsibility be clarified
- management actions be identified which are needed to protect or restore riparian zone values
- a program be put in place to undertake the necessary actions
- the program be evaluated regularly to ensure it is achieving its objectives.

4.3.5 Adaptive management

We need to manage our water resources in an environment of changing information, active community participation, and often incomplete knowledge of our systems. Adaptive management techniques have been evolved for resource management in such an environment. These techniques have been used and will continue to be used to effectively manage the water resources of the ACT. Adaptive management can be defined as *'a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs.'*

The concept of adaptive management was born from the need to manage resources when the risk of trial-and-error methods is too high but decisions cannot be postponed while further data are collected. The process works through active participation and learning, ongoing experimentation, and review. Actions and objectives are based on improved understanding and outcomes of monitoring and review. The adaptive management process is particularly useful where integrated knowledge is needed.

Adaptive management is based on the following principles:

- management decisions should examine economic, social and environmental values in an integrated way
- there may be many different stakeholders in environmental management issues
- there is uncertainty inherent in our understanding and management of environmental processes.

For practical implementation of adaptive management, a framework comprising the six following components is used:

- **Core components** comprise agreed stakeholder processes and community stewardship.
- **Information collation** in which information is pooled to refine the understanding of water resources and explore options. This component identifies knowledge links as well as gaps, and develops better communication between scientists, managers and other stakeholders.
- **Systems analysis and vision** identifies institutional arrangements and allows stakeholders to gain a broad understanding of the catchment systems in order to define their aspirations for the catchment. A range of participatory processes and engagement tools may be used in this step. Aspirations for catchments should be consistent with the current legislation and strategic plans from catchment coordinating bodies and government.
- **Plan making** in which management goals and targets are established and social, economic and ecological impacts are evaluated to negotiate and define a preferred strategy. A range of impact assessment techniques can be used during this phase of the framework.
- **Implementation** of the necessary management actions and definition of responsibilities. Implementation may also include establishment or reinterpretation of relevant codes of practice, guidelines, licenses, or permits.
- **Monitoring and reviewing** the effects of implementing the plan against the agreed environmental values, management goals and targets.

The process of adaptive management is iterative, with additional information from the monitoring and review process leading to a new cycle of systems analysis, plan making and implementation.

4.4 Facilitate incorporation of water sensitive urban design principles into urban, commercial and industrial development

4.4.1 Planning and development controls

Larger water sensitive urban design (WSUD) measures, such as ponds and wetlands, can more easily be implemented during new development or major redevelopment activities. At these times, measures that are very expensive to install in existing buildings or landscapes, can often be incorporated with minimal expense.

Planning and development controls are needed to ensure advantage is taken of all opportunities. These will be required at all levels of the planning, land development and building processes. At the higher level, we need to identify major water features that must be protected, enhanced and incorporated into the urban structure. Specific strategies and major elements (such as lakes and ponds) to be incorporated into the urban landscape then need to be established. For new subdivisions, specific measures need to be identified. On-block measures need to be applied through the development control and building control phases.

4.4.2 Research and development

A continuing research and development program will be needed, as WSUD is a new and

rapidly changing field. Some of this research has already started, for instance the investigation of generic WSUD approaches, and ACT Government investigations into more efficient use of water in public areas. Continuing this work with the demonstration of innovative ideas as part of new development, redevelopment and day-to-day living will be an important element in building our capacity to perform as a water resource management leader and in handling the issues before us.

4.4.3 Developer contributions to water sensitive urban design

Reducing a new development's contribution to stormwater flows is a requirement of the development approval system. For some developments, particularly multi-unit developments, this is achieved by construction of a stormwater retention tank, usually underground. This is costly and the outcome only meets this objective without gaining added benefit such as reusing the water for irrigation as is possible on larger sites.

On such sites it would be sensible to permit the developer to contribute the cost of the stormwater retention tank to an off-site work that would deliver the added benefits. This could be an urban wetland in the same sub-catchment as the development. Approving off-site works to achieve WSUD should not be needed routinely. It should only be made available for large developments on small sites where there is little space for WSUD.

4.5 Promote and provide for community involvement and partnership in management of the ACT Water Resources Strategy

4.5.1 Information and awareness

The drought and water restrictions have demonstrated the high level of community willingness and commitment to change water use practices. Underpinning the community's ability to make these changes is access to reliable, accurate and practical information about water resources, particularly on supply and demand issues and water sensitive urban design.

If the impetus to continue efficient water use practices can be maintained after the drought, the long-term behaviour change needed from the general community, business, industry and government to meet the ACT's water resource targets is possible. Without an information and awareness program to support ongoing learning and behaviour change these targets will be unachievable.

An advantage of information and awareness programs is that they are relatively inexpensive per unit of water saved, compared with building new infrastructure or demand measures such as incentives for showerheads or other water efficient appliances.

To be effective, information and awareness programs need to:

- be targeted to reach all facets of the community—general community, schools, business and industry, government and institutions, using a range of methods or mediums
- create a direct call to action that encourages everyone to take responsibility for their water usage
- be reinforced by demonstration of the measures, through practical, hand-on workshops and displays and also through government leading by example

- actively engage and involve community groups, business and industry to develop and deliver community-based learning strategies
- incorporate a dedicated water web site with more extensive information; interactive DIY water tune-up kit; interactive water use calculators; an education resource area for schools, general community, industry and business; access to brochures and links to other web sites
- incorporate the services of a special purpose technical unit accumulating knowledge, acting as a conduit to other water experts, providing advice to householders, industry, and government
- take account of the needs of people from different cultural backgrounds, with different literacy levels and those speaking a language other than English.

General community

Elements of the information and awareness program needed to reach the general community include:

- a media campaign incorporating seasonal newspaper features, television advertisements, a bus-back campaign, radio advertisements
- 'how to' information including new brochures and fact sheets, accessible through a range of venues, including shopfronts, libraries, community centres, web site, displays at nurseries, hardware stores and community events
- participatory programs including demonstration site visits; hands-on workshops (for example, water wise garden design); water conservation kits (for example, dye, displacement bag, information, water tune-up template, flow regulator); community-based projects
- a range of promotional products such as posters, fridge magnets, mirror or shower stickers and water bottles to reinforce required behaviours.

Community groups have indicated they are ready and willing to engage in activities to educate and involve the community in community-based projects around sustainable water use and management. This will be supported through:

- development of a community oriented learning and action package which can be tailored by various groups based on what is relevant for their needs
- support and funding to groups to undertake development and delivery of community water learning projects (for example, the Australian Government's Cool Communities model which provides successful communities with information, support and financial assistance to help undertake easy practical actions to achieve a reduction of household greenhouse gas emissions).

Schools based programs

Today's children will decide the future use of our water resources. Education can help raise the next generation with knowledge and attitudes that promote wise use of water.

A school water efficiency program, based on the model of 'Waste Wise Schools' recently adopted in the ACT, will lead to lasting behavioural and cultural change in schools, which will flow on to the families and local communities of participating schools.

Such a program, together with 'Waste Wise Schools' would provide a staged approach to the future development of a 'sustainable schools' program in the ACT, incorporating water, waste, energy and biodiversity.

The program will require:

- development of resources, including teacher kits and other information resources
- development and delivery of a professional development program on water efficiency and stormwater issues
- establishment of model schools
- retrofitting of these schools with water saving appliances
- web site development
- an awards program.

Business and industry

Development of effective programs for this group will involve working with industry and business to develop a range of measures to provide access to information about products, services, regulations and approval processes. Measures will include:

- web-based access to information
- workshops and forums on issues and case studies
- water wise awards
- showcasing of water efficient and/or sensitive homes and developments
- access to water auditing services
- access to a special purpose technical unit providing a conduit to water experts and information
- accreditation.

Government and institutions

Community consultation has shown strong desire from the community for:

- government and institutions to lead by example in water efficient practices
- Canberra and the ACT to become a showcase for the rest of Australia as a water efficient city.

Programs to support Government and institutions will include:

- development of a workplace information and awareness kit, incorporating a workplace water challenge or accreditation program
- access to water audit services
- access to a special purpose technical unit providing a conduit to water experts and information
- inclusion of water efficiency and water reuse guidelines in procurement policies and contracts
- support to demonstrate water reduction measures in buildings, public open spaces, and sports grounds to the local and regional community.

Overcoming cultural barriers

All members of the community will need to be involved in achieving more effective water resource management in the ACT, particularly for the behavioural change needed to improve water use efficiency. It is also desirable to facilitate involvement of all sectors of the community in community programs, such as Landcare.

Significant cultural and language barriers need to be overcome to facilitate greater involvement of the Indigenous community and people from non-English speaking backgrounds.

An important water resource consideration is Namadgi National Park's role in protecting a significant part of Canberra's urban water supply. Recently a joint Namadgi Management Board was established to prepare a new plan of management for the park. There is scope to build on this impetus and to generate interest among the Aboriginal community for wider involvement.

People of different cultural backgrounds can make significant contributions to demand management programs as a result of their previous experiences. Information and awareness programs need to communicate with people who do not speak English as a first language.

4.5.2 Community partnerships in developing sub-catchment management plans

Community participation in partnerships with government is essential to the successful development of sub-catchment management plans.

Integrated Catchment Management Framework

The ACT's *Integrated Catchment Management Framework* aims to achieve better management of the natural resources in the Territory. The Framework emphasises the importance of the contribution made by all stakeholders including the community.

The Framework recognises that community contribution on the ground can only be effective if it is underpinned by sound planning and the participants have the capacity to deliver the desired outcomes. To this end, the ACT Government supports community sub-catchment planning and provision of information and capacity building services for community groups. The value of grass roots community input into strategic planning for natural resource

management is also recognised and adequate community consultation arrangements are also supported.

The Framework identifies five building blocks for effective integrated catchment management. These are:

- an effective partnership between the community and government
- all partners have appropriate knowledge and skills
- appropriate legislative and planning instruments are in place
- mechanisms are in place for management coordination
- resources are used effectively.

Land use and group activities

The ACT community appreciates those features of the Territory's natural, built, social and cultural environment that are necessary for sustainable natural systems. The attributes of the 'Bush Capital', with its open spaces and reserves on the city's doorstep and easy access to outdoor recreation, contribute to the quality of life and well being of the community. Similarly, a significant proportion of the ACT community highly values the protection of ecosystems, the conservation of biodiversity and the safeguarding of natural processes such as clean air and water. This appreciation of the local environment provides the impetus for members of the community to become engaged in natural resource management activities.

Community natural resource management activities are wide ranging and include:

- rural landcare
- urban landcare
- Park Care (on reserves)
- Waterwatch
- sub-catchment planning
- providing advice to government.

Sub-catchment management planning

Sub-catchment management plans are an essential tool for coordinating natural resource management in the ACT. The process brings together community groups that may have previously been working in isolation or focusing on a single issue. Getting together and planning enables a more strategic approach to be taken to sub-catchment activities. The benefits include sharing a goal for the sub-catchment, prioritisation of issues on a sub-catchment basis and more efficient use of resources and effort in delivering on-ground action.

Sub-catchment planning also provides a basis for coordinating community and government activities. Although the community owns the plans, they are developed in association with the government. Participation in the process leads to better understanding between the partners

and generates goodwill as they work towards shared environmental outcomes. Significant gains for the environment have already been obtained through this collaborative arrangement as government resources and community effort have been combined on projects such as catchment-wide willow removal in the Ginninderra catchment.

4.5.3 Exploring innovation

Canberra has long prided itself on being a world leader in urban water management. Its system of lakes, ponds, wetlands and floodways has set a standard copied by many other cities. Other cities still look to Canberra for a lead in stormwater management but this is only one part of the urban water cycle and concentrates on improving water quality in public open space after water is gathered in large volumes. This misses the opportunities to more closely imitate nature by allowing urban run-off to infiltrate into the soil and to use urban stormwater as a substitute for mains water.

If Canberra aspires to again set the standard and to benefit from the increased urban and rural amenity which results from good water management, we will need to use all of our innovative skills to develop the systems and products which will best deal with the issues we now face.

Government, industry, and the education and scientific communities in the ACT will need to work together as partners to develop these systems. Our past history as an urban water management leader means we have the skills and capacity to develop the new ideas needed if we work together. History has also demonstrated that being recognised as a leader in water management creates opportunities for Canberra businesses.

A strong research and development program will be needed. Some of this research has already started. ACTEW has already initiated research to ensure we develop a better understanding of the implications of climate change and the impact of the bushfires. The ACT Government is investigating ways to make its use of water in public open space like sports fields more efficient.

Further research will be needed to design the best water sensitive urban design (WSUD) techniques to use in Canberra given that the difference of our soils, climate, run-off, etc. to other parts of Australia means we cannot simply use solutions designed for other environments.

There are some exciting and innovative developments in Canberra and elsewhere in Australia that are incorporating rainwater tanks, infrastructure for recycling treated sewage and greywater, and use of stormwater. These projects are important in demonstrating what can be done to reduce demand on our water supply system.

Examples of innovative solutions that could be considered are:

- new approaches and technologies to use stormwater flows. This work could look at private residential use through to large-scale projects.
- new more cost effective greywater systems which still provide adequate levels of health and environment protection
- small sewage treatment plants located within individual neighbourhoods coupled to

dual reticulation or other reuse systems which promote such reuse

- develop demonstration buildings to showcase best practice water efficient design
- identifying new ways to make our city more sustainable, for example by exploring the possibility of making new office buildings more self-sufficient by recycling as much water as possible. This could involve reclaiming greywater or even blackwater for toilet flushing and garden watering.

All of these ideas come at a cost and care needs to be taken that any innovation is aimed at developing the solutions that provide the best combination of economic, environmental, social and public health outcomes.

The development of these innovations needs to be closely linked to our Water Resources Goal and Objectives.

5 Appendix A: ACT water monitoring

5.1 Monitoring Categories

Monitoring information can be considered in two categories:

- condition assessment (for example, water quality, habitat condition)
- resource assessment (for example, river flow and rainfall data).

5.1.1 Condition assessment

Condition assessment is conducted for a range of objectives. The document *'Australian Guidelines for Water Quality Monitoring and Reporting by ANZECC and ARMCANZ (2000)'* reports that monitoring is conducted to:

- measure the quality of freshwater
- provide assurance that the water meets appropriate guidelines for its designated use
- investigate why the water may not be meeting such guidelines
- assess the loads of materials entering the water body from the catchment
- characterise the biota within a river or lake
- assess the state of the resource for State of the Environment reporting
- assess the effectiveness of management actions for contaminant control, restoration or rehabilitation of waters
- identify trends in the condition of the water body.

5.1.2 Resource assessment

Resource assessment in the ACT is largely undertaken for the following objectives:

- water resources assessment for drinking water supplies
- public health protection in recreational waters
- flood forecasting for roads, bridges and dams
- flood plain mapping for urban development non-structural flood protection
- extreme flood estimation, particularly for dams
- design for structural flood protection from urban stormwater
- rural flow assessment for resource management
- environmental flow releases determination
- determination of flow quantity for use in conjunction with quality monitoring.

Following identification of clear objectives, a monitoring program can be designed to achieve those objectives. Monitoring is expensive and needs to be tailored to address key objectives. Monitoring may take the form of a single study examining a particular issue, or ongoing monitoring to detect trends in resource status or condition.

The environmental values we seek to maintain in different waterbodies is the starting point to determine what most river and lake monitoring in the ACT should entail. For example, we might be seeking to maintain a catchment for water supply, as well as for aquatic ecosystem values or recreational fishing amenity. We would need to know the condition of water resources in the catchment to manage for these environmental values. We also have responsibilities to protect the environmental values of downstream waters, both in the ACT and downstream.

5.2 What should we monitor?

The condition or health of our water resources is ultimately reflected in their ecological integrity. Aquatic biota are a key indicator for assessment of ecological integrity, and the ability of waterbodies to provide the range of environmental values we expect. Impacts to biota are usually the final point of environmental degradation and pollution.

In addition to aquatic biota it is important to monitor the hierarchy of components that affect ecological condition—habitat and hydrological characteristics operate at larger scales, and water quality and biological interactions influence ecological condition at smaller scales. Assessment of these components requires information on hydrology, habitat features, water quality, and aquatic biota.

Monitoring is also necessary to ensure organisms or contaminants, which could impact on human health, are not a concern in waters humans consume or use for recreational activities.

Water resource assessment requires information on streamflow, groundwater, rainfall and other meteorological parameters.

The components required for condition and resource assessment are:

- **Aquatic biota** includes groups such as fish, macroinvertebrates, algae and frogs.
- **Water quality**—Traditional water quality monitoring can include monitoring of nutrients, trace metals, pesticides and herbicides, hydrocarbons, other chemicals, and physical measurements.
- **Flow and rainfall**—Streamflow normally requires significant infrastructure for accurate and reliable information. Rainfall data is similar, though the infrastructure requirements are smaller.
- **Groundwater characteristics** commonly monitored include depth of the water table, the salinity and the yield at which groundwater can be pumped.
- **Stream habitats** are characterised by the shape and size of the stream, the substrate in the bottom of the stream, and presence of logs and macrophytes. The complexity of stream habitat means it can be difficult to characterise.
- The **riparian zone** is that region immediately adjacent to lakes and rivers which is characterised by different vegetation. The riparian zone is an important interface for water

bodies, buffering the stream from upslope land uses and providing habitat. The riparian vegetation is the key measure, although the physical condition, for example, gullying, is also important.

5.3 Who is responsible for monitoring?

The range of agencies and groups responsible for water resource monitoring in the ACT is summarised in Table 7. Monitoring effort can be classed into four broad categories—agency monitoring conducted across the entire ACT (for example, water quality monitoring conducted by Environment ACT), agency monitoring of a particular area (for example, National Capital Authority monitoring of Lake Burley Griffin), community monitoring across the entire ACT, and monitoring required in relation to a licence or authorisation.

Table 7: Responsibility for monitoring of water resources in the ACT

Agency or group	Monitoring focus
Environment ACT	Compliance with licence and authorisation conditions
	Condition of lakes and rivers across the ACT
	Aquatic biota and biota in the riparian zone across the ACT
Canberra Urban Parks and Places (CUPP)	Condition of Canberra's urban lakes, ponds and urban waterways.
ACT Forests	Water quality in catchments used for plantation forestry
Roads ACT	Flood data for flood warning and infrastructure planning
ACT Health	Microbiological condition of waters used for body contact recreation
National Capital Authority	Water quality and flood operations of Lake Burley Griffin
ACTEW	Water resources in the current and possible future water supply catchments. Condition of rivers in the ACT water supply catchments and downstream of the Lower Molonglo treatment plant
Waterwatch	Community based monitoring focussed on river and stream condition across the ACT

5.4 What monitoring is done?

Monitoring is conducted for a range of variables, at different frequencies and at different sites. The monitoring conducted across the ACT has been summarised in Table 8. Included is information on the number of sites surveyed in each catchment, classified by the rigour of the survey. Surveys can be at different levels of intensity—from assessments of a number of variables and good quality control of the data, to basic assessments with less rigorous quality control.

Prominent features of the monitoring effort across the ACT are:

- Although there are a significant number of sites monitored across the ACT, only one

quarter have high quality data. For catchments with high quality data, the majority are sampled at two or fewer sites, which may not be representative of river or lake condition across a large catchment.

- Biota sampled are fish and the macroinvertebrate community structure (See Table 8). Fish tend to be sampled biennially or even less frequently. Macroinvertebrate sites are sampled twice yearly. Approximately half the catchments have sites with high quality data, focussing on the major streams and urban lakes.
- Water quality sites include lake and river sites sampled for a suite of variables and for microbiological quality. Again, approximately half the catchments have sites with high quality data.
- There is a comprehensive set of flow gauging and rainfall stations across the ACT. Continuous recording at these strategically chosen sites has provided an excellent database for water resource assessment.
- Very limited information on groundwater quality or groundwater flow rates is available.
- In-stream habitat and riparian zone condition are not well sampled across the ACT. The riparian zone information is particularly poor as the assessments reported here are at individual sites. A realistic assessment of riparian condition requires an assessment along the length of a river.

Table 8: Summary of monitoring undertaken in each sub-catchment

Sub-Catchment	Biota	Water quality	Flow & rainfall	Groundwater	Habitat	Riparian zone
Michelago	5 (11)	2 (3)	2 (2)	-	1 (2)	1 (2)
Tharwa	2 (3)	1 (3)	9 (9)	-	-	0 (1)
Kambah	4 (5)	1 (5)	-	-	-	0 (1)
Uriarra	4 (6)	1 (16)	3 (3)	-	-	0 (2)
Woodstock	1 (1)	1 (1)	-	-	-	-
Guises	-	-	-	-	-	-
Naas	0 (1)	0 (1)	2 (2)	-	-	0 (1)
Gudgenby	0 (9)	0 (8)	7 (7)	1 (1)	-	0 (8)
Tennent	0 (1)	1 (2)	2 (2)	-	-	0 (1)
Corin	5 (6)	1 (2)	5 (5)	-	1 (1)	1 (1)
Bendora	8 (8)	2 (2)	1 (1)	-	2 (2)	2 (2)
Lower Cotter	8 (8)	3 (3)	3 (3)	-	3 (3)	3 (3)
Paddys	3 (8)	1 (15)	2 (2)	-	1 (5)	1 (5)
Tuggeranong	4 (8)	7 (10)	6 (6)	-	1 (5)	1 (5)
Upper Molonglo	NSW catchment					
Kowen	-	1 (9)	4 (4)	-	-	-
Fyshwick	-	2 (2)	1 (1)	-	-	-
Jerrabomberra Headwaters	NSW catchment					
Jerrabomberra	2 (6)	1 (3)	6 (6)	-	1 (3)	1 (3)
Lake Burley Griffin	4 (4)	11 (11)	3 (3)	-	-	-

Sub-Catchment	Biota	Water quality	Flow & rainfall	Groundwater	Habitat	Riparian zone
Coppins	2 (3)	1 (8)	3 (3)	-	-	0 (1)
Woolshed	-	-	-	-	-	-
Sullivans	0 (7)	0 (3)	5 (5)	-	-	0 (3)
Woden	-	-	2 (2)	-	-	-
Weston	0 (2)	0 (2)	1 (1)	-	-	0 (2)
Tinderry	NSW catchment					
Googong	NSW catchment					
Lower Queanbeyan	0 (1)	-	2 (2)	-	-	-
Burra	NSW catchment					
Gungahlin	2 (6)	1 (4)	5 (5)	1 (1)	-	0 (3)
Lake Ginninderra	5 (11)	10 (13)	3 (3)	-	2 (5)	2 (5)
Parkwood	1 (13)	2 (7)	-	-	1 (6)	1 (6)

Note: the first number in each cell is the number of high quality sites in that catchment monitored for a particular component, for example, biota. The number in brackets is the total number of sites monitored. This summary does not include monitoring on water supply reservoirs, or on New South Wales catchments by New South Wales agencies.

6 Appendix B: Riparian zone management plan

The riparian zone is the place where aquatic systems are directly influenced by the adjacent terrestrial environment. Virtually all rainwater run-off must pass through the riparian zone before moving into adjacent aquatic or estuarine systems. It has been termed the terrestrial/aquatic interface.

Definition

There is no common agreed definition of the riparian zone across the ACT. In other parts of Australia the riparian zone has been defined in a number of different ways. A review of riparian vegetation by the *National Land and Water Resources Audit* (NLWRA 2000) recommended that a vegetation-based definition be used in upland regions where there is no floodplain development. This approach can be used in the ACT with the modification to include areas from which vegetation has been cleared, giving:

'The riparian zone is that region along lakeshores, streams and rivers where the existing or original emergent vegetation has distinctly different structure and/or floristics from that of adjacent terrestrial areas.'

Waterbodies covered by this management plan

Waterbodies in the ACT range in size from the Murrumbidgee River to ephemeral streams with no defined watercourse, and a series of lakes and ponds. This *Riparian Zone Management Plan* is intended to apply to all the streams, lakes and ponds listed in Table 12.

6.1.1 Functions of the riparian zone

The riparian zone provides a range of functions and services, including ecological functions, bank stability and erosion control, pollutant buffers, recreation and amenity, agriculture and material extraction.

Ecological functions

The riparian zone provides habitat for a range of flora and fauna, generates resources such as organic material for in-stream processes and maintains biodiversity. Examples of habitat provision are the use of riverine areas for nesting and perching by aquatic birds, and large woody debris that creates habitat for a range of aquatic and semi-aquatic species. The riparian zone shades the stream, buffering stream temperature, and is a source of in-stream organic material. It also provides habitat for threatened riparian dependent species, and creates a vegetated corridor for wildlife (honeyeater migration etc.).

In many instances we do not have an adequate understanding of animal–habitat relationships. In the absence of this information management plans may need to be based on knowledge of key species, or on an application of general principles of habitat management. Regional context is also an essential element of riparian management, and should be considered when goals are being formulated.

The riparian zone also affects in stream processes—providing shade, a source of organic material and habitat for some aquatic invertebrate species.

Land and Water Australia recommends that the width of riparian vegetation for habitat and wildlife corridors should range from 50 m to over 100 m depending on local circumstances.

However, it was accepted that a minimum of at least 30 m of riparian vegetation was better than none. Connection with other vegetated areas upstream and downstream should be maximised. In some instances the corridor function of the riparian vegetation plays a key role for ecologically important species. In this situation the longitudinal connection of riparian vegetation will need to be clearly defined.

The plant species promoted will depend on the ecological goals—an entirely natural community, protection of a particular wildlife species, or remediation of a degraded system to an acceptable state. Vegetation structural diversity is also important. There should be a full range of plant life forms typical to the area from understorey plants through to canopy trees.

Bank stability and erosion control

The vegetation in the riparian zone maintains bank stability by binding soil with root mats, etc. and reduces erosion. The following issues should be taken into consideration:

- recreation, catchment and adjacent land management practices impact directly on erosion, which in turn impacts on riparian zones
- urban infrastructure—erosion frequently occurs where stormwater pipes deposit surface run-off into the soft landscape or drainage lines adjacent to a waterbody
- riparian vegetation needs to be controlled at outlets entering directly into a stream to prevent blocking of the pipe and localised flooding
- erosion is an issue around formed lakes and for lake islands
- vegetation along soft landscaped drainage lines leading into riparian zones are sometimes controlled using herbicide to maintain a neat appearance. Vegetation along these drainage lines should be encouraged, as long as it does not block the stormwater outlet
- vegetation management in riparian zones is an issue in relation to weed control, i.e. willow removal along the Molonglo River
- recreation activities and exploitive uses have a major impact on riparian vegetation.

Pollutant buffers

Under natural conditions, sediment and nutrients are transported from land to water in run-off. Vegetated riparian land, by acting as a 'buffer', plays an important role in reducing this movement. When riparian vegetation is removed the ability of riparian land to act as a buffer is diminished, and the rate of transfer of sediment and nutrients from land to water increases. Increases in delivery of nutrients or sediment to streams can lead to eutrophication of waterways and smothering of in-stream habitat.

Buffer strips only trap and store sediment and nutrients effectively if the incoming overland flow is diffuse and less than about one centimetre deep. If the flow is concentrated or too deep it will overwhelm the capacity of the vegetation to intercept material.

Buffer strips do not act as effectively on slopes greater than 5 per cent; and such land is often an additional source of sediment. Land and Water Australia recommends that buffer strips be

a minimum of 10 m wide for low gradient land, and 5 m for steeper riparian land.

Recreation and amenity

Some riparian zones, particularly those around urban lakes and ponds, are designed principally for providing recreation opportunity and amenity values. These values are detailed in the relevant plans of management. Within these areas approved recreational activities are encouraged as long as they do not impact on other riparian values or the values of the waterbody. For many other riparian zones, recreation and amenity values are a secondary value.

Appropriate management of riparian vegetation in urban areas, natural creek lines and around formed waterbodies needs to be considered for amenity and recreational purposes. Examples are harvesting of *Vallisneria* and control of *Typha* where they reduce access and create hazards to the public.

Some sections of the urban lakes in the ACT have a hard-edged riparian zone. This approach is appropriate for specific recreational management objectives and is recognised as a riparian zone value. Nevertheless, future constructed waterbodies should aim to maximise natural riparian vegetation where possible, while taking into account recreation and maintenance.

Agriculture and material extraction

Some commercial activities take advantage of characteristics of the riparian zone. For example, agricultural production can focus on the richer riparian soils and proximity to water. Sand and gravel extraction are often associated with riparian zones.

Commercial uses of the riparian zone, including agriculture, sand and gravel extraction and forestry, differ from uses previously discussed. Preceding uses were for protection and maintenance of assets for the entire community. Commercial uses, while they can be legitimate and appropriate, involve the use of riparian resources and are for the benefit of individuals or commercial entities.

6.1.2 Riparian zones values in the ACT

The riparian zone values in Table 9 have been derived from existing policy that applies to the riparian zone including:

- the Territory Plan (stipulates environmental values for catchments. Riparian zone values have been derived from the catchment in which they occur)
- the Nature Conservation Strategy and Action Plans (include specific requirements for some riparian zones)
- Plans of Management (both urban and non-urban) including those for the River Corridors.

Different levels of some riparian zone values have been identified. For instance three levels of ecological functions have been identified to distinguish the ecological values expected of the pristine riparian zone in Namadji National Park from those of modified streams and those of urban lakes and ponds.

Table 9: Riparian zone values

Riparian values	Description of value
ECOL1	Ecological values provided by a largely unmodified riparian zone in a pristine catchment. Values will include instream and terrestrial habitat, water quality, biodiversity and passage for movement.
ECOL2	Ecological values provided by relatively intact riparian zone but where the catchment has been significantly modified, and longitudinal connection has been disrupted.
ECOL3	Ecological values provided by a riparian zone in an urban area that has been created during the construction of a pond or waterway.
BUFFER	Pollutant interception that would be achieved by a well vegetated well managed riparian zone without cross-zone rills or gullying.
REC1	Provide appropriate recreational amenity for riparian recreational activities including walking, fishing, picnicking, swimming, sailing, model boat clubs and aesthetic appreciation.
REC2	Provide appropriate recreational amenity for riparian recreational activities in sections of lakes and ponds lined with constructed walls.

6.1.3 Riparian zone condition required to achieve riparian values

There is a direct relationship between the riparian values for waterbodies (for example, ECOL1, BUFFER) and the on-ground conditions needed to meet these values (see Table 10). The condition of the riparian zone should be assessed using structural and functional components of the zone:

- geomorphological structure—ranges from streams with no widening, erosion, or armouring to streams with considerable erosion, aggradation, or widening
- vegetation—ranges from streams with structurally and floristically intact riparian vegetation to those that have lost all riparian vegetation
- fauna—ranges from streams with an intact, fully functioning faunal community to one with many species missing or one dominated by pest species
- longitudinal connection includes streams ranging from those with an uninterrupted riparian vegetation connection upstream and downstream to streams with a riparian zone fragmented by numerous gaps posing significant obstacles to the movement and/or colonisation of biota.

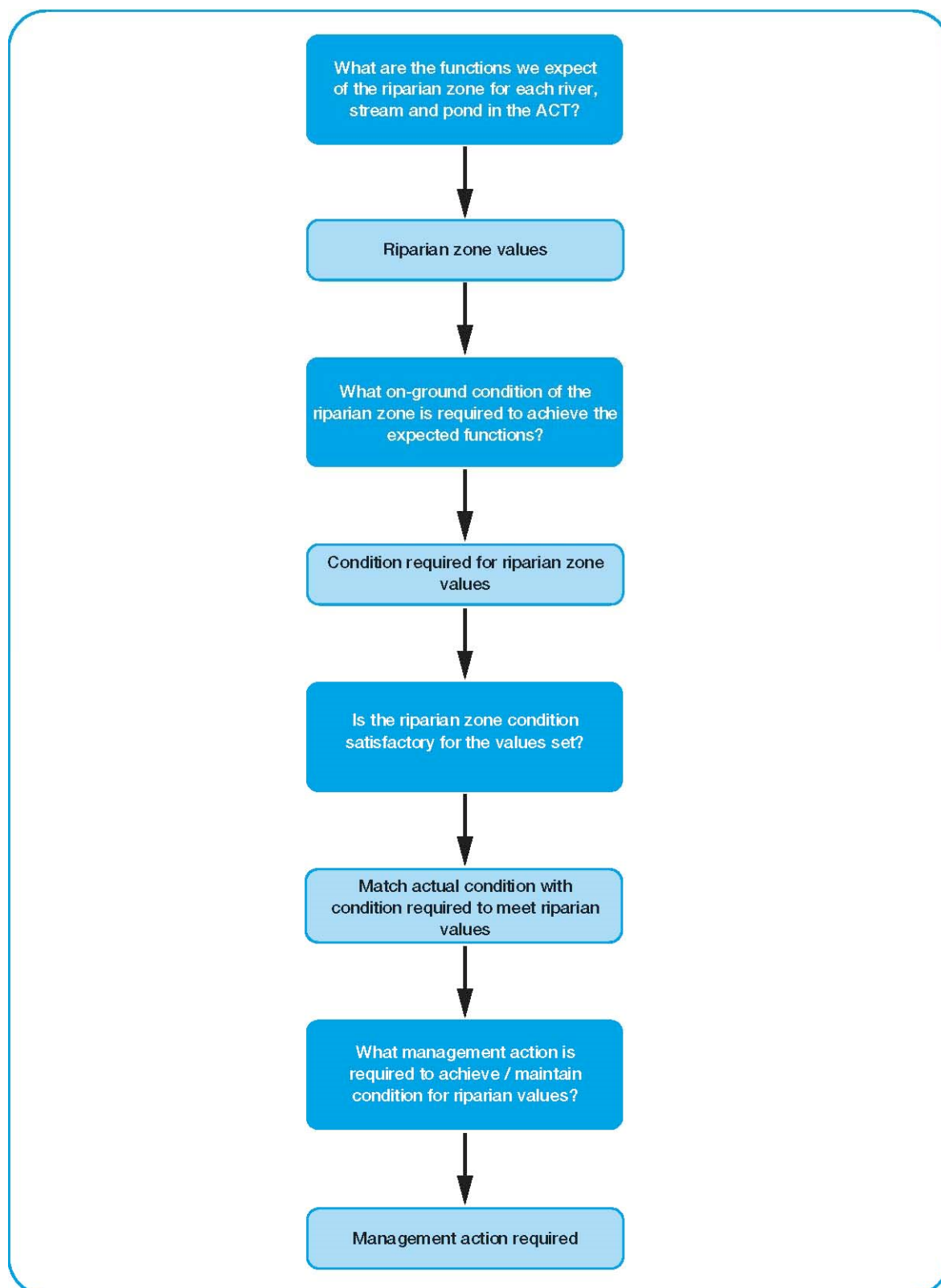
Table 10: Conditions required to achieve riparian zone values

	Geomorphological structure	Vegetation	Fauna	Longitudinal connection
ECOL1	Similar to pre-development condition. No bank or bed erosion, no armouring or deposition.	Vegetation structure and floristics similar to pre-development condition. Insignificant weed competition.	Fauna similar to pre-development condition. No introduced pests	Vegetation in good condition upstream/downstream for at least 5 km
ECOL2	Limited bank or bed erosion, limited armouring or deposition.	Loss of a limited percentage of expected species, small change to structure, minor weed competition.	Loss of a limited percentage of expected species, minor pest problems.	Vegetation in good condition though connection disrupted by numerous gaps upstream/downstream for 5 km
ECOL3	Bank not benched or undercut	Comprises overstorey, understorey and emergent macrophytes – all endemic species. Minor weed competition	Not applicable	Not applicable
BUFFER	No rills or erosion features passing through riparian zone into stream/waterbody	Healthy vegetation, especially groundcover in areas subject to overland flow	Not applicable	Not applicable
REC1	As for ECOL2 (rivers) or ECOL3 (ponds). Frequently require appropriate recreation infrastructure (eg access, parking, signage, furniture, boat launching facility, swimming beaches).			
REC2	As for ECOL3 (ponds). Frequently require appropriate recreation infrastructure (eg access, parking, signage, furniture, boat launching facility, swimming beaches).			

6.1.4 Management

The schema for riparian zone management in the ACT is described in Figure 3. It takes the form of a series of questions, leading from broad objectives to on-ground management actions.

Figure 3: Decision making for riparian zone management



Riparian management zone

The width of the riparian zone will depend on the stream size and form, altitude and topography. It may take expert advice to determine the width of the riparian zone at any point.

Consequently it is useful to define a riparian management zone for day-to-day management. In that way management actions applied to protect the riparian management zone will protect the 'true' riparian zone contained within it.

The riparian management zone is defined as a fixed distance from the top of the riverbank and is based on the bank full width. The top of the bank can be determined from the presence of flood deposits, the limits of lichen growth on rocks, an abrupt change in the slope of the bank, scour lines or vegetation limits.

Three categories of riparian management zone and one for lakes and ponds are defined:

- Murrumbidgee, Molonglo and Queanbeyan Rivers—the riparian management zone is that strip of land extending 50 m away from the top of the river bank on each side of the river;
- Cotter, Gudgenby, Naas—the riparian management zone is that strip of land extending 30 m away from the top of the river bank on each side of the river
- all other streams—the riparian management zone is that strip of land extending 20 m away from the top of the river bank on each side of the river
- lakes and ponds—the riparian management zone is an area extending back 30 m from the bank at full supply level.

Condition of zone in relation to riparian zone values

Appropriate management of a riparian zone requires an assessment of the riparian zone condition in terms of the quality requirements (see Table 10).

Where the condition falls short of the required outcome, management action activities may be needed. This may take the form of rehabilitation of a riparian zone to an original condition, remediation or protection of the zone.

Additionally, the factors threatening riparian zone condition in an area should also be identified. Factors that threaten the integrity of the riparian zone include:

- **grazing** can damage riparian vegetation (particularly understorey vegetation), prevent regeneration, compact soil and exacerbate erosion and bank slumping in the riparian zone
- **clearing** of the riparian zone
- **flow regime change**—increased frequency of high flows can increase bank and bed erosion and waterlogging. Reduced frequency, seasonal nature and size of flooding can affect regeneration of vegetation. Rapid drops in water levels can leave the bank saturated and can lead to slumping.
- **aquatic and terrestrial weeds**
- **excavation construction** clears vegetation, influences flow, and disturbs stream channels, which can accelerate erosion and sedimentation

- inappropriate **recreational activities**.

Management actions

- Management actions consist of remediation or rehabilitation; management of threatening processes; and monitoring.

Remediation or rehabilitation

Remediation, rehabilitation and protection actions may address geomorphological, vegetation or faunal condition.

Geomorphological condition

- bank stabilisation—a range of actions may be needed
- restoration of a more natural flow regime
- creation of pools by adding structures to create scour forces (groynes/logs).

Vegetation condition

- removal of grazing and other pressures to encourage natural regeneration
- removal of exotic species
- planting with appropriate species.

Fauna

- restoration of habitat (both in-stream and riparian)
- removal and/or management of pest animal species
- restoration of upstream–downstream connection of habitat.

Management of threatening processes

Management of a riparian zone may be needed without full information on the riparian condition or of the extent of threatening factors. For these circumstances the following default management approaches should be used to deal with threatening factors:

Agriculture

- exclude stock from riparian management zone except for habitat or fire fuel management purposes. This will require provision of alternative stock watering facilities.
- manage agricultural activities to ensure fertiliser, herbicide or pesticide applications; ploughing etc. do not impact on streams.

Clearing of the riparian zone

- prohibit clearing of native vegetation unless required for habitat or fire fuel management, or for approved construction.

Flow regime

- ensure the flow regime in regulated rivers and streams does not compromise streambed and bank condition.

Exotic vegetation

- clear and/or manage exotic plants in the riparian zone, focussing on those identified as weedy species (for example, willows) or those impacting on biota of concern. In the urban area there may be exotic tree species that are protected by tree protection legislation.

Excavation, construction and forestry activities

- exclude excavation, construction and forestry activities from the riparian management zone except when identified in an accepted Code of Practice (for example, road crossing) or for habitat management purposes (for example, controlled sand extraction to reinstate pools)
- require all permitted activities conducted within the riparian management zone to be conducted in accordance with an agreed Code of Practice, development application or management plan.

For guidance on the specific approaches and measures to use for remediation, rehabilitation or protection and for managing threatening processes, river and land managers should refer to the riparian guideline documents produced by Land and Water Australia found on its website at: <http://www.lwa.gov.au/products.asp>, including:

- Riparian Land Management Technical Guidelines Vol 1: Principles of sound management
- Riparian Land Management Technical Guidelines Vol 2: On-ground management tools and techniques
- River and Riparian Management Fact Sheet 1—Managing Riparian Land
- River and Riparian Management Fact Sheet 2—Streambank Stability
- River and Riparian Management Fact Sheet 3—Improving Water Quality
- River and Riparian Management Fact Sheet 4—Maintaining In-stream Life
- River and Riparian Management Fact Sheet 5—Riparian Habitat for Wildlife
- River and Riparian Management Fact Sheet 6—Managing Stock

Monitoring

A key component in effective riparian zone management is information on condition, on the factors impacting on condition, and on the effectiveness of management responses. Currently we have little information on any of these areas for the ACT riparian zones. An overview of riparian monitoring, including recommendations, is included in Appendix A.

6.1.5 Riparian zone responsibilities

Responsibility for managing the riparian zone has been delegated to a number of agencies and there are existing policy documents that either deal with the riparian zone or cover the area in which the riparian zone falls. These are listed in Table 11.

Table 11: Areas of responsibility and policies relating to the riparian zone

Management responsibilities	Agency	Management policy	Content of policy in relation to riparian zone
Fundamental riparian management principles	EACT EACT	The National Strategy for Ecologically Sustainable Development (ESD) Integrated Catchment Management Strategy for the ACT	Development in all areas including riparian zone should follow ESD principles. General recognition that riparian management needed.
Planning, and its implications for the riparian zone	ACTPLA	Territory Plan	No explicit recognition. Sets broad objectives for land uses including area in which riparian zones fall.
Fauna and flora protection	EACT EACT	Nature Conservation Strategy Threatened species action plans	Recognises linkages between streams and riparian zone and describes common impacts. Protection of riparian vegetation is an objective. Some action plans make explicit reference to condition / protection of riparian zone.
Wetlands	EACT	Draft wetland policy	Wetland definition does not include the riparian zone.
Willows	EACT	Willow Management Strategy of the Upper Murrumbidgee Catchment.	Management of willows in riparian zone.
Construction and operation of infrastructure in the riparian zone in the ACT (chiefly urban)	Roads ACT	Urban Stormwater, Edition 1, Standard Engineering Practices	Specifies infrastructure requirements in streamlines. Does not explicitly acknowledge riparian zone.
Riparian zone in parks and reserves	EACT	Nature park, nature reserve, river corridor, wetland and national park plans of management	Limited explicit recognition of the riparian zone even in plans for river corridors. Natural resource inventories and their management actions tend to focus on either water or terrestrial areas.

Management responsibilities	Agency	Management policy	Content of policy in relation to riparian zone
Riparian zone in urban open space	CUPP	Plans of management for regions including urban streams and lakes	No explicit recognition of streams or riparian zone.
Riparian zone in rural leases	Rural leaseholders	Property management agreements (standard clauses for management of the riparian zone)	Specifies management actions for the riparian zone.
Riparian zone in forestry land use	ACT Forests	Draft Water quality and riparian protection strategy	Specifies management actions for the riparian zone.
Riparian zone around Lake Burley Griffin	NCA	Lake Burley Griffin Plan of Management	Specifies management actions for the riparian zone.

EACT = Environment ACT

CUPP = Canberra Urban Parks and Places

ACTPLA = ACT Planning and Land Authority

NCA = National Capital Authority

Table 12: Riparian zone values for rivers, streams, lakes and ponds

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Cotter Catchment			
Blundells Creek	ECOL1, BUFFER	3.7 km	EACT
Bullock Head Creek	ECOL1, BUFFER	3.8 km	EACT
Burkes Creek	ECOL1, BUFFER	4.6 km	EACT
Bushrangers Creek	ECOL1, BUFFER	5.2 km	EACT
Condor Creek	ECOL1, BUFFER	12.0 km	EACT, ACT Forests
Cotter River	ECOL1, BUFFER	77.0 km	EACT, ACT Forests
Collins Creek	ECOL1, BUFFER	3.3 km	EACT
Coree Creek	ECOL1, BUFFER	2.5 km	EACT
Cow Flat Creek	ECOL1, BUFFER	4.8 km	EACT

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Creamy Flat Creek	ECOL1, BUFFER	6.4 km	EACT
Cribbs Creek	ECOL1, BUFFER	5.1 km	EACT
De Salis Creek	ECOL1, BUFFER	5.5 km	EACT
Franklin Creek	ECOL1, BUFFER	7.2 km	EACT
Gingera Creek	ECOL1, BUFFER	4.1 km	EACT
Ginini Creek	ECOL1, BUFFER	6.1 km	EACT
Jacks Creek	ECOL1, BUFFER	6.0 km	EACT
Kangaroo Creek	ECOL1, BUFFER	8.2 km	EACT
Licking Hole Creek	ECOL1, BUFFER	8.9 km	EACT
Long Creek	ECOL1, BUFFER	7.4 km	EACT
Lees Creek	ECOL1, BUFFER	10.9 km	EACT, ACT Forests
Mckeahnie Creek	ECOL1, BUFFER	5.9 km	EACT
Mosquito Creek	ECOL1, BUFFER	3.9 km	EACT
Porcupine Creek	ECOL1, BUFFER	7.2 km	EACT
Pierces Creek	ECOL1, BUFFER	11.0 km	EACT, ACT Forests
Snowy Flat Creek	ECOL1, BUFFER	6.0 km	EACT
Stockyard Creek	ECOL1, BUFFER	11.1 km	EACT
Unnamed1	ECOL1, BUFFER	3.6 km	EACT
Naas Catchment			
Back Creek	ECOL1, BUFFER	14.5 km	EACT
Bulls Flat Creek	ECOL1, BUFFER	3.8 km	EACT
Gudgenby Creek	ECOL1, ECOL2, BUFFER	9.5 km	EACT, Rural lessees
Left Hand Creek	ECOL1, BUFFER	7.2 km	EACT
Long Flat Creek	ECOL1, BUFFER	7.9 km	EACT
Naas Creek	ECOL1, BUFFER	28.9 km	EACT
Naas River	ECOL1, ECOL2, BUFFER	25.8 km	EACT, Rural lessees

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Sheep Station Creek	ECOL1, BUFFER	6.1 km	EACT
Reedy Creek1	ECOL1, BUFFER	7.6 km	EACT
Shanahans Falls Creek	ECOL1, BUFFER	4.2 km	EACT
Unnamed17	ECOL1, BUFFER	3.1 km	EACT
Unnamed2	ECOL1, BUFFER	8.5 km	EACT
Unnamed3	ECOL1, BUFFER	4.7 km	EACT
Gudgenby Catchment			
Bogong Creek	ECOL1, BUFFER	11.4 km	EACT
Booroomba Creek	ECOL1, BUFFER	14.2 km	EACT
Dry Creek	ECOL1, BUFFER	13.2 km	EACT
Gudgenby River	ECOL1, ECOL2, BUFFER	31.3 km	EACT, Rural lessees
Half Moon Creek	ECOL1, ECOL2, BUFFER	7.7 km	EACT, Rural lessees
Honeysuckle Creek	ECOL1, BUFFER	9.5 km	EACT
Hospital Creek	ECOL1, BUFFER	11.6 km	EACT
Hospital Creek East	ECOL1, BUFFER	7.3 km	EACT
Middle Creek	ECOL1, BUFFER	14.3 km	EACT
Nursery Creek	ECOL1, BUFFER	10.1 km	EACT
Orroral River	ECOL1, BUFFER	18.4 km	EACT
Rendezvous Creek	ECOL1, BUFFER	12.6 km	EACT
Sawpit Creek	ECOL1, BUFFER	7.8 km	EACT
Unnamed5	ECOL1, BUFFER	2.7 km	EACT
Unnamed6	ECOL1, BUFFER	3.3 km	EACT
Paddys Catchment			
Blue Gum Creek	ECOL1, ECOL2, BUFFER	16.7 km	EACT, Rural lessees
Billy Billy Creek	ECOL1, ECOL2, BUFFER	3.8 km	EACT, ACT Forests

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Gibraltar Creek	ECOL1, ECOL2, BUFFER	13.3 km	EACT, ACT Forests, Rural lessees
Hurdle Creek	ECOL1, BUFFER	4.8 km	EACT
Larrys Creek	ECOL1, ECOL2, BUFFER	7.9 km	EACT, Rural lessees
Mountain Creek	ECOL1, BUFFER	4.4 km	EACT
Punchbowl Creek	ECOL1, ECOL2, BUFFER	7.6 km	EACT, ACT Forests, Rural lessees
Paddys River	ECOL1, ECOL2, BUFFER	28.4 km	EACT, ACT Forests, Rural lessees
Tidbinbilla River	ECOL1, ECOL2, BUFFER	13.4 km	EACT, ACT Forests, Rural lessees
Tanners Flat Creek	ECOL1, ECOL2, BUFFER	7.6 km	EACT, ACT Forests, Rural lessees
Unnamed8	ECOL1, BUFFER	2.6 km	EACT
Murrumbidgee Catchment			
Bulgar Creek	ECOL1, ECOL2, BUFFER	5.2 km	EACT, ACT Forests, Rural lessees
Murrumbidgee River	ECOL1, ECOL2, BUFFER, REC1	58.7 km	EACT, Rural lessees
Reedy Creek2	ECOL1, ECOL2, BUFFER	3.1 km	EACT, ACT Forests
Sawyers Gully	ECOL1, ECOL2, BUFFER	7.0 km	EACT, Rural lessees
Swamp Creek	ECOL2, BUFFER	1.8 km	Rural lessees
Stony Creek	ECOL1, BUFFER	4.3 km	EACT
Uriarra Creek	ECOL1, ECOL2, BUFFER	13.9 km	ACT Forests, Rural lessees
Unnamed4	ECOL1, ECOL2, BUFFER	1.1 km	EACT, Rural lessees

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Unnamed7	ECOL1, ECOL2, BUFFER	3.2 km	EACT, ACT Forests
Lower Stranger Pond Creek	ECOL1, ECOL2, ECOL3, BUFFER, REC1	3.3 km	CUPP, EACT
Point Hut Pond Creek	ECOL1, ECOL2, ECOL3, BUFFER, REC1	5.4 km	CUPP, EACT
Molonglo Catchment			
Glenburn Creek	ECOL2, BUFFER	5.3 km	Rural lessees, ACT Forests
Jerrabomberra Creek	ECOL2, BUFFER	10.8 km	EACT, Rural lessees, CUPP
Molonglo River	ECOL2, BUFFER	58.0 km	EACT, Rural lessees, CUPP, ACT Forests
Queanbeyan River	ECOL2, BUFFER	0.6 km	Rural lessees
Reedy Creek3	ECOL2, BUFFER	8.3 km	EACT, Rural lessees, ACT Forests
Unnamed11	ECOL2, BUFFER	3.4 km	Rural lessees, ACT Forests
Weber Creek	ECOL2, BUFFER	5.3 km	Rural lessees, ACT Forests
Weston Creek	ECOL2, ECOL3, BUFFER, REC1	5.2 km	CUPP, ACT Forests, Rural lessees
Ginninderra Catchment			
Gooromon Ponds Creek	ECOL2, BUFFER	2.9 km	Rural lessees
Ginninderra Creek	ECOL2, ECOL3, BUFFER, REC1	23.4 km	EACT, Rural lessees, CUPP
Hall Creek	ECOL2, BUFFER, REC1	7.3 km	Rural lessees
Unnamed12	ECOL2, ECOL3, BUFFER, REC1	8.7 km	Rural lessees
Unnamed13	ECOL2, ECOL3, BUFFER, REC1	3.4 km	Rural lessees

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Unnamed14	ECOL2, ECOL3, BUFFER, REC1	2.9 km	Rural lessees
Unnamed15	ECOL2, ECOL3, BUFFER, REC1	2.6 km	Rural lessees
Tuggeranong Catchment			
Tuggeranong Creek	ECOL2, ECOL3, BUFFER, REC1	12.7 km	Rural lessees, CUPP
Village Creek	ECOL2, ECOL3, BUFFER, REC1	4.6 km	CUPP
Other Catchments			
Guises Creek	ECOL2, BUFFER	9.4 km	Rural lessees
Sullivans Creek	ECOL2, ECOL3, BUFFER, REC1	15.2 km	CUPP, ANU, Rural lessees
Woolshed Creek	ECOL2, BUFFER	12.3 km	Rural lessees, ACTPLA, CUPP EACT
Yarralumla Creek	ECOL2, ECOL3, BUFFER, REC1	8.1 km	Rural lessees, CUPP
Gungaderra Creek	ECOL2, ECOL3, BUFFER, REC1		Rural lessees, CUPP
Lakes And Ponds			
Lake Ginninderra	ECOL 3, BUFFER, REC1, REC2	105 ha	CUPP
Lake Tuggeranong	ECOL 3, BUFFER, REC1, REC2	57.1 ha	CUPP
Upper Stranger Pond	ECOL 3, BUFFER, REC1	4.4 ha	CUPP
Lower Stranger Pond	ECOL 3, BUFFER, REC1	4.1 ha	CUPP
Isabella Pond	ECOL 3, BUFFER, REC1	5.7 ha	CUPP
Tuggeranong Weir Pond	ECOL 3, BUFFER, REC1	7.5 ha	CUPP
Gungahlin Pond	ECOL 3, BUFFER, REC1	23.8 ha	CUPP
Yerrabi Pond	ECOL 3, BUFFER, REC1	26.4 ha	CUPP

Name	Riparian zone values	Stream length (km) or pond area (ha)	Management responsibility
Dunlop Pond 1	ECOL 3, BUFFER, REC1	0.7 ha	CUPP
Dunlop Pond 2	ECOL 3, BUFFER, REC1	0.7 ha	CUPP
West Belconnen Pond	ECOL 3, BUFFER, REC1	9.9 ha	CUPP
Point Hut Pond	ECOL 3, BUFFER, REC1	16.7 ha	CUPP
Gordon Pond	ECOL 3, BUFFER, REC1	0.1 ha	CUPP
Eddison Park Pond	ECOL 3, BUFFER, REC1	1.15ha	CUPP
Conder Wetland	ECOL 3, BUFFER, REC1	0.5 ha	CUPP
O'Connor Wetland	ECOL 3, BUFFER, REC1	0.29 ha	CUPP
Mckellar Wetland	ECOL 3, BUFFER, REC1	0.9 ha	CUPP
Barr Smith Pond	ECOL 3, BUFFER, REC1	0.32 ha	CUPP
Fern Hill Park Ponds	ECOL 3, BUFFER, REC1	1.2 ha	CUPP

7 Glossary

50th percentile flow	The flow that is exceeded 50% of the time.
80th percentile flow	The flow that is exceeded 80% of the time.
Basin	An area drained by a given stream and its tributaries.
Catchment	An area of land draining rainfall into a river or reservoir.
Catchment yield	The annual average volume of run-off from a catchment.
COAG	Council of Australian Governments.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
Demand management	An approach that is used to reduce the consumption of water (also called water conservation).
Environmental flow	The streamflow required downstream of a water storage to maintain appropriate environmental conditions in a waterway.
ESD	Ecologically Sustainable Development
Flow rate	Volume of water per unit of time (for example kilolitres or megalitres per day).
Gigalitre (GL)	1,000,000,000 Litres or 1,000 Megalitres.
Greenfield development	New urban development areas.
Greywater	Water from the laundry, bathroom and kitchen that does not contain faecal matter.
Kilolitre (kL)	1,000 Litres or 1 cubic metre.
Mains water	Water supplied by ACTEW through the urban water supply system.
Megalitre (ML)	1,000,000 Litres or 1,000 Kilolitres.
Per capita	Per person.
Reclaimed water	Effluent that has passed through a treatment process and has been reticulated to users, or domestic greywater used for garden irrigation or other purposes.
Regulation	A rule set by government requiring or prohibiting a specific action or outcome (for example, installation of dual flush toilets, restriction on water uses during drought periods).

Retrofitting	Installation of fittings or appliances on existing buildings (for example, dual flush toilets).
Run-off	That part of precipitation that flows from a catchment area into streams, lakes, rivers or reservoirs.
Sewage	The waterborne wastes from our homes, workplaces and other buildings.
Sewerage system	The pipes and plant for the collection, removal and treatment of sewage.
Streamflow	The flow in a stream or river.
Sub-catchment	The management unit used by the ACT for water resource management. Catchments in which ACT has an interest are divided into 32 sub-catchments.
Treated effluent	The treated water discharged from a sewage treatment plant.
Urban stormwater	Rainfall run-off from urban areas.
Volume	Kilolitre (kL) = 1,000 Litres or 1 cubic metre. Megalitre (ML) = 1,000,000 Litres or 1,000 Kilolitres. Gigalitre (GL) = 1,000,000,000 Litres or 1,000 Megalitres.
Water ACT	ACT's draft policy for sustainable water resource management released in July 2003 by the ACT Government.
Water cap	Cap on water diversions from the Murray–Darling River system set by the Murray–Darling Basin Ministerial Council to stop further deterioration of river health by limiting water use to 1994 levels of development.
Water conservation	See Demand management.
Water use efficiency	A measure of whether activities are being undertaken with the minimum amount of water needed and/or whether the water used is more pristine for the purpose than needed.
WSUD	Water sensitive urban design

Think water, act water

Volume 3: State of the ACT's water resources and catchments

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NOTE: Sub-catchment and water resource descriptions and diagrams are not provided in this word version of Volume 3. For these refer to the pdf version of the Water Resources Management Plan.

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1 ACT's geography

The overall geography of a region is a key determinant of the basic characteristics of water resources particularly for quantity, quality and flow patterns.

1.1 Climate

The climate is essentially continental, with hot summers and cold winters. Rainfall is fairly evenly distributed throughout the year, although the winter months are slightly drier. Mean annual precipitation in the ACT ranges from 950 mm in the mountains to 600 mm in the city. In common with the rest of inland Australia, the region experiences extended drought periods, although summer rainfall tends to occur as storms, with more prolonged, but gentler, rainfall in winter.

1.2 Soils and vegetation

Many of the soils of the upper Murrumbidgee basin have duplex profiles, with coarse-textured surface horizons and clay rich sub-soils. They are prone to sheet erosion and deep gullyng. The dispersive clays of these soils are easily eroded and yield high sediment and turbidity levels. This is most pronounced in the gently sloping depressions subject to soil moisture saturation.

The problem of erosion is aggravated by disturbance of vegetation and soil. The most erodible soils are on steeper, cleared slopes and riverbank areas. Undisturbed areas such as forested mountain slopes yield little material unless modified by logging operations or severe bushfires. Land use is the dominant factor determining the export of material such as soil, nutrients and soluble salts from catchments.

Vegetation is a significant determinant of water quality. It provides protection against soil erosion, intercepts precipitation and modifies soil composition. Vegetation types depend on many of the above factors, particularly climate, topography and soils.

2 ACT's water resources

Australia is the driest inhabited continent on earth. Canberra is the largest inland city in Australia. These two facts mean that the lakes and rivers of the ACT are key resources. They provide urban and rural water supply, and are a major recreation resource. They receive wastewater and stormwater discharges, and transfer floodwaters through the ACT. The environmental, scenic and recreational values of the lakes and rivers are particularly important to an inland city such as Canberra.

The ACT is entirely within the Upper Murrumbidgee River Catchment. The Upper Murrumbidgee covers an area of 13,000 km², of which the ACT occupies 2,400 km². The Murrumbidgee River rises in the south-western part of the catchment. It flows some 30 km before reaching Tantangara Reservoir, where much of its flow is diverted to Lake Eucumbene. The river then flows unimpeded for 150 km to discharge into Burrinjuck Reservoir to the north of the ACT.

The combination of extended dry periods and major floods results in large ranges of flow in ACT rivers and streams. For example, in over 50 years of records at the Cotter Crossing gauge, the annual discharge of the Murrumbidgee River has varied by factors of about 5

around the mean. Since 1927, there have been 52 days on which there has been no flow in the Murrumbidgee at Cotter Crossing. The mean annual flow of the Murrumbidgee at Burrinjuck Dam is 1,383 GL of which 426 GL is contributed from water resources controlled by the Territory.

The average annual runoff from ACT controlled catchments is 494 GL. Of this, 269 GL is designated by the Environmental Flow Guidelines as environmental flow, leaving 225 GL available for consumptive use. On average 65 GL is used with an average of 35 GL returned to the Molonglo River as treated effluent. The remaining 160 GL flows from the ACT to become part of the water stored in Burrinjuck Dam for use downstream.

The drainage system of the Murrumbidgee basin has been modified as a result of the construction of dams for hydroelectricity generation, irrigation and municipal water supply and provision of ornamental lakes. Some 27 per cent of the runoff that would have reached the ACT, as measured at the Mount McDonald gauging station, is diverted from the catchment at Tantangara Dam for hydroelectricity and irrigation. The numerous farm dams and the clearing of native forest for other land uses have also had an impact on streamflows.

In addition, a number of dams have been constructed on the Cotter and Queanbeyan Rivers as part of the Canberra and Queanbeyan water supply and within the urban area as part of the stormwater system. The dimensions of the major storages are detailed in Table 1.

Table 1: ACT major lakes and reservoirs: uses and dimensions

Lake or Reservoir	Primary Designated Use	Sub-Basin	Volume (GL)	Mean Depth (m)	Mean Annual Inflow (GL) ¹	Catchment Area (sq km)
Googong Reservoir	Municipal water supply	Queanbeyan	125	17.3	148	873
Corin Reservoir	Municipal water supply	Cotter	76	24	61	197
Bendora Reservoir	Municipal water supply	Cotter	11	14	106	290
Cotter Reservoir	Municipal water supply	Cotter	4.7	9	155	482
Lake Burley Griffin	Landscape & Recreation	Molonglo	33	4.7	243	1865
Lake Ginninderra	Pollution control, Landscape & Recreation	Ginninderra	3.7	3.5	11	92
Lake Tuggeranong	Pollution control, Landscape & Recreation	Tuggeranong	2.6	3.4	8	64

Note 1: Mean annual inflow includes water diverted for use.

2.1 Municipal water supply

Water for Canberra and Queanbeyan is provided from two main sources. The Cotter Catchment's two main dam storages supply over 60 per cent of the water needs over time, and this water is distributed through the Mount Stromlo Water Supply Facility.

The main storage dam on the Cotter River is Corin Dam. Water is released from Corin to top up the much smaller Bendora Dam, as needed. A pipeline connects Bendora Dam to Mount Stromlo Water Treatment Plant and from there is distributed to town reservoirs. The water is gravity fed, no pumping is required. This not only keeps the cost of using this water low but also provides a positive environmental benefit through the power generated by a mini hydro facility at Mount Stromlo.

The remaining demand is provided from the Googong Dam and Water Treatment Plant on the Queanbeyan River in NSW. Googong Dam is used to supplement supply for peak summer periods, and in drought periods. All of the water from Googong must be pumped up some 50 to 80 metres, depending on the storage water level, to the Googong Water Treatment Plant before distribution to Queanbeyan and Canberra.

Table 2: Municipal water supply use and returns 1996 to 2003 (volumes in GL)

Year Ending June 30	ACTEW Diversions Cotter and Googong	LMWQCC ¹ Discharge	QSTP ² Discharge	Net ACT Diversion
1993	50.2	34.8	N/A	-
1994	59.4	32.7	N/A	-
1995	60.6	30.1	N/A	-
1996	53.3	32.2	3.5	17.5
1997	61.8	33.7	3.4	24.7
1998	73.1	30.7	3.2	39.2
1999	59.4	32.7	3.5	23.2
2000	58.0	32.6	3.9	21.5
2001	63.0	30.3	3.9	28.8
2002	65.9	30.6	3.8	31.5
2003	65.8	28.4	2.3	35.1
Average	62.5	31.4	3.4	27.7

Note 1: LMWQCC = Lower Molonglo Water Quality Control Centre

Note 2: QSTP = Queanbeyan Sewage Treatment Plant

N/A Not Available

2.2 Sub-catchment and streamflow details

Catchments in which the ACT has an interest are divided into 32 separate management units or sub-catchments. Sub-catchments in which the ACT has an interest are those within the ACT, water supply catchments upstream of Googong Dam, or those that flow into or through the ACT. The boundaries of the sub-catchments are shown in Figure 1.

Table 4 sets out information about water volumes for each sub-catchment in which the ACT has an interest.

Information about water that the ACT controls is also shown. ACT controlled water includes all water within the ACT which is not defined as 'national land' in the National Capital Plan. It also includes water from the catchment of the Googong Dam, which the ACT controls on behalf of the Commonwealth.

Many of the values shown will have changed from those originally published in the *Water Resources Management Plan 1999*. This results from changes to flow equations used to estimate volumes from stream height measurements, refinements to estimating methods used for catchments that are not measured and an increase in the amount of data available for sub-catchments that have only been monitored for short periods.

Detailed information on water volumes for each sub-catchment, from which Table 4 is derived, is provided below along with a range of other information about geography and land

use in each sub-catchment.

2.3 Environmental flows

For ACT waterbodies there are four elements that are considered in designating environmental flow. These are set in the *Environmental Flow Guidelines* and are:

- **Low flows** are based on the 80th percentile flows calculated on periods of not more than a month. The 80th percentile flow is the flow that is exceeded 80 per cent of the time.
- **Flushing flows** are required to ensure that channel structure and the dependent ecological processes are maintained. The discharge that research elsewhere has found to be the most critical is the 1 in 1.5 to 2.5 years annual recurrence interval flood event. In ACT rivers, other than water supply catchments, the short duration of high volume flows and a limit on abstraction of 10 per cent of flows over the 80th percentile will ensure that flushing flows occur with this frequency.
- **Special purpose flows** have not been set at this stage, except for the requirement of spawning flows in the Cotter River. A flow adequate for spawning has been defined as the 50th percentile monthly flow during the spring months (September, October and November) and the 80th percentile monthly flow for the months August and December to March. In two out of every five years flows are to be at or above the spawning level for each month in the August to March period.
- **Maintenance of impoundment levels** is required to protect macrophytes. For urban lakes and ponds the maximum drawdown as a result of abstraction is 0.20 m below spillway level.

2.4 Determining allocations

Ten per cent of flows above the 80th percentile has been selected as a suitable portion of water for abstraction in most sub-catchments.

This 10 per cent threshold has been selected using the best available scientific advice on the provision of habitat diversity and quality, nutrient and sediment cycling, movement of biota and connectivity between aquatic and terrestrial habitats.

For 'Water Supply Catchments' 100 per cent of flows above the 80th percentile are available for abstraction.

The following table sets out the proportion of flow for consumption and for the environment in the water supply catchments in the last 5 years.

Table 3: Water supply catchments—consumption and environmental flows 2000 to 2003

Calendar Year	Environmental Release (GL)	Potable Consumption (GL)
2000	41.5	58.9
2001	36.0	67.2
2002	36.1	68.6
2003 [†]	13.5	53.6

2.5 Groundwater allocations

The ACT's groundwater reserves are not large and are contained within confined fractured rock aquifers with yields generally less than 1.0 litre per second. In addition, salinity levels can be high (over 1,000 milligrams per litre of total dissolved salts). Hence only limited groundwater use occurs. As a result, little analysis has been undertaken into the actual performance of particular ACT aquifers.

The amount of groundwater available for extraction from each sub-catchment is limited to 10 per cent of groundwater recharge until research on a specific sub-catchment determines that a higher level of groundwater use is sustainable.

Groundwater recharge is the entry of water into the saturated zone or water table and the associated flow away from the entry point within the saturated zone. Any assessment of recharge must be based on long-term data due to the slow recharge rates of most aquifers.

Table 4: ACT controlled water resources (volumes in megalitres) as at 30 September 2003

Catchment			ACT, NSW & Commonwealth			ACT					
			Total Water Resources (ML)	Environment Allocation (ML)	Water Available for Use (ML)	Total ACT Controlled Water (ML)	Environment Allocation (ML)	ACT Controlled Water Available for Use (ML)	Existing ACT Controlled Water Use (ML)	Allocation provision 2004-2014 (ML)	ACT controlled groundwater Available for Use (ML)
Murrumbidgee and tributaries	1	Michelago	59,919	55,090	4,830	2,517	2,314	203	0	20	100
	2	Tharwa	9,622	8,806	816	9,622	8,806	816	43	100	250
	3	Kambah	7,259	6,643	616	7,259	6,643	616	203	100	173
	4	Uriarra	17,009	15,580	1,429	17,009	15,580	1,429	18	100	180
	5	Woodstock	5,416	4,974	442	1,334	1,225	109	0	100	30
	6	Guises	4,888	4,410	478	2,145	1,935	210	4	50	76
Gudgenby and tributaries	7	Naas	38,554	35,619	2,934	38,554	35,619	2,934	2	50	950
	8	Gudgenby	50,522	46,569	3,953	50,522	46,569	3,953	26	50	1,300
	9	Tennent	7,407	6,884	522	7,407	6,884	522	0	50	150
Cotter and tributaries	10	Corin	75,751	19,283	56,468	75,751	19,283	56,468	29,700	1,800	950
	11	Bendora	33,906	9,533	24,373	33,906	9,533	24,373	21,000	1,200	500
	12	Lower Cotter	36,045	9,342	26,702	36,045	9,342	26,702	0	12,000	600
	13	Paddys	39,799	36,571	3,227	39,799	36,571	3,227	88	200	1,010
Tuggeranong Ck and tributaries	14	Tuggeranong	9,222	8,387	835	7,909	7,193	716	47	100	60
Molonglo and tributaries	15	Upper Molonglo	42,880	39,050	3,830	1,274	1,160	114	2	10	34
	16	Kowen	7,478	6,746	732	5,427	4,896	531	3	400	160
	17	Fyshwick	2,251	2,033	218	1,896	1,712	184	125	50	68
	18	Jerrabomberra Headwaters	6,787	6,122	664	0	0	0	0	0	0
	19	Jerrabomberra	5,439	4,906	534	4,696	4,236	461	173	50	240
	20	Lake Burley Griffin	7,788	7,083	705	5,625	5,116	509	69	100	68
	21	Coppins	5,362	4,832	529	5,362	4,832	529	95	200	119
	22	Woolshed	6,643	5,998	645	2,407	2,173	234	188	50	64
	23	Sullivans	6,328	5,726	602	6,328	5,726	602	331	100	73
	24	Woden	6,817	6,191	626	6,817	6,191	626	188	100	56
Queanbeyan River and tributaries	25	Weston	3,995	3,628	367	3,995	3,628	367	8	100	24
	26	Tinderry	82,805	7,571	75,234	82,805	7,571	75,234	10,280	2,700	0
	27	Googong	8,575	784	7,791	8,575	784	7,791	1,200	300	0
	28	Lower Queanbeyan	9,538	8,599	939	22	20	2	0	0	0
	29	Burra	11,784	1,077	10,707	11,784	1,077	10,707	1,600	500	0
Ginninderra Ck and tributaries	30	Gungahlin	5,246	4,727	519	5,246	4,727	519	309	100	80
	31	Lake Ginninderra	6,056	5,456	600	6,056	5,456	600	313	50	50
	32	Parkwood	12,247	11,098	1,149	5,684	5,150	533	21	50	90
Total			633,336	399,319	234,016	493,776	271,955	221,821	66,036	20,780	9 7,455

3 Sub-catchment and water resource descriptions

This section contains descriptions of each of the 32 sub-catchments in the ACT or in which the ACT has an interest. For each sub-catchment a map is provided showing catchment boundaries and land use categories from the Territory Plan. Information on the percentage of each land use is also provided. A short description of the geography and the method used to determine flows for each sub-catchment are included. A range of information on water flows and volumes is provided. All volumes are averages in megalitres.

NOTE: Sub-catchment and water resource descriptions and diagrams are not provided in this word version of Volume 3. For these refer to the pdf version of the Water Resources Management Plan.