Queensland Water Recycling Strategy

October 2001
The dawn of a new century has provided an opportunity to reassess our development over the past two centuries and look to the future. Our progress has been rapid with access to seemingly abundant resources. But population growth globally is placing more and more pressure on land and water resources.

In Queensland, our natural conditions are challenging. We have a climate with extremes that require good planning and careful management of all our natural resources to prevent land degradation. Yet the demand for water is growing, both from increasing urban populations and primary producers.

We all share the responsibility of keeping our catchments healthy. Unfortunately, a century of development and over-extraction has placed many of our rivers and streams under stress, threatening the ecosystems which rely upon them for survival and creating an urgent need for sustainable management.

There are steps that can be taken to ease these pressures. By using our water more efficiently and recycling wherever possible, large volumes of existing water can be saved or reused to benefit communities and the catchments in which they live. The Queensland Parliament has recognised this with unanimous endorsement for actions to increase the use of rainwater tanks.

The Queensland Water Recycling Strategy draws together the many aspects of water recycling and the implications for industry, agriculture, residential living, the environment and other important community elements. It was developed with extensive consultation with the community and the water industry.

Community involvement is an essential ingredient if we are to recycle water in our homes, industries and farms. The Queensland Government has an important role in helping the broader community understand the benefits of water recycling and the benefits it offers to our lives.

Your support is now vital in making sure the Strategy meets the needs of communities across Queensland. The Strategy is a step forward in the better management of water in Queensland. It will be a dynamic approach to match the changing and dynamic growth of this state. As new technologies allow further applications that are safe for people and the environment, the strategy will be updated. But change will always reflect community views.

Dean Wells
Minister for Environment
The Queensland Water Recycling Strategy has been developed by the Environmental Protection Agency with extensive stakeholder participation.

Following public consultation, the Queensland Water Recycling Strategy draws on the information from a wide range of source documents. Readers should consult the sources referred to, to determine the suitability of the reference for their needs.

Copies of this document are available from the Environmental Protection Agency.

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Executive Summary

The Queensland Water Recycling Strategy (QWRS) provides a framework that includes all levels of government. It encourages the adoption of sustainable water recycling to better manage our water resources for this and future generations, and to support economic growth while protecting the environment and safeguarding public health.

The aim of the QWRS is to encourage and support the use of water recycling that is safe, environmentally sustainable and cost-effective.

The QWRS outlines the opportunities and potential gains to be made through sustainable water recycling and addresses challenges for the future.

The Strategy articulates Queensland’s vision to be recognised as a leader in sustainable water recycling.

The QWRS provides a set of guiding principles, policy positions on uses and sources of recycled water, and action plans with objectives and targets to guide public and private sector initiatives.

The objectives include legislative reform, development of guidelines and codes of practice and/or regulations, increasing community awareness and participation, research, establishment of demonstration projects, and provision of training and information for the workplace.

To ensure that the QWRS is successful, it will be subject to periodic, comprehensive and independent reviews.

The QWRS was developed through extensive participation by, and in consultation with, representatives from the broad community, peak industry bodies and associations, educational institutions, and local and State Government agencies.

This process, and the public consultation, guided the development of an integrated strategy that reflects the views of all sectors.

With advances in knowledge and changed community expectations, total water resource management and planning programs now include water recycling as an element of integrated resource management, along with water conservation, water use efficiency, and management of the allocation of existing water sources in our catchments.

The QWRS clearly states Queensland Government policy positions on specific uses and sources of recycled water and addresses the issue of the need to provide financial incentives for water recycling.

These policies are part of an integrated approach to management and planning for the total water cycle in Queensland’s urban and rural communities.

In reflecting this, the QWRS provides information on recycled water applications and some current water recycling initiatives.

The lead agency for the implementation of the QWRS is the Queensland Environmental Protection Agency (EPA).

Sustainable water recycling provides economic, environmental and social benefits for those willing to invest in this valuable resource.
In light of the guiding principles, the following action plans provide a foundation for sustainable water recycling in Queensland:

1. Change laws to support water recycling.
2. Provide guidance for using recycled water.
3. Provide technical training and information for the workplace.
4. Increase community awareness and participation in water recycling.
5. Encourage further research into key aspects of water recycling.
6. Use demonstration projects to raise community awareness of water recycling.
7. Support water recycling projects.

As the QWRS was developed through partnership with the community, so too will it be implemented through partnership with the community.

While the Government will provide leadership, and work strategically with all sectors, the success of water recycling depends on community-wide involvement and acceptance of sustainable water recycling.
1. Queensland Water Recycling Strategy

The Queensland Water Recycling Strategy (QWRS) is unique, written in partnership between members of the Queensland community and the Queensland Government. This initiative responds to the need to use our existing water resources more wisely. One way to achieve this is to use recycled water where appropriate.

The QWRS sets a framework to enable Queensland to use recycled water more effectively and efficiently, to accommodate increases in population, and to support economic growth while helping to protect the environment and safeguarding public health.

The QWRS is framed in the context of total water cycle management and planning. This integrated approach also requires that short-term considerations should not commit recycled water to be used outside its originating catchment when, in the long term, the most beneficial use would be within that catchment.

The QWRS supports seeking the most beneficial uses of the available recycled water.

The QWRS identifies opportunities, potential gains and challenges for sustainable water recycling from:
- municipal effluent;
- industrial effluent;
- agricultural effluent;
- greywater in unsewered and sewer areas;
- blackwater in unsewered areas;
- urban stormwater; and
- rainwater.

Sustainable water recycling provides economic, environmental and social benefits for those willing to invest in this valuable resource.

1.1 Context for action
Queensland’s population is expected to rise by 40% over the next 21 years (ABS 2000). The challenge facing the Queensland Government, the private sector and water managers is to meet, sustainably, the water needs of the community and the environment. New opportunities are now arising to improve the way in which we source water and use water.

The challenge for the future is for governments at all levels, industry and the community to take up the concept of the multiple use of water as a business opportunity to provide sustainable economic development.

The complex social and environmental issues associated with water are all too evident. Salinity and habitat destruction, for example, can affect the lifestyle and wellbeing of whole communities.

Some trends that are occurring in the USA, Europe and Australia involve alternatives to traditional supply of services such as water and energy. These include distributed systems rather than large centralised systems. In the case of water, alternative supply and treatment includes rainwater tanks, bottled water and in-home filter systems.

Water recycling must be included as part of a water planning process that takes into account these broader issues.

... to enable Queensland to use recycled water more effectively and efficiently, to accommodate increases in population, and to support economic growth while helping to protect the environment and safeguarding public health.

1 Based on Scenario II (ABS 2000), which assumes an annual net overseas migration gain of 70,000 medium net internal migration gains and losses for States and Territories, and a total fertility rate of 1.75 births per woman until 2005-06, then remaining constant.
The Queensland Government is committed to an integrated water resource management approach in the State. This commitment also aligns with the national water reform processes agreed to by the Council of Australian Governments (COAG).

Water recycling and water use efficiency will be key elements in a more holistic approach to future water management strategies. This will ensure that water recycling is not used as an alternative to redressing inappropriate water management practices.

Opportunities for water recycling occur in nearly all areas where water is used, such as agriculture (through the irrigation of field crops), industry, residential and community (irrigation of open spaces), and the collection of rainwater and urban stormwater.

Recycling water for use elsewhere can reduce the level of nutrients (and other pollutants) entering waterways and sensitive marine environments.

Alternatively, recycling water can preserve, and in some cases enhance, the health of waterways, wetlands, flora and fauna through increased environmental flows in rivers and streams.

Water recycling can save resources as well as create a resource. For example, recycled water originating from treated municipal effluent can contain nutrients. If this water is used to irrigate agricultural land, less fertiliser needs to be applied to the crops. Recycling may defer the need for new or upgraded dams and sewage treatment plants.

Sustainable water recycling activities will help protect the environment, conserve water resources and contribute to the State’s economic prosperity.

1.2 Vision
Our vision is for Queensland to be recognised as a leader in sustainable water recycling.

1.3 Aim
The aim of the Queensland Water Recycling Strategy is to encourage and support the use of water recycling that is safe, environmentally sustainable and cost-effective.

1.4 Definition
Water recycling, as defined in this Strategy, is the sustainable and beneficial use of appropriately treated wastewater, urban stormwater and rainwater, in ways that safeguard public health and environmental values.

1.5 Guiding principles
The following principles have been developed to ensure that water recycling achieves the best possible balance of public health, economic and environmental outcomes:

• Water recycling must be considered as part of total water cycle management and planning. That is, water management, planning, assessment and allocation...
Queensland Water Recycling Strategy

processes may take water recycling into account.
• The quality of the recycled water must be matched to its purpose.
• Water recycling must be consistent with ecologically sustainable development.
• Decisions on water recycling must adequately address public health, environmental and economic factors.
• Water recycling projects must be socially desirable. That is, social costs and benefits must be considered when a project’s potential viability is assessed.
• Water recycling decision-making processes must be transparent to all stakeholders.
• Community involvement must be encouraged in the planning, development, implementation and assessment of water recycling as part of wider water management processes.
• Reliable information on water recycling will be provided and will be readily available to the community and users and producers of recycled water.

1.6 Why recycle water?
The expected 40% rise in Queensland’s population over the next 21 years, together with significant increases in agricultural and industrial activities, will put existing water resources under pressure.

Increasing focus is being placed on the health of waterways and the need to provide more natural flows to maintain the ecosystems dependent on the waterways.

The challenge facing the Queensland Government, industry and water managers is to sustainably meet the increasing water needs of the community and the environment. Opportunities are now available to improve the way in which we use water and use alternative sources, including recycled water.

Water recycling provides many benefits. Appropriately managed, water recycling activities can conserve supplies, be environmentally responsible and make economic sense.

2 Defined under the Environmental Protection Act 1994 as protecting ‘Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends’. 3 Including private (where possible) and environmental costs. 4 Including those accrued to the local community and the region.
Water recycling makes best use of existing resources by:
• conserving high-quality water supplies (for example, for drinking) by substituting recycled water for applications that do not require that quality (James 1997);
• providing an alternative source of supply to help meet both present and future water needs; and
• reducing the quantity of nutrients (for example, nitrogen, phosphorus) entering waterways, an aim supported by the Queensland Government’s Reef Protection Policy and the South East Queensland Regional Water Quality Management Strategy.

Water recycling has been practised in numerous countries, including Australia, for many years (Hunter 1994) and an increasing number of public and private sector organisations in Queensland are already using recycled water.

Factors driving its further use include:
• community enthusiasm for the concept of water recycling;
• increasing pressure on existing water resources due to population growth and increased agricultural demand;
• recognition that recycled water can be a very reliable source of supply;
• the growing number of successful water recycling projects in Queensland, in other parts of Australia and overseas;
• growing recognition among water and wastewater managers of the economic, social and environmental benefits of using recycled water;
• greater recognition of the environmental and economic costs of constructing, operating and managing water storages (for example, dams and weirs);
• increased awareness of the environmental impacts associated with overuse of water supplies in some parts of Australia;
• preference for recycling over effluent discharge, coupled with tighter controls on the quality and quantity of any effluent discharged to the environment, under the Environmental Protection Act 1994 and associated regulations, including the Environmental Protection (Water) Policy 1997;
• proposed changes to current water allocation arrangements and the introduction of water trading in Queensland;
• the widespread introduction of new water charging arrangements that better reflect the full cost of delivering water to the consumer, in line with the COAG water reform processes; and
• increased costs associated with upgrading and operating wastewater treatment plants to meet higher quality standards.

Water recycling approaches and applications around the world were investigated and reviewed as part of the development of the QWRS. This approach of monitoring overseas developments will be continued throughout the implementation phase.
2. Policy Positions

The policy positions set out below provide guidance at a general level. Where necessary, legislation will be amended to reflect these policy positions.

The Queensland Government will review its positions periodically. Some of these positions may change in light of further research and technological advances.

Research and development activities will be encouraged, as these will enable the range of uses of recycled water to be expanded.

Queensland Government agencies will lead by example and, where practical, consider water recycling activities in their policy, planning and operational activities.

A local government that operates a sewerage system must, under the Environmental Protection (Water) Policy, implement an environmental plan about trade waste management. This ensures that wastewater streams discharged to sewers by industry do not impact adversely on the potential to recycle water from the local government’s sewerage system.

2.1 Uses of recycled water
Where it is safe, environmentally sustainable and cost-effective, the Queensland Government supports the use of appropriately treated recycled water (that is, wastewater, urban stormwater or rainwater treated to a quality suitable for its use), and treated wastewater application techniques that are appropriate for intended use, for:
• agricultural, industrial and non-potable (residential and community) purposes. Where necessary, existing guidelines will be revised and new codes of practice, guidelines and/or regulations developed; and
• indirect potable purposes, aquifer storage and/or recovery and environmental purposes. The development of codes of practice, guidelines and/or regulations for these uses is recognised as a matter of priority. In the interim, consultation should be undertaken on a case-by-case basis with Queensland Health (QH), the Department of Natural Resources and Mines (NR&M), and the Environmental Protection Agency (EPA).

The Queensland Government does not support the use of treated effluent for direct potable purposes and does not intend to change this position.

2.1.1 Aquaculture
The Queensland Government supports internal water recycling within individual aquaculture projects where it is safe, environmentally sustainable and cost-effective.

Research into the use of recycled water sourced from outside an individual aquaculture project is still in its infancy.

Proposals to use external recycled water sources should be discussed on a case-by-case basis with QH, the Department of Primary Industries (DPI), and the EPA.

2.1.2 Treated effluent currently being discharged to waterways, estuaries or ocean
Where it is safe, environmentally sustainable and cost-effective, the Queensland Government strongly encourages the recycling of treated effluent in preference to discharge to waterways, estuaries or ocean.

Treated effluent that is discharged, rather than recycled, must be treated to discharge standards specified by the EPA.

The Queensland Government does not support the use of treated effluent for direct potable purposes and does not intend to change this position.
2.2 Sources of recycled water
Where it is safe, environmentally sustainable and cost-effective, the Queensland Government supports:

• on-site greywater recycling in unsewered areas;
• on-site blackwater recycling in unsewered areas;
• regulated trials of on-site greywater recycling in sewer areas;
• urban stormwater recycling;
• rainwater tanks.

2.2.1 On-site greywater recycling in unsewered areas
The Queensland Government continues to support the use of greywater in unsewered areas where it has been appropriately treated and managed on-site.

Its treatment and use must comply with the requirements of the Standard Sewerage Law, the Health Act 1937, the Environmental Protection Act and the relevant local government requirements.

2.2.2 On-site blackwater recycling in unsewered areas
The Queensland Government continues to support the use of blackwater in unsewered areas where it has been appropriately treated and managed on-site.

Its treatment and use must comply with the requirements of the Standard Sewerage Law, the Health Act, the Environmental Protection Act and the relevant local government requirements.

2.2.3 On-site greywater recycling in sewer areas
Current legislation does not allow the use of treated or untreated greywater in sewer areas. However, it is proposed to amend the legislation to allow regulated trials to assist in the development and testing of treatment methods and their practical and safe application. Trials will be carried out only with the agreement of the relevant local government. Trials will be subject to conditions to ensure that they will not have adverse impacts on public health or the environment.

2.2.4 On-site blackwater recycling in sewer areas
The Queensland Government does not allow the on-site use of treated or untreated blackwater in sewer areas and does not intend to change this position.

2.2.5 Urban stormwater
Where it is safe, environmentally sustainable and cost-effective, the Queensland Government supports the use of appropriately treated urban stormwater for:

• agricultural purposes;
• industrial purposes;
• non-potable (residential and community) purposes;
• aquifer storage and recovery; and
• environmental purposes.

When urban stormwater is used for aquifer storage and recovery and environmental purposes, consultation should be undertaken, on a case-by-case basis, with QH, NR&M, and the EPA until appropriate codes of practice and/or guidelines are developed.

2.2.6 Rainwater tanks
The Queensland Government supports the use of water from rainwater tanks for potable and non-potable purposes.

When used for drinking purposes, the water may require treatment to be of suitable quality. Rainwater tanks must be appropriately constructed, installed and maintained to prevent access by mosquitoes and contaminant input and must comply with regulations and by-laws of the relevant local government.
Water recycling is already a familiar concept. It has been practised in Queensland for many years, principally for irrigation of open spaces.

The community consultation phase of the QWRS showed there is widespread community enthusiasm for its increased adoption for an extended range of uses. As water recycling activities are adopted more widely, providers and users require guidance.

Through the implementation of the QWRS, water recycling will be undertaken in a coordinated and integrated manner.

Providers and users of recycled water will receive assistance to determine the most appropriate recycling options, to ensure that these options include the community, are environmentally sustainable, are economically viable and safeguard public health.

Water recycling will be considered as one of a range of water supply alternatives for meeting the community’s water use needs.

It is intended to move Queensland to an integrated water resource management approach incorporating least cost planning methodology for economic, social and environmental benefits.

In some cases, it may become evident that water recycling is not the best option for a particular location, and intending providers and users need to be able to make informed decisions.

The Queensland Government has clearly stated its policy position on specific uses and sources of recycled water.

However, the Queensland Government will also require Government agencies to ‘lead by example’ by considering the application of best practice in water recycling management when framing legislation and policies and when planning projects.

The Queensland Government will further examine international, national and State codes of practice and standards on water recycling, some of which are contradictory or do not cover all of the relevant issues, making it difficult for planners and designers to make appropriate decisions (DNR 1998).

3.1 Financial incentive schemes for local governments

Local governments have initiated most of the current water recycling projects.

The following schemes provide financial assistance to local governments that are responsible for municipal wastewater treatment, for either treatment plant upgrades or water reuse, and are administered by the Department of Local Government and Planning (DLGP).

Existing incentive programs are considered to provide an adequate platform for support, although some adjustment may be necessary to ensure that proposals are consistent with total water resource management approaches. The overall level of funding to each scheme, however, would not be increased.
3.1.1 Local Governing Bodies’ Capital Works Subsidy Scheme

Two elements of the Local Governing Bodies’ Capital Works Subsidy Scheme (LGBCWSS) relevant to water recycling are wastewater reuse and municipal wastewater treatment.

### Wastewater reuse

A subsidy of up to 50% is provided for the planning, design and construction costs of water recycling projects that obtain treated effluent from local government sewage treatment plants as an alternative to discharging that effluent to waterways.

While this subsidy is not intended to provide commercial benefit to private individuals or organisations (for example, large-scale agricultural irrigation), each case is considered on its own merits, and projects involving private recipients of treated effluent will be considered.

### Municipal wastewater treatment

A subsidy of up to 40% applies to the planning, design and construction costs of new projects and augmentation of existing ones. Eligible projects include sewage treatment and nutrient removal works and disposal of effluent after treatment, and disposal and reuse of sludge (a by-product of sewage treatment).

The subsidy may also be available for demand management (that is, effluent reduction) strategies.

There is sufficient flexibility within the existing LGBCWSS to allow the inclusion of water recycling proposals that will have significant economic, social, public health or environmental impacts on water treatment infrastructure.
Proposals must include a least cost planning analysis against an overall management plan that considers demand management as well as supply infrastructure options.

For example, where it can be clearly demonstrated that rainwater tanks will result in the deferral of capital works, local governments could include a rebate program for inclusion in the overall costing that is eligible for subsidy.

Details of eligibility criteria for including demand management measures such as rainwater tanks into this scheme will be incorporated into existing information programs delivered to local governments by DLGP.

This approach is consistent with the view that water recycling programs must be considered as part of an overall water management approach and that suitable support mechanisms are required.

3.1.2 Smaller Communities Assistance Program
The Smaller Communities Assistance Program (SCAP) has eligibility conditions similar to those of the LGBCWSS and focuses on smaller communities (those with fewer than 5000 people).

It provides a subsidy of up to 100% of the costs of water supply and sewerage services, and could include provisions for water recycling or other water use efficiency measures such as rainwater tanks.
3.1.3 Advanced Wastewater Treatment Technologies Program

The Advanced Wastewater Treatment Technologies Program (AWTTP) is designed to encourage the introduction in Queensland of new and/or innovative wastewater treatment technologies.

Funding for research and/or introduction of new technologies is accessible by local governments, or other organisations in collaboration with local governments.

3.2 Other financial incentives & issues

Further support is available through programs such as the Innovation Start Up Scheme of the Department of State Development (DSD), Sustainable Industries and Sector Partnerships Program (EPA) and general resource development programs.

These programs are not specifically designed to support water recycling and have their own competitive criteria for eligibility. However, they are a potential source of support.

Some of the water recycling projects already initiated by local governments involve collaboration with private sector organisations.

Funding for projects is considered on a case-by-case basis and is available primarily for the public component of a project. Specific factors taken into consideration include the project’s benefit to the community and its viability.

Funding is not intended to provide private commercial benefit and is therefore not available for private or commercial entities.

A concern expressed by agriculture, industry and other private sector organisations instigating water recycling activities is their ineligibility for financial assistance through these programs.

However, where a private sector organisation engages in a long-term contract with local government to provide a service that would normally be provided by the local government, such as sewage treatment as a public benefit, the infrastructure required to provide the service is eligible for a subsidy.

The Queensland Government will consider providing further financial incentives for water recycling when existing financial incentive schemes for water resource use are next reviewed and when new schemes are developed.

Proponents of water recycling projects can also seek assistance from the Commonwealth Government through programs such as the Natural Heritage Trust (Coast and Clean Seas) and Landcare.

These programs are primarily intended to assist in the capital cost of demonstration projects and planning studies.
Implementing the Queensland Water Recycling Strategy will be a crucial element in achieving sustainable water resource management in Queensland.

The EPA is the lead agency for the QWRS. As lead agency, the EPA undertakes to form a Water Recycling Strategy Steering Committee, which will provide advice through the Director-General to the Minister for Environment on the implementation and progress of the QWRS. The EPA will report on progress to the Steering Committee and the Minister.

Achieving the vision for the QWRS depends on a well-integrated, coordinated and collaborative approach.

The QWRS contains a set of objectives supported by targets. Some targets will be implemented and supported through collaboration with key State agencies (see Appendix 4) and local governments, some by intergovernmental initiatives, and some by partnerships between government, industry, agriculture and urban property developers, environmental groups, training providers, educational institutions, community organisations, users and potential users of recycled water, and the broader community.

In line with the participatory planning approach adopted during its development, the implementation of the QWRS will proceed in partnership with, and between, these groups.

4.1 Reporting, monitoring and evaluating

To ensure that the QWRS is consistent with whole-of-government water recycling policy and planning and is meeting its targets, the Strategy will be subject to periodic comprehensive reviews:

• The first review will be carried out in the second half of 2002.
• The Steering Committee will arrange for regular reviews to be carried out to monitor the implementation of the QWRS thereafter.
• The Steering Committee will arrange for a full review of the QWRS to be carried out in June 2004 and to make recommendations regarding any further resource requirements.
• The Queensland Government will review its positions periodically. For instance, some of these positions may change in the light of further research and technological advances.

Key factors to be considered will include assessments and evaluations of:

• outcomes of water recycling projects;
• effectiveness of targets;
• progress toward targets;
• effectiveness of action plans;
• progress toward implementing action plans;
• developments in research and guidelines into water recycling;
• advice from stakeholder groups; and
• the level of integration of water recycling into planning and management practices by key Government departments.

Performance indicators will be set and used to assess the effectiveness of the implementation of the QWRS.

Achieving the vision for the QWRS depends on a well-integrated, coordinated and collaborative approach.
Opportunities for water recycling exist in nearly all areas where water is used. The following sections provide a brief overview of the opportunities, potential gains and challenges for sustainable water recycling across the major water use sectors.

Recycling currently occurs in Queensland in:
- agriculture—irrigation of field crops;
- aquaculture—using internal sources of recycled water;
- industry—including multiple use within the enterprise;
- residential and community (non-potable)—irrigation of open spaces;
- environmental—supplementary flows in streams;
- greywater and blackwater recycling—landscape irrigation in unsewered areas only; and
- rainwater tanks, mainly in rural and rural-residential areas.

Predicted short-term growth areas for water recycling include:
- agriculture—irrigation of pasture, crops and forestry;
- industry—particularly in electricity generation and to meet cooling and wash down requirements in other heavy industries;
- residential and community (non-potable)—irrigation of open spaces; and
- aquifer storage and recovery.

Expected long-term growth is likely to occur in areas such as:
- industry, using internal and external sources of recycled water;
- residential and community (non-potable), via dual reticulation in residential and industrial developments;
- urban stormwater, using water-sensitive urban design and water harvesting;
- rainwater tanks; and
- the environment, wetlands, ornamental lakes and supplementary stream flows.

5.1 Agriculture
Currently agriculture consumes around 65% of the total water used in Queensland.

Recycled water could be used in a variety of applications, including:
- crops (for example, fruit, vegetables, cotton and sugarcane);
- hydroponics;
- pasture production and turf farms;
- horticulture (for example, plant nurseries, vineyards and cut flowers); and
- forestry (depending on the type and use of the timber).
In Queensland, around 9000 ML of treated sewage effluent per year are applied to crops, pastures and private farms (DNR 1996).

This is around 3% of the total treated sewage effluent produced across the State (Bryan, Gardner & Beavers 1994).

By contrast, in Florida, USA, around 34% of treated effluent produced within the State is used for agricultural irrigation (Florida Department of Environmental Regulation, in USEPA & USAID 1992); and in California, 63% of treated effluent is used for this purpose (California State Water Resources Control Board, in USEPA & USAID 1992).

Some internal water recycling is carried out in Queensland’s agricultural sector.

A 1996 survey of 37 piggeries found that 81% had some form of irrigation to land, including pasture, grain or cotton crops and horticulture (DPI 2000).

Recycled water from feedlots is used to irrigate grain and forage crops and improved pasture. Effluent from dairies is generally used within the dairy farm to irrigate pasture (DPI 2000).

Opportunities
The water demands of agriculture provide many opportunities for water recycling.

In volume terms, the greatest potential lies in irrigation of pasture, field crops and tree crops (Kinhill & GHD 1999). The reasons are:
• a lack, in some areas, of alternative water supplies;
• the water needs of irrigated agriculture; and
• the availability of considerable land areas that are required for large-scale recycling activities (Okun 1998).

Cotton and sugarcane have been identified as potential users of treated effluent (DPI 2000).

Sugarcane, in particular, is highlighted for two reasons: many canegrowing areas are located close to supplies of treated municipal effluent, and sugar is a processed product that is subject to high temperatures during manufacture, thereby lowering health risks (Gardner et al. 1998).
Queensland communities adjacent to canegrowing areas produce about 60,000 ML of treated municipal effluent per year (Bryan, Gardner & Beavers 1994).

This has the potential to produce an additional 75,000 tonnes of sugar, worth around $22 million annually.

The major source of recycled water for irrigation is likely to be treated municipal effluent, but effluent from intensive livestock raising could also be used for irrigation of suitable crops (DPI 2000).

**Challenges**

Considerations during implementation of water recycling in agriculture include:

- distance of agricultural enterprises from sources of recycled water (transport and pumping costs can limit water recycling activities);
- range of scientific knowledge of sustainable practices among potential users;
- health requirements (the quality requirements of recycled water are determined according to the likelihood of human contact and the irrigation technique used);
- possible concern by farmers and consumers about product safety and acceptability in Australia and overseas (Gardner, Vieritz & Littleboy 1998);
- environmental concerns (for example, increases in soil salinity);
- incomplete guidelines or inconsistent application of them;
- lack of community education and awareness of water quality and treatment processes;
- lack of confidence in the operators and regulators of water recycling schemes;
- mismatch between a constant supply of recycled water and the periodic demand for it (for instance, the need for large storages during wet periods for use during dry times, thus increasing costs); and
- requirement for nutrient reduction if excess recycled water is discharged to a waterway, (DPI 2000).

**Eli Creek Irrigation Project: Hervey Bay, Queensland**

The Eli Creek Irrigation Project supplies around 1500 ML of treated municipal effluent to over 300 ha of private sugarcane land, one turf farm and one area of improved pasture (DPI 2000).
5.2 Aquaculture
The aquaculture industry in Queensland focuses mainly on farming barramundi, silver perch and red claw crayfish. The freshwater aquaculture industry recycles almost all of the water it uses (internal recycling). This water is then supplied to other ponds or used for irrigation (DPI 2000).

Research is currently being carried out into water recycling in saltwater aquaculture farming (mainly prawn farming) for internal use (DPI 2000).

Opportunities
There has been some interest in using recycled water from municipal wastewater treatment plants or from other industries (external recycling) in the aquaculture industry (DPI 2000).

There may be opportunities in the long term for this application in Queensland, but at present it is only in its research and development phase.

Aquaculture also presents opportunities for multiple water use—that is, the use of water for more than one crop or process.

In Queensland, cotton growers in the Dalby district are trialling silver perch in irrigation ring tanks, afterwards using the water to irrigate their cotton crop.

This is a relatively simple water reuse strategy and indicates an interest in diversification and in achieving a better return from each unit of water through multiple reuse.

Challenges
As many aquaculture facilities already recycle water internally, issues for consideration during implementation relate primarily to the use of municipal, industrial and agricultural effluents as water sources. They include:
- health concerns regarding human consumption of produce;
- community perceptions and marketability of produce;
- water quality requirements and costs of treatment; and
- cost of infrastructure.

Department of Primary Industries (DPI) and Natural Heritage Trust (NHT)projects
DPI and NHT currently have a number of recycling research projects. These include:
- internal recycling on a prawn farm near Cairns using a recirculating pond system. The project aims to examine whether zero water discharge can be achieved without affecting yield or quality of prawns (Robertson 2000); and
- using finfish, combined with other processes, to absorb waste nutrients and improve the quality of the effluent before discharge (Gillespie 2000).
Opportunities, Potential Gains and Challenges

5.3 Industry

Industry can recycle its own wastewater (internal recycling) or use recycled water from sewage treatment plants or other industries (external recycling).

Recycled water can be ideal for industries that do not require drinking water quality (USEPA & USAID 1992).

Industry uses include (Kinhill 1999):
• cooling in a variety of processes;
• boiler-feed water;
• process water;
• wash down and cleaning;
• flushing toilets and urinals; and
• ancillary uses (for example, dust suppression and irrigation of grounds).

Businesses that may be able to use recycled water include:
• commercial car washes;
• paper mills;
• mines;
• petroleum refineries;
• power stations;
• manufacturers of concrete, bricks, textiles, metals and paint;
• road construction companies;
• tanners and hide curers;
• tourist resorts; and
• distilleries and wineries.

Opportunities

At present, less than 0.5% of municipal effluent is being directly recycled by industry in Queensland (Kinhill 1999).

Overseas experience indicates that there is potential for expansion in water recycling by industry.

According to Kinhill and GHD (1999), ‘it is estimated that commercial/industrial water usage could account for 20-30% of water consumption as a maximum, but the opportunity for reuse (in South-east Queensland) would be practically limited to something of the order of 5%’.

Internal recycling has great potential to reduce demands on Queensland’s water resources. Internal commercial recycling is currently practised in some water-intensive industries. For example, mining operations often recycle their own water.

Recycling of treated municipal effluent in industry has greater potential for growth than internal recycling. It does, however, require the municipal wastewater treatment plant and the target industry to be located reasonably close together.

Industry may also be able to gain access to recycled water by sewer mining. This involves taking wastewater from the sewer, treating the water on-site and reusing it (John Wilson & Partners 1995).

Sewer mining could provide water recycling opportunities for industrial areas. There may also be some growth in industrial use of agricultural effluent from piggeries and dairies. However, this is likely to be limited by the seasonal fluctuations in production of such effluent (DPI 2000).

The greatest industrial recycling potential is for large industries, such as power stations that require large volumes of water for cooling. Metal and mineral industries also require large volumes of water for their production processes. Other industrial recycling applications, such as boiler-feed or wash down water, may also be viable.
Challenges

Considerations during implementation of water recycling in industry include:

• proximity of source to recycling applications;
• water quality concerns, especially with respect to the food industry and potential health impacts;
• volume of water available and consistency of supply;
• perceptions of the community and of employees;
• lack of incentives;
• lack of awareness of, and information on, industrial recycling methods;
• potential liability;
• reluctance to adopt the required significant changes to procedures, water handling practices and process equipment;
• cost in comparison with the cost of alternative water sources;
• lack of community education and awareness of water quality and treatment processes;
• lack of confidence in the operators and regulators of water recycling schemes;
• water quality requirements (for example, to avoid scaling, corrosion, biological growth and contamination in cooling water); and
• (for sewer mining) the necessity, in many cases, for individual on-site treatment facilities (John Wilson & Partners 1995; Kinhill 1999).

Sun Metals Zinc Refinery, Queensland

Sun Metals recycles all internally produced wastewater, using nanofiltration and reverse osmosis technology, at its newly constructed zinc refinery in Townsville. The recycled water replaces town water as a make-up to cooling tower and boiler circuits. The volume recycled is 350 ML per year, out of a total water requirement of 900 ML per year.

Millmerran Power Station, Queensland

A power station is under construction at Millmerran. Cooling water for the project is being provided from the Wetalla treatment plant at the rate of 1000 ML per year. An 80-kilometre pipeline transfers the treated effluent to the power station. This diversion of treated effluent from the waterway for reuse by the power station is the first stage in Toowoomba City Council’s plan to move toward recycling the majority of its effluent (up to 11,000 ML per year) by 2010. The power station’s use of recycled water assists in saving the Council the cost of upgrading the existing treatment works.

BP Refinery and Luggage Point Wastewater Treatment Plant, Queensland

The Brisbane City Council’s Luggage Point Wastewater Treatment Plant uses micro-filtration, reverse osmosis and disinfection to produce recycled water for industrial use. The plant produces 4000 ML of recycled water each year. The BP Refinery uses this recycled water as cooling tower and boiler-feed make-up water for its new Queensland Clean Fuels project.
5.4 Residential and community: non-potable
Non-potable water is water that is fit for purposes other than drinking.

For individual houses and groups of houses, recycled non-potable water can be used for:
• toilet flushing;
• car washing;
• cleaning; and
• garden irrigation.

At the community level, non-potable water can also be used for the irrigation of open spaces (for example, golf courses, sports fields, cemeteries, parks, freeway landscaping, urban beautification and new water features) and for a variety of recreational purposes such as artificial lakes for boating.

Development of recreational facilities using recycled water needs to take into account the degree of body contact with the water.

Dual reticulation is one way in which non-potable water can be supplied. It involves the supply of water from two separate sources, using two sets of pipes.

One set provides potable water (for drinking, cooking, bathing and laundry); the other provides recycled water for non-potable purposes.

The Springfield Total Urban Development, a new residential development located between Brisbane and Ipswich, will demonstrate, among other things, dual reticulation to a selected group of houses. It is estimated that around 50% of water used by the average household could be supplied from non-potable supplies via dual reticulation (Kinhill & GHD 1999).

Dual reticulation can be used not only by households but also by industry.

Opportunities
Local governments have implemented many of the existing water recycling projects in Queensland. A recent DNR survey revealed that 59 local governments and community councils propose to expand existing water recycling activities, with irrigation the focus of their activities (White 1999). In addition, it is anticipated that within the next five years 19 local governments and community councils will implement water recycling activities for the first time.

Irrigation using treated municipal effluent is likely to increase, especially in the following areas:
• urban open spaces such as parks, gardens, sports fields and resorts; and
• golf courses and turf farms.

Challenges
Considerations during implementation of non-potable water recycling for residential and community purposes include:
• health concerns (in terms of human contact);
• community perceptions;
• lack of relevant guidelines, compliance with existing guidelines and inconsistencies between existing guidelines;
• costs of infrastructure and treatment of water;
• costs to retrofit existing developments (for example, installation of dual reticulation systems);
• proximity to the source of recycled water;
• seasonal variations in demand for irrigation (Thomas et al. 1997);
• technical issues such as irrigation methods and issues of public access;
• lack of confidence in the operators and regulators of water recycling schemes;
• environmental sustainability; and
• availability of open space and the amount of irrigation required (Thomas et al. 1997).
5.5 Indirect potable use

Indirect potable use is the intentional withdrawal, treatment and distribution of water for drinking from a water source that is fed, in part, by the discharge of treated effluent (National Research Council 1998).

Generally the treated effluent comprises only a small percentage of the source water (Crook 1999).

The treated effluent must be of such a quality that the mixture of it and its receiving water can be further treated to meet appropriate potable water requirements. Under indirect potable use, the effluent component of the potable water has been through two high quality treatment processes and significant dilution.

There are two basic types of indirect potable use. In the first type, treated effluent is considerably diluted and stored for lengthy periods. Indirect potable use may also take place where treated effluent is discharged to a waterway and forms part of a downstream community's drinking water supply (Thomas et al. 1997).

Dilution and storage of treated effluent

Dilution and storage of treated effluent allows a large degree of control over the quality of the water in storage.

Before the community uses the stored water, it is treated again to ensure that it meets appropriate potable water quality requirements.
Because dilution and storage of treated effluent involves a deliberate choice to recycle treated effluent under controllable conditions, it is considered to come within the deliberations of the QWRS. This type of indirect potable use is rarely used in Australia.

Overseas, it predominantly involves aquifer recharge—particularly in the USA, where recharge schemes have been operating since 1962 (Crook 1999). Aquifer recharge is covered in detail in Section 5.7.

There is only one operational scheme involving surface water storage in the USA (Crook, 1999; USEPA 2001).

The National Research Council of the USA (NRC) has investigated the viability of this type of indirect potable use (National Research Council 1998). While it identified no obvious adverse health effects, it observed that the existing data was sparse and of a limited nature.

The NRC 1998 concluded that “...planned indirect potable reuse is a viable application of reclaimed water—but only when there is a careful, thorough, project-specific assessment that includes contaminant monitoring, health and safety testing, and system reliability evaluation”.

It also concluded that the quality requirements for the indirect potable use “should exceed those normally applied to drinking water and wastewater treatment facilities”.

The quality of the treated effluent generally needs to be better than that of the water with which it is mixed.

Lack of community education and awareness of water quality and treatment processes, community perceptions and health concerns are issues in regard to this application.

Some existing and planned projects in the USA have not met any open public opposition; but some consumers may have been unaware that they were, or would be, drinking recycled water.

Conversely, public and political pressure, based primarily on health concerns, recently caused the rejection of a proposed aquifer recharge scheme and the indefinite postponement of two proposed indirect potable use schemes based on surface water storages in the USA (Crook 1999).

Indirect potable use involving dilution and storage of treated effluent may simplify the provision, and reduce the cost, of infrastructure for water recycling, and would simplify management and monitoring requirements.

In schemes based on surface water storages, it would defer the need for new, highly expensive, storages or the expansion of existing storages.

**Occoquan Reservoir (USA)**

Since 1978, the Upper Occoquan Sewage Authority’s Regional Water Reclamation Plant has been discharging highly treated effluent to the upper reaches of the Occoquan Reservoir. This reservoir is the principal water supply for around one million people in northern Virginia (Crook 1999).

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**Dilution and storage of treated effluent allows a large degree of control over the quality of the water in storage.**
The option of indirect potable use through the dilution and storage of highly treated effluent is not on the agenda of the Queensland Government. The above overseas trends should however be noted and monitored, especially with regard to the extent to which public and environmental health is safeguarded, and the community is fully aware and its concerns are addressed.

**Discharge of treated effluent to a waterway**
Where treated effluent is discharged to a waterway, it is diluted by streamflow, which is variable, and undergoes some more treatment by natural processes as it moves downstream.

When this water is extracted for community use, it is further treated to appropriate potable water quality requirements. This type of indirect potable use occurs in many countries, including the United Kingdom (for example, along the Thames River) and Australia (Thomas et al. 1997).

According to one source, a survey cited by Thomas et al. (1997), the water supply from the Condamine River in Queensland contained 8.6% sewage effluent at Dalby and 7.3% at Chinchilla. In New South Wales, the highest concentrations of effluent were 5% at Walgett and 2% at Gunnedah, both on the Namoi River. The survey found that this situation occurred, to a lesser extent, in all of the rivers examined, including the Balonne, Darling, Murrumbidgee, Nepean, Murray and Yarra."

In Queensland, the discharge of treated effluent to a waterway is already regulated through an environmental authority (under the Environmental Protection Act) or a development approval (under the Integrated Planning Act 1997).

The provider of any drinking water supply already has a duty of care to develop and operate a scheme that delivers water of the required quality.

Therefore, the QWRS does not need to cover the type of indirect potable use where treated effluent is discharged to a waterway and forms part of a downstream community’s drinking water supply.

**5.6 Direct potable recycling**
Direct potable recycling is the direct recycling of effluent that has been treated to drinking quality standards to the drinking water distribution system (without an intermediate stage of storage or mixing with surface water or groundwater).

No application of direct potable recycling is practised in Australia.

The Queensland Government does not support the use of treated effluent for direct potable purposes and does not intend to change this position.

**5.7 Aquifer storage and/or recovery**
Recycled water can be used to recharge groundwater in an aquifer during times of excess water availability. The water is stored and later recovered to meet peak seasonal or long-term demands. The recovered water can be used for normal purposes such as agriculture, industrial use and town water supplies (Resource Sciences & Knowledge 2000). The use of aquifer recharge for direct potable purposes is covered in Section 5.5.
The functions of aquifer storage include:
• preventing saltwater intrusion into aquifers (USEPA & USAID 1992);
• improving the quality of saline aquifers;
• improving the quality of the treated water; and
• helping to stop land from subsiding (Resource Sciences & Knowledge 2000).

The potential for aquifer storage and recovery depends on the characteristics of the aquifer, the quality of water being stored, and the ultimate use of the groundwater. One of the advantages of aquifer storage and recovery is that aquifers provide a natural storage mechanism, eliminating the need for surface storage facilities such as dams (USEPA & USAID 1992).

Opportunities
There is increasing interest in aquifer storage and recovery in Australia to store and treat large quantities of recycled water. There may be opportunities for aquifer storage and recovery in suitable locations in the coastal irrigation areas and on a small scale in South-east Queensland (Resource Sciences & Knowledge 2000). There are examples of saltwater intrusion into aquifers (for example, Burnett, Bundaberg and Proserpine) where aquifer recharge could be used beneficially to limit or stop this intrusion.

Challenges
The major issue that will affect the widespread adoption of aquifer storage and recovery is the geology of individual aquifers.

The South-east Queensland region is not the most promising area for aquifer storage and recovery because many aquifers are unsuitable and little suitable land is available. In addition, land prices are high (Resource Sciences & Knowledge 2000).

The other main factors that influence this type of recycling in Queensland include:
• the need for better understanding of hydraulic and geochemical characteristics of aquifers and the processes occurring within them (Dillon et al. 1999);
• the cost of treating recycled water to the high quality needed to protect or improve groundwater quality;
• high capital and operating costs (Kozicki & Antoniou 1998);
• possibility of increasing the danger of aquifer contamination (USEPA & USAID 1992);
• clogging of the well or aquifer (Dillon et al. 1999);
• requirement for a large area over which to operate and maintain the aquifer recharge system (USEPA & USAID 1992);
• climatic conditions (climates with marked wet and dry seasons or areas with high seasonal water demands are preferable for aquifer recharge projects);
• insufficient community acceptance;
• proximity to source of recycled water; and
• health concerns.

Bribie Island, Queensland
Highly treated effluent is used to form a hydraulic barrier between the seawater and groundwater, on Bribie Island. This ground-water is ‘harvested’ for drinking water, via a series of trenches that intercept the watertable. Approximately 5ML of recycled water per day is discharged to a series of basins. This reclaimed water then percolates through the soil to form a hydraulic barrier preventing saltwater intrusion. Comprehensive water quality tests within the drinking water supply have confirmed that no reclaimed water has mixed with the groundwater used for drinking purposes (Resource Sciences & Knowledge 2000).
Environmental uses of recycled water include:

- restoring riverine environments such as wetlands that have been degraded as a result of altered or reduced streamflows;
- constructing new wetlands; and
- creating ornamental lakes designed for wildlife habitat or aesthetics.

Supplementing streamflow can have a negative effect on the stream environment as supplemented flows rarely mimic the natural flow regime. This may lead to problems such as:

- encroachment of vegetation due to constant availability of base flows; and
- reduced biodiversity and growth in exotic species due to lack of flow variability.

### Opportunities

The use of recycled water for restoring and constructing wetlands is likely to grow in the future.

### Challenges

The key challenge in using recycled water for the environment is to incorporate flow variability, particularly periods of low flows, within the supplemented flow regime.

Other challenges include:

- proximity of the supply source; and
- need for water of a suitable quality and cost of treating recycled water to get that quality.

5.9 Greywater and blackwater

On-site recycling of greywater and blackwater is not allowed in sewered areas in Queensland under current legislation.

However, it is permitted, with constraints, in unsewered areas, where around 20% of the population lives. In these unsewered areas there is increasing use of small-scale, single-dwelling sewage treatment plants.

These treatment plants treat greywater and blackwater to produce an effluent suitable for garden watering.

These systems require care and proper maintenance; otherwise poor-quality effluent may be discharged, creating a health or environmental hazard.

The on-site use of greywater in unsewered areas is also regulated by local governments and depends on the diligence of the householder to make it effective and avoid causing adverse environmental and public health impacts.
Opportunities, Potential Gains and Challenges

For example, excessive amounts of greywater used for garden watering can cause soil clogging and odours, and may attract vermin and allow mosquito breeding.

Greywater is used mainly for garden watering but can also be used for toilet flushing after suitable treatment. It may have high levels of pathogens and should be treated before use. Human contact with greywater should be avoided (Jeppesen 1993).

Opportunities
While the on-site use of treated greywater or blackwater in sewered areas is not permitted under Queensland legislation, it is proposed to amend the legislation to allow regulated trials of greywater use in sewered areas.

This would assist in the development and testing of treatment methods and their practical application. In the meantime, opportunities for growth of this form of water recycling will be restricted to unsewered areas.

Challenges
Considerations during implementation of on-site recycling of greywater and blackwater include:
• potential health risks;
• suitability of the soil;
• potential contamination of the environment, especially groundwater (Thomas et al. 1997);
• lack of commitment to maintenance by some home owners, resulting in discouragement of the practice by health regulators and local governments; and
• cost to individual householders with existing reticulated water supply connections.

It may be argued that the use of urban stormwater and rainwater is not recycling, because the water has not already been used. However, given the lack of any existing comprehensive strategy covering the use of urban stormwater or rainwater, and the potential benefits of each, the Queensland Government decided to incorporate the use of urban stormwater and rainwater into the QWRS.

In Queensland, urban stormwater has not been used as a water source to any large degree (McCourt 1996). This is because potable water supply sources have rarely failed, and the cost of traditional sources of potable water has historically been subsidised and therefore relatively low (McCourt 1996).

Other issues affecting urban stormwater use are reliability of supply (volume and regularity of rainfall) and quality of the water, which can vary considerably, depending on factors such as level of urbanisation (and consequent pollution) and frequency and quantity of rainfall (McCourt 1996).

Nevertheless, treated urban stormwater can be used in a wide variety of ways including:
• potable purposes, through the use of rainwater tanks;
• industrial uses;
• non-potable residential uses (for example, toilet flushing, garden watering);
• non-potable community uses (for example, open space irrigation of parks and gardens, establishing urban lakes and for cleaning);
• aquifer storage and recovery; and
• environmental purposes (for example, construction of wetlands).

5.10 Urban stormwater
The many and varied benefits of using urban stormwater include:

- conserving high-quality water supplies by using stormwater instead;
- protecting the environment (for example, wildlife habitats by decreasing stormwater runoff);
- reducing the need for expanding or building new dams and water storages;
- creating recreational opportunities; and
- reducing flood damage and peak flows of water (Victoria Stormwater Committee 1999).

### 5.11 Rainwater tanks

Rainwater tanks are used to collect and recycle rainwater that falls on a roof. Many people in rural areas already rely on rainwater tanks for their water supply, but people in urban areas are also now showing more interest in using rainwater tanks to provide an alternative source of water, giving as reasons a preference for the taste of the rainwater, reducing their water bills and playing a part in protecting the environment (WaterWise 1998).

Rainwater tanks have the potential to reduce demands on our water supplies. Mitchell, McMahon and Mein (1996) found that a 13 kilolitre rainwater tank (for laundry, toilet and garden watering) and use of greywater for watering gardens resulted in a 41-49% reduction in demand for town water and a 49-56% reduction in urban stormwater runoff.

Rainwater tanks can be used not just on an individual household basis but also for larger storages servicing industrial premises and groups of houses (WBM Oceanics Australia 1999).

Before a rainwater tank is installed, consideration needs to be given to the area’s rainfall, available roof area, size of the tank, how the rainwater will be used and the amount of rainwater used daily. These factors influence the amount of rainwater available and the reliability of supply. It is also necessary to find out what building, health and planning regulations apply to rainwater tanks in the local area (WaterWise 1998).

The benefits and costs associated with rainwater tanks also need to be considered. Many benefits are difficult to quantify: these include protection of the environment, flood mitigation and, for some people, the softness of rainwater (which can provide a better tasting water, and requires less soap for cleaning).

Rainwater tanks can also save around 10-20% of the cost of providing headworks (dams and weirs) in some instances (Lehmann 1998). Some costs are involved for the householder, and each situation needs to be looked at individually. Installation and operating costs of rainwater tanks are the responsibility of the householder (Lehmann 1998).

Water quality is another important issue. Airborne pollutants (from industrial activities, smog and agricultural crop dusting or spraying), animal and bird faeces, and leaves and dust on the roof can affect rainwater quality.

Rainwater tanks can also save around 10-20% of the cost of providing headworks (dams and weirs)...

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5 Savings are project-specific.
Steps can be taken to help improve water quality. A first-flush device should be installed, especially if the water is for drinking purposes. This diverts the initial wash down of rainfall containing pollutants away from the tank (Lehmann 1998).

Care must be taken to ensure that rainwater tanks do not encourage mosquito-borne disease by providing a mosquito-breeding habitat.

5.12 Water-sensitive urban design
Water-sensitive urban design (WSUD) is the application of a wide range of measures within a catchment to mitigate the impacts of urban development on the total water cycle (McAlister 1997).

WSUD incorporates features such as detention and retention basins to reduce peak flows of stormwater, grassy swales, natural channel design and porous pavements, which help the water to infiltrate and decrease pollutants (WBM Oceanics Australia 1999).

The most prevalent example of WSUD is in high-density development, where stormwater is directed to an underground storage for later uses, such as irrigating gardens and lawns, or for wash down purposes.

An issue that may specifically affect growth of WSUD is a lack of knowledge of the design and construction processes (WBM Oceanics Australia 1999).

5.13 Water harvesting in urban areas
Water harvesting is the collection and storage of stormwater for future use. In urban areas, this involves collecting the water in:
- rainwater tanks from houses, commercial, industrial and institutional buildings (discussed above in 5.11);
- dams in urban areas (Kinhill & GHD 1999); and
- lakes or wetlands into which water flows, is diverted or is pumped, when there is significant stream flow (McAlister 1999).

Water harvesting can supply about 5-10% of town water needs if used for irrigation of public parks and gardens and golf courses.

Opportunities
Urban stormwater recycling is a viable option for Queensland (WBM Oceanics Australia 1999). However, it should be considered as a supplement to other water supply sources rather than as a sole supply.

In new residential developments, water harvesting can play a part in the establishment of urban lakes and on-site retention systems, including rainwater tanks. In urban areas, individual households and businesses in existing developments, and also local governments, are likely to increase their use of rainwater tanks in the long term.
Opportunities, Potential Gains and Challenges

Challenges
Considerations during implementation of urban water harvesting include:

- the variable pattern of rainfall in some parts of Queensland, which affects reliability of supply;
- quality of urban stormwater (affected by factors such as population density, soil type and climate) (Mitchell, Mein & McMahon 1999);
- cost of collection, treatment and storage of urban stormwater;
- competitive cost of alternative supplies;
- lack of suitable areas for storages;
- health concerns, both perceived and real; and
- perceived lack of need (for example, a survey of selected Queensland local governments revealed that the majority saw no potential for the adoption of a wide range of innovative stormwater recycling techniques) (WBM Oceanics Australia 1999).

The Healthy Home project
The Healthy Home project is a joint initiative of the homeowner, NR&M, the University of Queensland, Gold Coast City Council and the EPA. The Healthy Home is a ‘proof of concept’ example of a water and energy-efficient house of the future. Its design includes water-saving devices, rainwater for drinking, and a greywater system designed for non-potable use outside the house. Initial water use of 810 litres per day was similar to consumption rates in a typical urban home on the Gold Coast. Water use was reduced by 15% to 690 litres per day, mostly by using less water to irrigate the sandy garden soil. In a year of average rainfall, rainwater alone is expected to supply over 80% of the total water requirements. This illustrates the potential for sustainable water use in households in high-density urban areas along coastal Queensland.

Sun Metals Zinc Refinery, Queensland
The Sun Metals Zinc Refinery uses stormwater in processing and as make-up water for the cooling water circuit, thus meeting a requirement of 550 ML per year out of the total requirement of 900 ML per year.

6 The greywater is currently discharged to the sewer as required, in a sewered area, under current legislation. Permission was obtained from the Gold Coast City Council to install the greywater system on the basis that greywater would be discharged to sewer after being monitored for chemical and microbiological characteristics.
The following integrated set of action plans will achieve significant outcomes in sustainable water recycling for Queensland.

These action plans are based on the guiding principles set out earlier and are the means by which the Queensland Government will achieve its vision for water recycling.

The actions range from research to community education, from changing legislation to providing technical training and guidelines, and include demonstration projects and information for the workplace.

These actions will be undertaken in partnership with all stakeholders, as the Queensland Government cannot, and should not, be expected to carry the responsibility for water recycling alone.

**Objective**
- Develop a consistent, whole-of-government legislative framework that encourages and facilitates water recycling that is safe, environmentally sustainable and cost-effective.

**Targets**
- Develop a joint action plan with the responsible Government agencies to review relevant existing legislation, including regulations, identifying any areas that may unnecessarily discourage water recycling, and other areas where new legislative provisions are needed by June 2002.

- Amend legislation to allow regulated trials of on-site greywater recycling in sewered areas to assist the development and testing of treatment methods and their practical and safe application by June 2002.

- Develop (or amend) legislation, including regulations, that deals with water recycling, with emphasis on consistency and approval processes that are easy to follow by December 2003.

**Commentary**
There are many State and Commonwealth Acts and Regulations that have the potential to impact on water recycling.

The Legislative Environment Water Recycling Background Study, prepared by the Queensland Environmental Law Association (QELA 2000) to assist in the development of the QWRS, provides valuable information on these Acts and Regulations.

The principal State Acts and Regulations include:
- Environmental Protection Act 1994
- Environmental Protection Regulation 1998
- Environmental Protection (Water) Policy 1997
- Food Production (Safety) Act 2000
- Health Act 1937
- Health Regulation 1996
- Integrated Planning Act 1997
- Local Government Act 1993
- Sewerage and Water Supply Act 1949
- Standard Sewerage Law
- Standard Water Supply Law
- Stock Act 1915
- Water Act 2000
Many existing and potential providers and users of recycled water are concerned about the numerous laws administered by different Government agencies, and the complexity and lack of consistency in the existing legislation. They would prefer a single approval process for water recycling projects. The background study also concluded that water recycling legislation should be simplified.

It is proposed to amend relevant State legislation, including regulations, to provide for sustainable water recycling, taking into account the concerns of existing and potential providers and users of recycled water.

The result will be a consistent legislative framework that encourages and facilitates water recycling, but does not make use of recycled water mandatory.

The first step towards achieving this is to review existing legislation to identify any areas that may unnecessarily discourage water recycling and other areas where new legislative provisions are needed.

The QWRS has identified for immediate action the need to amend existing legislation to allow regulated trials of on-site greywater use in sewered areas.

Subject to the agreement of the relevant local government these trials will assist the development and testing of treatment methods and their practical and safe application.

Other options have been suggested, such as load-based licensing, tradable permits and performance bonds. The issues raised by these proposals are complex and will take time to consider. The EPA will investigate these options and will monitor developments in Australia and overseas for future consideration during the planned reviews of the QWRS.

Action Plan 2: Provide guidance for using recycled water

Objectives
• Ensure that State and local government, industry and the community have access to professional guidance, appropriate for Queensland conditions, to enable them to undertake water recycling that is safe, environmentally sustainable and cost-effective.
• Make every effort to ensure that Australian Standards adequately consider water recycling.
• Provide guidance for the appropriate and safe use of rainwater collection tanks.
Targets
• Review, and identify gaps in, all existing codes of practice and guidelines and, taking into account any strong evidence of stakeholder demand, determine priority needs specific to Queensland by February 2002.
• In consultation with State and local government, industry and peak bodies and, according to priority needs, adopt, adapt or revise existing, or develop new, codes of practice and guidelines for use of recycled water to provide professional guidance for Queensland water providers and users by June 2004.
• Determine if existing Australian Standards adequately deal with the use of recycled water and, depending on the findings, recommend to Standards Australia amendments to existing Standards, or highlight the need for new Standards by June 2002.
• Develop guidelines for the safe and appropriate use of rainwater collection tanks in Queensland by June 2002.
• Develop a compendium that includes and identifies those codes of practice and guidelines that are mandatory (through legislation), represent minimum or best practice, or have been adopted as the standard practice by June 2003.
• Review existing and new guidelines and codes of practice. Ongoing.

Commentary
The need to provide guidance
Some guidance is currently available, however, many uses are not covered, or are not covered in sufficient detail.

National guidelines for water recycling deal broadly with recycling of treated municipal effluent or cover specific uses of recycled water.

Some guidelines have been developed by the National Water Quality Management Strategy (NWQMS). For further details, see Appendix 3.

The NWQMS guidelines will provide the basis for Queensland guidelines, or will be adopted if no specific Queensland guidelines are developed.

However, additional guidance is needed because:
• existing codes of practice and guidelines do not cover, or do not cover in sufficient detail, some uses of recycled water;
• some codes of practice and guidelines are outdated, incomplete, contradictory or not suitable for Queensland; and
• some codes of practice and guidelines, while largely adequate, need to be reviewed and revised to incorporate the latest scientific knowledge, techniques and practices.
Types of guidance
Codes of practice promote water recycling that safeguards public health and environmental values. Most will cover a specific use of recycled water. For instance, one code may be developed to deal with the irrigation of pasture and crops and another to deal with the use of recycled water for fire-fighting.

Compliance with codes of practice will be mandatory, if they are referred to in relevant legislation or regulations, or if they are specified as project approval conditions by a local government.

Guidelines provide users of recycled water with best practice advice on planning, design, operation and management of water recycling schemes, including broader operational issues, such as energy use. Compliance with newly developed Queensland guidelines will not be mandatory but will be recommended as best practice.

Development of guidance
Industries may wish to develop their own guidelines for recycling water. The Queensland Government will encourage the development of such industry guidelines and may provide input into them.

Ideally, the development of codes of practice and guidelines should occur simultaneously, since they are interrelated. Although this is preferred, it will not always be possible, because Government agencies have the primary responsibility for developing codes of practice in consultation with stakeholders, whereas guidelines are generally industry-driven.

Because of resource constraints, priorities have to be set, giving precedence to Queensland-specific water recycling activities that are already occurring, those that are likely to grow substantially and those that have significant environmental or public health issues associated with them.

All new and updated codes of practice and guidelines will be produced in consultation with relevant Government agencies, local government, industry and the community. Where possible, existing or proposed international, national and interstate codes of practice and guidelines will be adopted or adapted to avoid inconsistencies and repetition.

If new codes of practice and guidelines are specifically developed for Queensland, they will, where possible, be consistent with national and interstate codes of practice and guidelines.

Public health issues (including the development of appropriate microbiological and chemical criteria) and issues relating to potential use of recycled water for specialist uses such as fire fighting will be a priority in developing codes of practice and guidelines. The emphasis will be on producing documents that industry and the community can easily understand.

Industries may wish to develop their own guidelines for recycling water. The Queensland Government will encourage the development of such industry guidelines and may provide input into them.
Codes of practice and guidelines may include (but are not limited to):
- use of recycled water to irrigate pasture and crops;
- use of recycled water to irrigate urban open space areas such as parks, gardens, sports fields and resorts (with restricted and unrestricted access);
- use of recycled water to irrigate golf courses;
- use of recycled water for industrial purposes;
- dual reticulation;
- recycling of stormwater for urban applications;
- use of recycled water for recreational purposes; and
- indirect potable use.

Codes of practice and guidelines will be widely distributed to relevant users and providers of recycled water. Their introduction will be phased in to allow time for adoption.

A compendium of codes of practice and guidelines will be developed, which includes and identifies those that are mandatory (through legislation), represent minimum or best practice or have been adopted as the standard practice.

Demonstration or early implementation projects will be documented and results disseminated to provide guidance on water recycling.

Australian Standards
An Australian Standard is a published document that sets out the technical specifications or other criteria necessary to ensure that a material or method will consistently do the job it is intended to do.

While Australian Standards are not mandatory in themselves, they may become mandatory when adopted into legislation.

Current relevant Australian Standards do not specifically deal with water recycling.

For example, in the Standard for the colour coding of pipes, the colour for recycled water is the same as that for treated water—blue or green (Standards Australia 1995).

The international colour code for pipes carrying recycled water is purple, and it would be preferable to bring Australian Standards into line with this system.

All relevant Standards will be critically examined so that recommendations for possible amendments or the introduction of new Standards can be submitted to Standards Australia.

Guidance for rainwater collection tanks
The Environmental Protection Agency will develop guidelines to ensure the appropriate and safe use of rainwater tanks across Queensland.

The guidelines will look at:
- the circumstances where rainwater tanks would be cost-effective;
- locations in which rainwater tanks may be appropriate;
- appropriate uses of rainwater;
- water quality and health issues;
- appropriate construction, management, maintenance and testing regimes; and
- mechanisms to mitigate any constraints on the adoption of rainwater tanks.
Action Plan 3: Provide technical training and information for the workplace

Objectives

• Facilitate the development and promotion of appropriate training courses to equip providers and users of recycled water with the necessary skills and knowledge.
• Develop, publish and circulate information on safe handling and water recycling practices in the workplace, for all users of recycled water and their staff.

Targets

• Negotiate with Industry Training Advisory Bodies (ITABs) and key training providers for the completion of a training needs analysis in relation to water recycling by June 2002.
• Facilitate, provide input into and encourage the development of training courses by educational institutions, ITABs and other relevant training organisations in the development, design, operation, maintenance and management of water recycling projects and technologies for the use of recycled water by June 2003.
• Promote training courses on water recycling. Ongoing from June 2002.

• Conduct information seminars and other awareness-raising activities to disseminate technical information (including codes of practice and guidelines as they are produced). The programs will be delivered through existing industry organisations wherever practical. At least two such events will be conducted each year from February 2002.
• Develop, publish, circulate and update information sheets progressively (and/or CD-ROMs) for users of recycled water and their staff in consultation with Queensland Health. Ongoing from February 2002.
• Provide information (on the Internet and in printed form) on legislation, codes of practice and guidelines, relevant articles and books, training courses, and research findings in consultation with ITABs, industry and peak bodies. Ongoing from February 2002.

Commentary

The need for training and information
The sustainable use of recycled water depends on regulators, providers and users of recycled water having a thorough understanding of the design, management, operation, maintenance and monitoring of water recycling projects.
Training and dissemination of information are therefore important components of the QWRS.

Issues to be considered within a training strategy include:
- identifying training needs to determine where the skills gaps are, who the target audience is and what additional training (if any) should be provided. Some analysis\(^7\) of training courses has been undertaken in the past and this information will be incorporated into a training needs analysis; and
- planning and implementation of training (for example, specific locations where training needs to take place, any barriers to training that might exist, and actions that will encourage the uptake of training courses).

Development of new courses
After completion of a training needs analysis, training courses can be designed and developed if necessary. The developers of training courses should give serious consideration to accreditation of the new courses, particularly those of long duration that focus on water treatment and management.

While the EPA will not develop and implement training courses itself, it will facilitate and provide input into training courses developed by others or courses under review. These courses will be promoted as part of the QWRS.

Information developed and used to increase awareness in the general community may also be useful for technical training (see Action Plan 4).

Dissemination of information
Basic information sheets on safe handling and recycling practices will be published and circulated to all users of recycled water and their staff. The EPA will produce and distribute such information sheets in printed form; the same information may also be provided on CD-ROM and on the Internet.

The EPA will conduct information seminars and other awareness-raising activities to disseminate technical information (including codes of practice and guidelines as they are produced). The programs will be delivered through existing industry organisations wherever practical.

The EPA will distribute general information on water recycling to a wide range of parties including water users, industry and the community, via the Internet and in printed form.

Information will cover issues such as:
- legislation;
- technical standards/guidelines;
- articles and books relevant to recycling projects;
- water recycling research findings; and
- water recycling training courses and conferences.

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\(^7\) A national review of training of the water industry is currently near finalisation. The EPA will be cognisant of this review and its findings will be taken into consideration when developing the proposed training strategy.
Action Plan 4: Increase community awareness and participation in water recycling

Objectives:
• Increase community awareness of water recycling, its benefits and its role in total water resource management and planning.
• Adapt existing water management programs to include water recycling.
• Develop and implement a model community participation program to actively encourage community input into water recycling activities.
• Assist in training presenters of community education and model community participation programs.

Targets:
• Increase and promote the number of awareness programs to provide simplified general information to the community on water recycling, its benefits, its comparative costs and benefits, and its role in total water resource management and planning. Ongoing.
• Adapt and promote existing water management education programs, for a range of audiences, to include water recycling, by June 2002, and ongoing.
• Actively encourage local governments, industry, agriculture and community groups to distribute educational material by June 2002.
• Update, develop, evaluate and promote professionally planned educational modules and materials, and culturally appropriate programs—for schools, TAFE colleges, universities and Government agencies—on water recycling and its role in total water resource management and planning by December 2002.
• Actively encourage community, industry, local and State Government participation to develop and implement a model community participation program based on successful participation models by June 2002.
• Continually encourage and promote regional partnerships and community-wide participation in the planning, development and implementation of water recycling. **Ongoing.**
• Provide assistance to train water management educators to implement and promote community education and participation programs and to undertake cross-cultural training **by December 2002.**
• Continually monitor all community programs, including culturally appropriate programs, and complete an evaluation report **by June 2003.**

**Commentary**

Community attitudes and awareness

As part of the development of the QWRS, DNR commissioned ACNielsen Research (2000) to undertake a Queensland survey on water recycling, which found that:
• strong support exists for the general concept of water recycling, with 91% of respondents indicating they would use recycled water if it were available; 8
• from the general community’s perspective, two of the main factors preventing greater use of recycled water are lack of knowledge (36%) and lack of awareness (24%); 9
• 91% 10 agreed that they needed more information before feeling confident about using recycled water; and
• health and water quality concerns were also seen as barriers to greater use of recycled water (see Action Plan 5 for information on planned research into public health issues).

This survey, and other studies (Booker et al. 2000), also found that the level of support for water recycling decreased for more personal uses. In other words, support for the use of recycled water to irrigate golf courses is greater than support for its use for showering.

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8 This includes using rainwater tanks.
9 Note: Multiple responses allowed in survey question.
10 Of community respondents, does not include respondents representing local government and commercial entities.
Need for community awareness and education, and formal education programs

The Caloundra Maroochy Wastewater Management Strategy (Rowland Company 1997) concluded that education is a critical factor for future water management decisions that involve recycling:

‘A common theme throughout the study was the need for greater understanding within the community on some of the fundamental issues relating to water, that is, water supply, wastewater management, water resources, bulk water and water quality.’

Community awareness and education programs will be developed to provide detailed information, particularly for those communities where water recycling is already occurring or where consultations on future water recycling opportunities are to be undertaken.

The material will provide easily understood information on:
- sources and components of recycled water;
- the need for water recycling;
- uses of recycled water and its potential to supplement and/or replace existing water resources;
- water quality and treatment;
- impact of recycled water on public health and the environment; and
- costs compared to those of other water supply and wastewater management options.

Formal education modules on water recycling will be developed for schools, TAFE colleges and universities, within water management education programs.

This is in addition to the technical training provided to those working directly with recycled water.

Water-related organisations, peak industry bodies and educational institutions will be encouraged to develop, update and promote educational materials on water recycling.

Where appropriate, partnership agreements will be formed with these organisations to deliver particular programs.

Once the educational modules are developed, they will be disseminated through, among others:
- Australian Water Association;
- Community Water Education and Extension Support Unit of NR&M;
- Waterwatch Queensland;
- WaterWise;
- Healthy Waterways;
- Catchment Management and Landcare groups; and
- Local governments.
Community participation
The EPA will develop a model community participation program, based on relevant and successful community participation models, to help communities become actively involved in and consulted on local water recycling issues (in the planning, development and implementation stages).

This program, to be developed in the form of a self-help kit, will provide a guide for organisations that do not already have a participation program.

It will help them to undertake consultation, clarify terminology and use positive language.

It will also provide suggestions for managing vital processes such as education and risk communication and establishing effective working relationships with stakeholders.

The Queensland Government recognises that additional people with suitable technical knowledge and presentation skills will be needed to present education and participation programs.

The availability of appropriately trained presenters has the potential to influence the success of the QWRS. The EPA will therefore provide assistance to train presenters of the community education and participation programs.
Action Plan 5:
Encourage further research into key aspects of water recycling

Objectives
• Review and prioritise Queensland’s water recycling needs and identify funding opportunities.
• Undertake a comprehensive health effects study including risk analysis.
• Undertake a study to determine a range of environmental and related cost benefits for water recycling activities.
• Compile a database that determines the amount of recycling already occurring, identifies future opportunities and allows performance monitoring and benchmarking.
• Collaborate with other relevant research agencies and programs in Australia.
• Promote the use of Decision Support Systems that lead to the adoption of sustainable and financially viable water recycling projects.

Targets:
• Form an eminent research and development group to review and prioritise Queensland’s water recycling research needs and to identify funding opportunities by May 2002.
• Develop a prioritised health effects study program by October 2002.
• Carry out case studies to determine economic and social values for water recycling by April 2003.
• Compile a database of water recycling activities from which performance indicators (targets) and benchmarks can be derived by June 2003.
• Collaborate with other research agencies in Australia. Ongoing.
• Promote the use of Decision Support Systems. Ongoing.

Commentary
Prioritising research needs
The Queensland Government has identified the following priority areas of research in relation to water recycling:
• public health—risk assessment of microbiological and chemical contaminants in recycled water and water storage systems, risk-minimising management techniques;
• environment—environmental costs and benefits of water recycling;
• economics—economic costs and benefits of water recycling and associated activities; and
• technology—advances in recycled water and stormwater treatment technology and treatment plant operations.

Further research into these key areas will make it possible to assess the long-term sustainability of water recycling.

The EPA will establish an expert research and development group comprised of individuals from a variety of research organisations (for example, Queensland Government agencies, State and Commonwealth research organisations, universities, peak industry bodies and other research organisations) to conduct a comprehensive review of existing information to determine priority needs specific to Queensland.

This group will be required to identify avenues of funding for such research priorities. To ensure that research into the areas of water recycling is conducted, greater coordination of such research is also necessary.

The expert research and development group will also investigate opportunities for Queensland Government agencies to join relevant research programs such as those conducted by the Cooperative Research Centres (CRCs).
Such agencies will assist in the coordination of research and dissemination of water recycling information specific to Queensland.

Areas requiring research
Several key areas of water recycling research are being carried out, or are proposed, as a part of the QWRS. These are described below.

Public health
The potential health implications of water recycling are a key concern for providers and users alike.

Public health concerns relate primarily to:
• personal contact with pathogenic organisms, heavy metals or other contaminants found in recycled water; and
• the presence of disease carriers such as mosquitoes or snails as a result of water recycling activities.

Environment
A study will be undertaken to place an appropriate economic value, or range of values, on the environment and related benefits and costs of water recycling across Queensland.

Economics
Economic constraints such as ‘proximity of a source to a recycling application, volume availability and supply, and cost in comparison with alternative water sources’ have been identified as challenges for water recycling in industry across Queensland (Kinhill 1999). Cost estimates and budget are often documented in project evaluations, but data on economic viability of various applications are often limited (CIRM 1999).

Decision Support Systems
Practical computer-aided modelling programs assess the sustainability of water recycling by evaluating site-specific information on use, demand, storage requirements, treatment requirements, source availability and suitability for recycling. This information allows proponents of water recycling projects to assess the financial viability and sustainability of their projects at the early stages of planning.

Where possible, Decision Support Systems will be promoted through the information kit (see Action Plan 7) to assist in the adoption of sustainable and financially viable water recycling projects.

Surveys
It is proposed that periodic surveys be conducted to determine the degree to which water recycling is already occurring and to identify future water recycling opportunities among different sectors of the community. The collated data will be used as benchmarks on which future water recycling targets (which will take into account issues such as quality) can be based.

Objectives

**Action Plan 6:**
Use demonstration projects to raise community awareness of water recycling

- Maintain support for projects for demonstration, research and operational purposes that raise awareness of water recycling in the community.
- Encourage the development of further demonstration projects through partnerships with the community, government and industry, and collate and disseminate information and findings to the wider community.

Targets
- Maintain operational support for the Advanced Water Recycling Demonstration Plant, in collaboration with industry, educational institutions, local governments and the community.

Ongoing.
Action Plans to Implement Sustainable Water Recycling

- Maintain funding and ongoing support for Community Demonstration Projects until March 2004.
- Continue identification of existing and new operational water recycling projects established by government, ecotourism resorts, industry and within urban developments. Collate details and results, and actively promote the outcomes. Ongoing until June 2004.
- Continue provision of research information from Community Demonstration Projects funded by the Queensland Government, in consultation with industry and peak bodies until June 2004.

Commentary
Raising awareness
Consultation during the development of the QWRS has highlighted the need to raise awareness of water recycling within local governments, industry and the community at large.

An effective method of raising awareness among a cross-section of the community is through demonstration projects.

This approach has been adopted to show the broader community a wide range of applications of recycled water from various sources strategically selected across Queensland.

These demonstration projects will also provide opportunities to communicate to the public a wide range of water recycling issues such as public health. Consultation confirmed that research on water recycling needs to increase.

Demonstration projects provide an appropriate mechanism for collating scientific data relating to water recycling issues, such as effectiveness of treatment and monitoring technologies, and public health, economic and environmental impacts.

Existing demonstration projects
The Queensland Government has initiated the demonstration projects described below. These initiatives will assist in fostering understanding and acceptance of a range of water recycling practices within the community. They will also enable valuable research that will help refine water recycling guidelines and standards to suit Queensland conditions.

Advanced Water Recycling Demonstration Plant
The Advanced Water Recycling Demonstration Plant (AWRDP) is a transportable water recycling plant that demonstrates a range of advanced water treatment technologies. The plant is unique in Australia and is one of only a few in the world. It is currently located in the Pine Rivers Shire near Brisbane and was officially opened in August 2000.

Springfield Water Recycling Demonstration Project
Located within the Springfield residential development, the Springfield Water Recycling Demonstration Project aims to demonstrate water recycling technologies to local governments, developers and contractors.

Four recycling applications–irrigation of public open spaces, school irrigation projects, urban stormwater harvesting and dual reticulation–are being demonstrated at Springfield.

The project will help promote community awareness of water recycling applications in an urban environment. It is jointly funded and administered by Commonwealth, State and local governments as well as the property developer (DNR 2000).
**Community Demonstration Projects**

In the current round of funding, thirteen specific Community Demonstration Projects (CDPs) have been developed by various organisations (for example, local governments, educational institutions, private enterprise, community groups and individuals) and ongoing funding has been committed until 2003-04.

These and any future CDPs will provide the opportunity for individual projects to demonstrate a range of recycling applications that are likely to have widespread application in the future.

Operational water recycling schemes

Water recycling schemes are emerging throughout Queensland, particularly in the areas of: ecotourism; Queensland Government institutions such as schools, public housing, recreation and sporting facilities; industry uses such as components of the manufacturing process; new urban developments; and supermarket and commercial complexes.

Unlike the demonstration projects mentioned above, these are operational water recycling schemes and they have the potential to demonstrate a variety of water recycling applications suited to Queensland’s climatic conditions. They also provide the opportunity to demonstrate water recycling to a much wider community.

Promotion of operational water recycling schemes

Providing opportunities to demonstrate safe and sustainable water recycling practices will encourage their widespread adoption in Queensland.

The Queensland Government will collate information on water recycling initiatives throughout the State and promote such demonstration projects through, for example, the information kit (see Action Plan 7).

Providing data for research

In the past, the data available from demonstration projects in Australia have mainly been restricted to broad issues such as health and financial viability. The projects did not provide the necessary scientific data for establishing benchmarks and making informed decisions (CIRM 1999.).

Research data need to cover issues such as:

- health (contaminants, long-term effects and risk assessment);
- sustainability (economic and environmental); and
- treatment and monitoring technology.

There is also a need to gather information on community attitudes and acceptance, and various ownership and management options. It is vital that all projects funded by the Queensland Government provide scientific data to assist water recycling research.

**Action Plan 7:**

**Support water recycling projects**

**Objectives**

- Demonstrate leadership by considering water recycling as an option when framing policies and planning for Queensland Government projects.
- Increase water recycling through partnerships between Government departments and the private sector, and by providing financial and non-financial assistance.

**Targets:**

- Develop a water recycling information kit for the public, by May 2000 and update as necessary thereafter. **Ongoing.**
- Prepare a program based on the Queensland Government leading by example by June 2002.
• Prepare a model contract, including a sale agreement, for providers and users of recycled water by December 2002.
• Review the range of cost-effective water recycling measures that are already eligible for funding assistance without increasing the overall level of funding by December 2002.

Commentary
Water recycling, initiated by private and public sector organisations in Queensland, has increased in recent years.

As the move towards water recycling continues, providers and users need to ensure that these recycling practices protect public health, are environmentally and economically sustainable and are accepted by the community. Providers and users of recycled water have requested guidance. The following issues have been raised as needing consideration:
• the most appropriate recycling option(s);
• environmental and economic sustainability;
• public health issues;
• cost-benefit issues;
• opportunities for assistance and partnerships; and
• contractual agreements between providers and users of recycled water.

Discussions with providers and users of recycled water revealed that one of their needs is a single contact point that could provide the necessary information.

The EPA therefore plans to prepare a user-friendly information kit, clearly outlining the Government support that is available for water recycling projects. The kit will include information on:
• useful contacts;
• economic, environmental, public health, technical and hydrological aspects of water recycling;
• codes of practice, guidelines and legislation;
• approval processes;
• roles and responsibilities of project proponents;
• educational material for providers, users and the general public;
• water recycling Decision Support System models; and
• websites that provide information on water recycling.

The information kit will be available to individuals who are interested in, or involved in, water recycling activities.

Providers and users of recycled water already have formal and informal contractual agreements governing the provision and use of recycled water. Many parties to these agreements have expressed the desire for a model contract to provide guidance.

The EPA will develop a model sale agreement that effluent providers and users will be able to use as a guide.

The EPA, in developing this contract, will examine other model contracts developed for water recycling, such as the standard contract drafted by Goulburn Valley Region Water Authority in Victoria (Sherman 1998).

To encourage the further adoption of sustainable water recycling practices by private sector organisations, Queensland Government departments will lead by example, by considering water recycling as an option in Government policies and planning activities.

Opportunities exist, throughout Government agencies, to adopt a variety of water recycling applications and recycled water will be considered as an alternative source of supply where possible.

The Queensland Government will consider providing further financial incentives for water recycling when existing financial incentive schemes for water resource use are next reviewed and when new schemes are developed.
The Queensland Water Recycling Strategy was developed and finalised in partnership with the community, State and local government. Implementation of the Action Plans will be developed and implemented in partnership with all relevant stakeholders.

The partnership with Queensland Health and Queensland Department of Natural Resources and Mines, will be integral to the successful implementation of the QWRS.

The community endorsed collaborative agencies nominated in the draft Strategy to implement the QWRS during the final consultation process. The Steering Committee will also ensure relevant and comprehensive stakeholder involvement in the implementation of the Action Plans.

### Action Plan 1: Change Laws to support Water Recycling

**Objective:**
- Develop a consistent, whole-of-government legislative framework that encourages and facilitates water recycling that is safe, environmentally sustainable and cost-effective.

**Targets:**
- Develop a joint action plan with the responsible Government agencies to review relevant existing legislation, including regulations, identifying any areas that may unnecessarily discourage water recycling, and other areas where new legislative provisions are needed.
- Amend legislation to allow regulated trials of on-site greywater recycling in sewered areas to assist the development and testing of treatment methods and their practical and safe application.
- Develop (or amend) legislation, including regulations, that deals with water recycling, with emphasis on consistency and approval processes that are easy to follow.

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### Action Plan 2: Provide Guidance for using recycled water

**Objectives:**
- Ensure that State and local government, industry and the community have access to professional guidance, appropriate for Queensland conditions, to enable them to undertake water recycling that is safe, environmentally sustainable and cost-effective.
- Make every effort to ensure that Australian Standards adequately consider water recycling.
- Provide guidance for the appropriate and safe use of rainwater collection tanks.

**Targets:**
- Review, and identify gaps in, all existing codes of practice and guidelines and, taking into account any strong evidence of stakeholder demand, determine priority needs specific to Queensland.

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• In consultation with State and local government, industry and peak bodies and, according to priority needs, adopt, adapt or revise existing, or develop new, codes of practice and guidelines for use of recycled water to provide professional guidance for Queensland water providers and users.
• Determine if existing Australian Standards adequately deal with the use of recycled water and, depending on the findings, recommend to Standards Australia amendments to existing Standards, or highlight the need for new Standards.
• Develop guidelines for the safe and appropriate use of rainwater collection tanks in Queensland.
• Develop a compendium that includes and identifies those codes of practice and guidelines that are mandatory (through legislation), represent minimum or best practice, or have been adopted as the standard practice.
• Review existing and new guidelines and codes of practice.

**Action Plan 3: Provide Technical Training and Information for the Workplace**

**Objectives:**
• Facilitate the development and promotion of appropriate training courses to equip providers and users of recycled water with the necessary skills and knowledge.
• Develop, publish and circulate information on safe handling and water recycling practices in the workplace, for all users of recycled water and their staff.

**Targets:**
• Negotiate with Industry Training Advisory Bodies (ITABs) and key training providers for the completion of a training needs analysis in relation to water recycling.
• Facilitate, provide input into and encourage the development of training courses by educational institutions, ITABs and other relevant training organisations in the development, design, operation, maintenance and management of water recycling projects and technologies for the use of recycled water.
• Promote training courses on water recycling.
• Conduct information seminars and other awareness-raising activities to disseminate technical information (including codes of practice and guidelines as they are produced). The programs will be delivered through existing industry organisations wherever practical. At least two such events will be conducted each year.
• Develop, publish, circulate and update information sheets progressively (and/or CD-ROMs) for users of recycled water and their staff in consultation with Queensland Health.
• Provide information (on the Internet and in printed form) on legislation, codes of practice and guidelines, relevant articles and books, training courses, and research findings in consultation with ITABs, industry and peak bodies.
Action Plan 4: Increase community awareness and participation in water recycling

Objectives:
• Increase community awareness of water recycling, its benefits and its role in total water resource management and planning.
• Adapt existing water management programs to include water recycling.
• Develop and implement a model community participation program to actively encourage community input into water recycling activities.
• Assist in training presenters of community education and model community participation programs.

Targets:
• Increase and promote the number of awareness programs to provide simplified general information to the community on water recycling, its benefits, its comparative costs and benefits, and its role in total water resource management and planning.
• Adapt and promote existing water management education programs, for a range of audiences, to include water recycling.
• Actively encourage local governments, industry, agriculture and community groups to distribute educational material.
• Update, develop, evaluate and promote professionally planned educational modules and materials, and culturally appropriate programs—for schools, TAFE colleges, universities and Government agencies—on water recycling and its role in total water resource management and planning.
• Actively encourage community, industry, local and State Government participation to develop and implement a model community participation program based on successful participation models.
• Continually encourage and promote regional partnerships and community-wide participation in the planning, development and implementation of water recycling.
• Provide assistance to train water management educators to implement and promote community education and participation programs and to undertake cross-cultural training.
• Continually monitor all community programs, including culturally appropriate programs, and complete an evaluation report.
Action Plan 5: Encourage further research into key aspects of water recycling

Objectives:
- Review and prioritise Queensland’s water recycling needs and identify funding opportunities.
- Undertake a comprehensive health effects study including risk analysis.
- Undertake a study to determine a range of environmental and related cost benefits for water recycling activities.
- Compile a database that determines the amount of recycling already occurring, identifies future opportunities and allows performance monitoring and benchmarking.
- Collaborate with other relevant research agencies and programs in Australia.
- Promote the use of Decision Support Systems that lead to the adoption of sustainable and financially viable water recycling projects.

Targets:
- Form an eminent research and development group to review and prioritise Queensland’s water recycling research needs and to identify funding opportunities.
- Develop a prioritised health effects study program.
- Carry out case studies to determine economic and social values for water recycling.
- Compile a database of water recycling activities from which performance indicators (targets) and benchmarks can be derived.
- Collaborate with other research agencies in Australia.
- Promote the use of Decision Support Systems.
**Action Plan 6: Use demonstration projects to raise community awareness of water recycling**

**Objectives:**
- Maintain support for projects for demonstration, research and operational purposes that raise awareness of water recycling in the community.
- Encourage the development of further demonstration projects through partnerships with the community, government and industry, and collate and disseminate information and findings to the wider community.

**Targets:**
- Maintain operational support for the Advanced Water Recycling Demonstration Plant, in collaboration with industry, educational institutions, local governments and the community.
- Continue active participation in the management and delivery of the Springfield Water Recycling Demonstration Project.
- Maintain funding and ongoing support for Community Demonstration Projects.
- Continue identification of existing and new operational water recycling projects established by government, ecotourism resorts, industry and within urban developments. Collate details and results, and actively promote the outcomes.
- Continue provision of research information from Community Demonstration Projects funded by the Queensland Government, in consultation with industry and peak bodies.

**Action Plan 7: Support water recycling projects**

**Objectives:**
- Demonstrate leadership by considering water recycling as an option when framing policies and planning for Queensland Government projects.
- Increase water recycling through partnerships between Government departments and the private sector, and by providing financial and non-financial assistance.

**Targets:**
- Develop a water recycling information kit for the public, and update as necessary thereafter.
- Prepare a program based on the Queensland Government leading by example.
- Prepare a model contract, including a sale agreement, for providers and users of recycled water.
- Review the range of cost-effective water recycling measures that are already eligible for funding assistance without increasing the overall level of funding.
## Appendix 1: Glossary

<table>
<thead>
<tr>
<th>Common term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>agricultural effluent</td>
<td>liquid waste that flows from piggeries, feedlots, dairy and aquaculture entities. Excludes irrigation runoff, which is covered by NR&amp;M’s Rural Water Use Efficiency Initiative</td>
</tr>
<tr>
<td>agricultural purposes</td>
<td>use of recycled water for food crops, hydroponics, pasture production, turf farms, field crops, horticulture (nurseries, vineyards and cut flowers) and forestry. The water may be used for irrigation or other activities (for example, shed cleaning)</td>
</tr>
<tr>
<td>appropriately treated</td>
<td>(where the quality of recycled water is) improved to the standard required for its intended use. This can be achieved using biological, chemical or physical treatment methods</td>
</tr>
<tr>
<td>aquifer</td>
<td>rock formation containing water in recoverable quantities (Walker 1995)</td>
</tr>
<tr>
<td>aquifer recharge</td>
<td>the infiltration or injection of natural waters or recycled waters into an aquifer, providing replenishment of the groundwater resource (Resource Sciences &amp; Knowledge 2000)</td>
</tr>
<tr>
<td>aquifer storage and recovery</td>
<td>injection of recycled water into aquifers for storage. The water may be recovered later to meet water demands</td>
</tr>
<tr>
<td>beneficial use</td>
<td>the use of any element or segment of the environment that contributes to public benefit, welfare, safety, health or aesthetic enjoyment (ARMCANZ, ANZECC &amp; NHMRC 2000)</td>
</tr>
<tr>
<td>blackwater</td>
<td>water that contains human waste (urine, faeces)</td>
</tr>
<tr>
<td>Decision Support System</td>
<td>computerised management system which provides guidance to decision makers about environmental, economic and social aspects of alternative water recycling options</td>
</tr>
<tr>
<td>direct potable recycling</td>
<td>the immediate addition of recycled water to the drinking water distribution system (without an intermediate stage of storage or mixing with surface water or groundwater)</td>
</tr>
<tr>
<td>dual reticulation</td>
<td>the simultaneous supply of water from two separate sources, requiring two sets of pipes: one to provide potable water (for drinking, cooking bathing and laundry purposes); the other to provide recycled water for non-potable purposes</td>
</tr>
<tr>
<td>ecologically sustainable</td>
<td>defined under the Environmental Protection Act 1994 as protecting ‘Queensland’s environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends'</td>
</tr>
<tr>
<td>Common term</td>
<td>Definition</td>
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<tr>
<td>effluent</td>
<td>treated or untreated liquid waste flowing from agricultural and industrial processes, or from sewage treatment plants</td>
</tr>
<tr>
<td>environmental flow</td>
<td>the release of water from storage to a stream to maintain the healthy state of that stream (WBM Oceanics Australia 1999)</td>
</tr>
<tr>
<td>external recycling</td>
<td>use of recycled water produced by another organisation</td>
</tr>
<tr>
<td>greywater</td>
<td>water that contains waste from the kitchen, laundry or bathroom, but which does not contain human waste (urine or faeces)</td>
</tr>
<tr>
<td>groundwater</td>
<td>subsurface water from which wells, springs or bores are fed (ARM CANZ, ANZECC &amp; NHMRC 2000)</td>
</tr>
<tr>
<td>indirect potable use</td>
<td>the intentional withdrawal, treatment and distribution of potable (drinking) water from surface water or groundwater that contains some proportion of treated effluent</td>
</tr>
<tr>
<td>industrial effluent</td>
<td>liquid waste produced by industry and its processes</td>
</tr>
<tr>
<td>industrial purposes</td>
<td>(use of recycled water by industry for) purposes including cooling processes, operation of boilers, manufacturing and processing activities, wash down and cleaning, toilet and urinal flushing and other uses (for example, dust suppression and irrigation of grounds)</td>
</tr>
<tr>
<td>industry</td>
<td>the commercial, manufacturing, processing, petroleum, power generation, tourism and mining sectors</td>
</tr>
<tr>
<td>internal recycling</td>
<td>the use of recycled water by the entity that produced the wastewater</td>
</tr>
<tr>
<td>irrigation</td>
<td>the watering of crops, pasture, golf courses, parks, gardens and open spaces, which may involve using different application methods (for example, drip, trickle, spray and flood)</td>
</tr>
<tr>
<td>least cost planning</td>
<td>also known as ‘integrated resource planning’. A framework in which both demand side and supply side options are rigorously compared to produce the minimum overall community cost, including environmental and social costs</td>
</tr>
<tr>
<td>load-based licensing</td>
<td>a licensing system where charges are based on the type of discharge, the amount of discharge and the sensitivity of the receiving environment, instead of charges being based on a fixed fee</td>
</tr>
<tr>
<td>municipal effluent</td>
<td>treated water discharged from a sewage treatment plant</td>
</tr>
<tr>
<td>Common term</td>
<td>Definition</td>
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<tr>
<td>municipal wastewater</td>
<td>(see sewage)</td>
</tr>
<tr>
<td>nanofiltration</td>
<td>a pressure-driven membrane separation process. In water treatment, nanofiltration is used to remove non-volatile substances such as natural and synthetic organics, colour and disinfection by-product precursors, and multivalent inorganic substances (for example, water softening by removing calcium and magnesium) (Symons, Bradley &amp; Cleveland 2000)</td>
</tr>
<tr>
<td>non-potable purposes</td>
<td>purposes other than for drinking, cooking, bathing and laundry (for example, irrigation of gardens, lawns and toilet flushing)</td>
</tr>
<tr>
<td>performance bond</td>
<td>a risk premium paid to a financial institution to guarantee that funds are available for rehabilitation or restoration if the enterprise fails</td>
</tr>
<tr>
<td>potable</td>
<td>of a quality suitable for drinking, cooking, bathing and laundry purposes</td>
</tr>
<tr>
<td>rainwater tanks</td>
<td>tanks used to collect and store rainfall from roofs for beneficial use</td>
</tr>
<tr>
<td>recycled water</td>
<td>appropriately treated wastewater, urban stormwater and rainwater</td>
</tr>
<tr>
<td>reverse osmosis</td>
<td>an advanced method used in water and wastewater treatment that relies on a semi-permeable membrane to separate the water from its impurities (WBM Oceanics Australia 1999)</td>
</tr>
<tr>
<td>safe</td>
<td>minimising risk to public health and the health of the environment. This definition will be more precisely worded in guidelines which will be prepared to address the specific requirements of various water recycling applications</td>
</tr>
<tr>
<td>sewage</td>
<td>the used water of community or industry, conveyed through sewers to be treated at a sewage treatment plant</td>
</tr>
<tr>
<td>sewage effluent</td>
<td>(see municipal effluent)</td>
</tr>
<tr>
<td>sewer mining</td>
<td>diversion and treatment of raw sewage for on-site purposes such as irrigation (DPI 2000)</td>
</tr>
<tr>
<td>stormwater</td>
<td>all surface water runoff from rainfall, predominantly in urban catchments. Such areas may include rural residential zones (WBM Oceanics Australia 1999)</td>
</tr>
<tr>
<td>Common term</td>
<td>Definition</td>
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<tr>
<td>subsidy</td>
<td>non-repayable grant of money</td>
</tr>
<tr>
<td>tradable permits</td>
<td>rights to discharge effluent, taking into account quantity and quality of the effluent, which can be exchanged between firms and individuals. A limit is usually set on the total number of permits issued</td>
</tr>
<tr>
<td>treated effluent</td>
<td>liquid waste flowing from agriculture and industry processes, or sewage treatment plants, that has been subjected to screening, sedimentation, biological or chemical processes to improve its quality</td>
</tr>
<tr>
<td>wastewater</td>
<td>the used water of community, industry, or agriculture</td>
</tr>
<tr>
<td>water quality</td>
<td>the chemical, physical and biological condition of water (DPI 2000)</td>
</tr>
<tr>
<td>water recycling</td>
<td>sustainable use of appropriately treated wastewater, urban stormwater and rainwater for beneficial purposes, in ways that safeguard public health and environmental values</td>
</tr>
<tr>
<td>water resource</td>
<td>the sources of supply of groundwater and surface water in a given area (DPI 2000)</td>
</tr>
<tr>
<td>water-sensitive urban design</td>
<td>the application of a wide range of within-catchment measures to manage the impacts of urban development on the total water cycle (McAlister 1997)</td>
</tr>
<tr>
<td>watertable</td>
<td>a surface that defines the top of the saturated zone in an unconfined aquifer, at which the pressure of the water is equal to that of the atmosphere (Resource Sciences &amp; Knowledge 2000)</td>
</tr>
</tbody>
</table>
### Appendix 2: Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ABS</td>
<td>Australian Bureau of Statistics</td>
</tr>
<tr>
<td>ANZECC</td>
<td>Australian and New Zealand Environment and Conservation Council</td>
</tr>
<tr>
<td>ARM CANZ</td>
<td>Agriculture and Resource Management Council of Australia and New Zealand</td>
</tr>
<tr>
<td>CIRM</td>
<td>Centre for Integrated Resource Management</td>
</tr>
<tr>
<td>CRC</td>
<td>Cooperative Research Centre</td>
</tr>
<tr>
<td>DLGP</td>
<td>Department of Local Government and Planning</td>
</tr>
<tr>
<td>DNR</td>
<td>Department of Natural Resources</td>
</tr>
<tr>
<td>DPI</td>
<td>Department of Primary Industries</td>
</tr>
<tr>
<td>DSD</td>
<td>Department of State Development</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>GHD</td>
<td>Gutteridge Haskins and Davey</td>
</tr>
<tr>
<td>ITAB</td>
<td>Industry Training Advisory Body</td>
</tr>
<tr>
<td>LGB CWSS</td>
<td>Local Governing Bodies' Capital Works Subsidy Scheme</td>
</tr>
<tr>
<td>ML</td>
<td>megalitre(s)</td>
</tr>
<tr>
<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
</tr>
<tr>
<td>NR&amp;M</td>
<td>Department of Natural Resources and Mines</td>
</tr>
<tr>
<td>NRC</td>
<td>National Research Council (USA)</td>
</tr>
<tr>
<td>NWQMS</td>
<td>National Water Quality Management Strategy</td>
</tr>
<tr>
<td>QELA</td>
<td>Queensland Environmental Law Association</td>
</tr>
<tr>
<td>QH</td>
<td>Queensland Health</td>
</tr>
<tr>
<td>QWRS</td>
<td>Queensland Water Recycling Strategy</td>
</tr>
<tr>
<td>SCAP</td>
<td>The Smaller Communities Assistance Program</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>USEPA</td>
<td>United States Environmental Protection Agency</td>
</tr>
</tbody>
</table>

As mentioned above, there are national guidelines dealing with recycled water, some of which have been developed by the National Water Quality Management Strategy (NWQMS).

The NWQMS is a joint initiative currently being developed by the Commonwealth, State and Territory Governments under the auspices of the Australian and New Zealand Environment and Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) (NWQMS 2000).

The NWQMS is producing five separate documents dealing with particular aspects of sewerage systems.

The most important document relating to recycled water is the Guidelines for Sewerage Systems—Use of Reclaimed Water (2000).

Other published national NWQMS guidelines of relevance to the QWRS include:

- Australian Guidelines for Urban Stormwater Management (2000);
- Guidelines for Sewerage System—Acceptance of Trade Waste (Industrial Waste) (1994);
- Guidelines for Sewerage Systems—Effluent Management (1997);
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000); and

The NWQMS has also developed Effluent Management Guidelines that cover internal recycling in specific industries, including:
- Dairy Sheds (1995);
- Dairy Processing Plants (1999);
- Intensive Piggeries (1995);
- Aqueous Wool Scouring and Carbonising (1999);
- Tanning and Related Industries (1999); and
Appendix 4: List of key State agencies involved in the Implementation of the QWRS

Department/Agency (alphabetical)

Department of Aboriginal and Torres Strait Islander Policy and Development
Department of Employment and Training
Department of Families
Department of Housing
Department of Industrial Relations
Department of Innovation Information, Economy, Sport and Recreation
Department of Local Government and Planning
Department of Main Roads
Department of Natural Resources and Mines
Department of Primary Industries
Department of Public Works
Department of State Development
Education Queensland
Environmental Protection Agency
Premier and Cabinet
Queensland Fire and Rescue Services
Queensland Health
Queensland Transport
Queensland Treasury
TAFE Queensland

ACNielsen Research 2000, Local government authority knowledge and attitudes survey, Queensland Department of Natural Resources, Brisbane, unpub.


CIRM 1999, Demonstration and Research Water Recycling Background Study, Queensland Department of Natural Resources, Brisbane, unpub.


DNR 1996, Interim Guidelines for Reuse or Disposal of Reclaimed Wastewater, Queensland Department of Natural Resources, Brisbane.

DNR 1998, Queensland Wastewater Reuse Strategy—Background Paper, Queensland Department of Natural Resources, Brisbane.


DPI 2000, Agricultural Water Recycling Background Study, Queensland Department of Natural Resources, Brisbane.


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Kinhill and GHD 1999, South-East Queensland Water and Wastewater Management and Infrastructure Study: final report for phase 1—water sources and infrastructure needs, Vol 1, Kinhill, Milton.


QELA 2000, Legislative Environment Water Recycling Background Study, Queensland Department of Natural Resources, Brisbane.

Resource Sciences and Knowledge 2000, Groundwater Recharge Background Study, Queensland Department of Natural Resources, Brisbane.

Robertson, C. 2000, ‘Recirculation prawn farming project approved’, Aquaculture News, April, Queensland Department of Primary Industries, Brisbane.


WBM Oceanics Australia 1999, Stormwater Recycling Background Study, Queensland Department of Natural Resources, Brisbane.

White, D. 1999, Urban water recycling background study, Queensland Department of Natural Resources, Brisbane, unpub.
Please contact:
Queensland Water Recycling Strategy
Environmental Protection Agency
P.O. Box 155
Brisbane Albert Street
Queensland 4002

Phone: (07) 3224 8612
Fax: (07) 3227 8341
Email: qwrs@env.qld.gov.au
Website: www.env.qld.gov.au/sustainable_water/