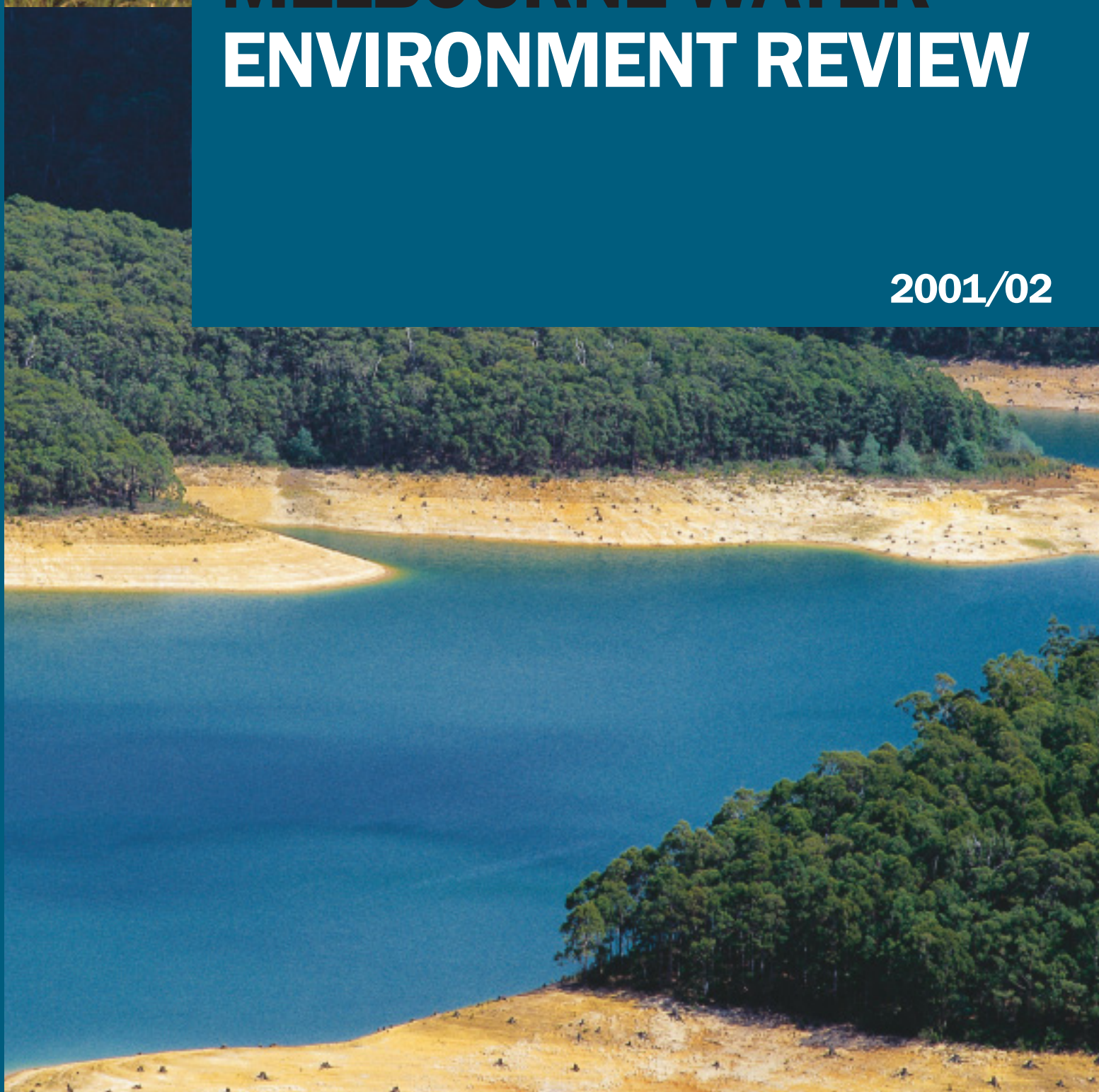
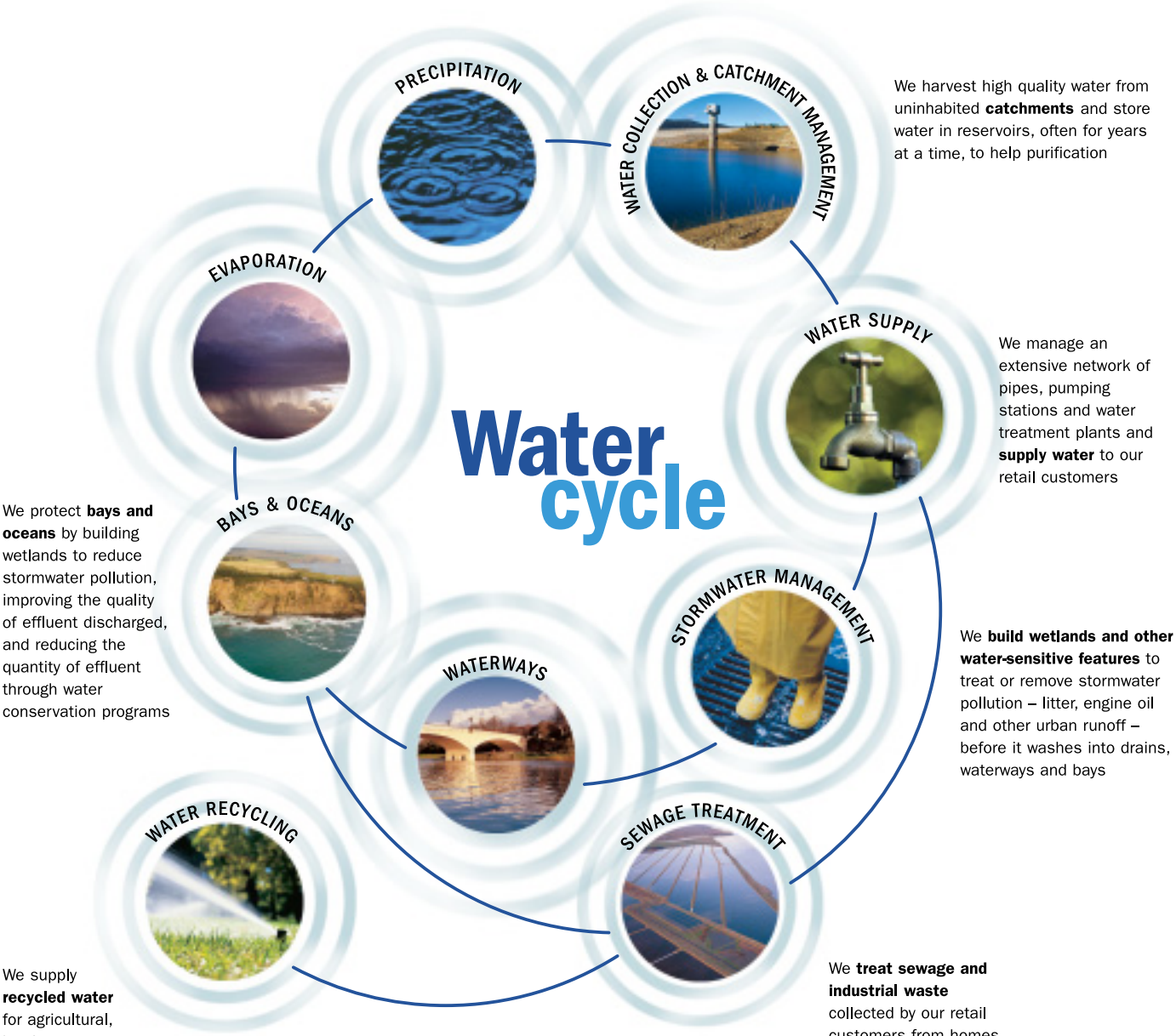
MELBOURNE WATER ENVIRONMENT REVIEW

2001/02



We manage Melbourne's water resources in a way that aims to ensure that future generations enjoy one of the best urban environments in the world.

Our activities span the water cycle and include:



We harvest high quality water from uninhabited **catchments** and store water in reservoirs, often for years at a time, to help purification

We manage an extensive network of pipes, pumping stations and water treatment plants and **supply water** to our retail customers

We **build wetlands and other water-sensitive features** to treat or remove stormwater pollution – litter, engine oil and other urban runoff – before it washes into drains, waterways and bays

We **treat sewage and industrial waste** collected by our retail customers from homes and businesses

We protect and improve **waterways** by managing irrigators, stabilising beds and banks, preventing flooding, fencing off stream frontages, removing willows and other weeds, planting native species and releasing water from reservoirs to ensure environmental flows

We supply **recycled water** for agricultural, horticultural and other businesses and to irrigate open spaces such as golf courses

We protect **bays and oceans** by building wetlands to reduce stormwater pollution, improving the quality of effluent discharged, and reducing the quantity of effluent through water conservation programs

Front cover: Lake Borrie at the Western Treatment Plant; wetlands near Hampton Park; Upper Yarra Reservoir.

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Melbourne Water charter

Melbourne Water is owned by the Victorian Government. We manage Melbourne's water supply catchments, remove and treat most of Melbourne's sewage, and manage waterways and major drainage systems.

Our drinking water is highly regarded by the community. It comes from protected mountain ash forest catchments high up in the Yarra Ranges east of Melbourne. We are committed to conserving this vital resource, and to protecting and improving our waterways, bays and the marine environment. We recognise our important role in planning for future generations.

Our vision is to show leadership in water cycle management, through effective sustainable and forward-looking management of the community resources we oversee. We are a progressive organisation that applies technology and innovation to achieve environmentally sustainable outcomes.

The business objectives established to realise our vision are to:

- provide excellent customer service
- operate as a successful commercial business
- manage Melbourne's water resources and the environment in a sustainable manner
- maintain the trust and respect of the community.

We also appreciate that achievements occur through the contribution of our people and through our values. We are people who:

- recognise that we achieve more by working with others
- feel privileged to be the custodians of our water resources
- behave with integrity
- attain excellence through creativity and innovation
- celebrate our achievements and learn from our experiences.

At Melbourne Water, we understand that engaging our stakeholders is the key to achieving our vision of leadership in water cycle management.

Melbourne Water is a statutory authority. The responsible minister is the Minister for Environment and Conservation, the Honourable Sherryl Garbutt.

Environment snapshot

At Melbourne Water, we manage the natural and built environment for the community now and for the future.

We made significant progress in protecting and improving waterways and bays, and in ensuring the sustainable use of our water resources and energy. The following is a snapshot of our environmental performance.

Indigenous trees and shrubs are planted along Melbourne's rivers and creeks as part of a major project to improve waterway health.

Protecting the marine environment

We worked to protect the long-term health of Port Phillip Bay, continuing our upgrade of the Western Treatment Plant and constructing stormwater treatment wetlands to reduce the amount of nitrogen entering the Bay.

Following extensive scientific research and community consultation, we submitted detailed plans to EPA Victoria for a $170 million environmental upgrade of the Eastern Treatment Plant at Bangholme.

The first stage of an ammonia reduction project at the Eastern Treatment Plant to improve the quality of effluent discharged to Bass Strait was completed successfully.

We worked closely with councils to reduce stormwater pollution by implementing a pilot project to improve environmental practices at building sites and continuing to develop stormwater management plans. We also incorporated water-sensitive urban design concepts into some 30 development proposals.

A successful water recycling trial using membrane technology to treat water directly from sewers showed how we can reduce the discharge to the marine environment and keep Melbourne's parks and gardens green without using precious supplies of drinking water.

We also gained two new water recycling customers in the Werribee Tourist Precinct. These schemes will reduce the amount of irrigation water used from the Werribee River.

Protecting our waterways

As the drought continued into its sixth year, we were able to achieve environmental flows at all our sites, apart from a single daily flow on the Thomson River. Restrictions were introduced for several months on the diversion of water from the Yarra and Maribyrnong rivers.

We worked in partnership with councils and other stakeholders, spending more than $36.3 million on projects to improve our waterways and drainage system and planting more than 200,000 trees and shrubs. Landowners and local environment groups fenced out livestock to revive rural waterways under our expanded Stream Frontage Management Program.

Protecting and enhancing aquatic life is a major priority for us, and we were particularly pleased with an increase in platypus populations in areas of improved stream habitat and Melbourne's first census of frog populations, which are important indicators of stream health.

Preserving our water resources

We continued to play a major part in developing the Victorian Government's Water Resources Strategy for Melbourne for the next 50 years. A major Strategy Directions Report was released for community consultation in May 2002. We have committed $800,000 to develop the strategy, with a final report due to the Minister for Environment and Conservation late in 2002.

Among our water conservation initiatives were programs to engage industry and meet community, business and environmental needs. A training program educated plumbers so that they can pass on advice to consumers such as information on water-efficient appliances.

We also continued awareness programs with the education sector and councils, and developed websites to provide information on water storage levels and drought.

Meeting the greenhouse challenge

We began a $30 million project at the Eastern Treatment Plant to replace imported, non-renewable energy with renewable or "green" energy in our operations. This project, which includes using biogas created in our sewage treatment processes, will reduce our greenhouse gas emissions by 24,500 tonnes a year.

We are also upgrading our processes at the Western Treatment Plant to capture more methane from the covered lagoons and become increasingly energy-efficient.

By 2005/06, Melbourne Water will reduce greenhouse emissions by 35 per cent.

Protecting internationally significant wetlands

A strong community partnership was the catalyst for the Edithvale-Seaford Wetlands being named wetlands of international significance under the Ramsar Convention. The Ramsar Bureau cited the wetlands' conservation benefits, stormwater management and encouragement of environmental research and education.

We worked with the local community and other stakeholders to complete a draft Ramsar and Conservation Management Plan as part of a submission to Environment Australia on the implications of the environmental upgrade at the Western Treatment Plant. The submission included several fauna and flora studies.

Environment policy

Melbourne Water aims to show leadership in water cycle management.

Melbourne Water will:

- Work towards achieving a sustainable balance between environmental protection and economic development that is in the interests of future generations.
- Implement environmental policies and procedures within the framework of environmental management systems consistent with the Australian water industry environmental management guidelines and ISO 14001.
- Comply with statutory and corporate requirements and, through a continual improvement process, develop strategies to meet expected medium to long-term regulatory trends.
- Minimise the environmental impact of the organisation's activities and ensure that management, employees and contractors:
  - are equipped to anticipate and manage the environmental risks and responsibilities in their day-to-day work,
  - take all reasonable care to address the environmental aspects of business activities.
- Involve customers, stakeholders and the community in current activities, new projects and strategies through appropriate consultation and education programs.
- Integrate environmental management with business planning, decision-making and economic evaluation processes.

Melbourne Water will fulfil this policy by:

- Conducting regular environmental audits and assessments of the corporation's compliance with statutory and corporate requirements and periodically providing appropriate information to the Board, shareholders, customers, employees and the community.
- Undertaking research and development and contributing to the transfer of environmentally sound technology and management methods throughout the water industry.
- Identifying and implementing waste minimisation strategies (including the recycling and reuse of products) to minimise risk and add value to the business.
- Minimising the environmental impacts of Melbourne Water through:
  - using a risk management approach appropriate to the potential for environmental damage,
  - carefully evaluating decisions to avoid, wherever practicable, serious and irreversible environmental damage,
  - identifying and critically assessing options for proposed projects and strategies,
  - sound environmental management of the construction phase,
  - developing and implementing environment improvement plans for current operations,
  - developing emergency preparedness plans where potential hazards exist.

Measuring our environmental performance

Indicator	2001/02 Plan	2001/02 Actual	2002/03 Plan	2003/04 Plan	2004/05 Plan
Renewable energy generation* (percentage of total energy used that Melbourne Water generates from renewable sources)	–	34	41	54	62
Sewage spills					
– wet weather	4	0	4	4	4
– dry weather	0	0	0	0	0
Compliance with EPA Victoria licence effluent discharge requirements at the Eastern and Western treatment plants (number of breaches)	0	0	0	0	0
Meeting river environmental flows at water harvesting points (number of breaches of obligations)	0	0	0	0	0
Percentage of biosolids used from*					
Eastern Treatment Plant	–	–	33	67	100
Western Treatment Plant	–	–	–	–	–
Water recycled* (percentage of total water volume discharged from sewage treatment plants that is recycled)	–	2.4	4	5	8
Reduction in nitrogen discharge (annual nitrogen discharge savings through constructing wetlands, in tonnes)	10	17	20	30	40
Water conservation* (percentage reduction in demand from retail water companies)	–	–	1.5	1.5	1.5

* Targets were established during 2001/02

Protecting the marine environment

We aim to minimise the environmental impact on our bays and oceans to ensure that future generations can enjoy these natural assets.

We are upgrading our sewage treatment plants to improve the quality of effluent discharged, and working with councils, developers, research organisations and the community to improve stormwater quality in waterways and drains flowing into the bays.

Licences issued by EPA Victoria govern the quality of treated effluent discharged from the treatment plants. Licence requirements must be consistent with State Environment Protection Policy quality objectives for receiving waters. These objectives have been developed to balance the value to the community of our sewerage services and to protect the long-term health of the marine environment.

Fisherman at Gunnamatta Beach, near the outfall into Bass Strait. It was reported to be a great season for fishing in the area.

ACHIEVEMENTS

- Completed the first stage of an ammonia reduction project, which will improve the quality of effluent discharged from the Eastern Treatment Plant.
- Submitted a comprehensive sustainable resource management plan to EPA Victoria to upgrade the Eastern Treatment Plant.
- Reduced the nitrogen discharged to Port Phillip Bay from Western Treatment Plant to 2,661 tonnes - a 29 per cent reduction on the 2000/01 level.
- Completed seven wetlands to improve the quality of stormwater entering Port Phillip Bay.
- Developed a Ramsar and Conservation Management Plan for the Western Treatment Plant and neighbouring conservation reserve, including flora and fauna surveys.
- Achieved 100 per cent compliance for discharge parameters from our sewage treatment plants.
- Completed the second stage of a study tracing sediment sources in Western Port.
- Completed a further eight stormwater management plans with councils to reduce stormwater pollution.
- Worked closely with the development industry to incorporate water-sensitive urban design concepts in more than 30 development proposals.
- Recycled 5,683 million litres of water at Western Treatment Plant and 1,156 million litres at Eastern Treatment Plant. This represents 2.4 per cent of the total effluent from both plants.
- Undertook a successful on-site water recycling trial in King's Domain gardens, demonstrating how water treated directly from sewers can keep Melbourne's parks and gardens green.

DISAPPOINTMENTS

- Delays in construction works at three wetlands (Police Road, Huntingdale Road and Jacana southern system) due to unfavourable site conditions.
- Emissions from an engine in the outfall pump station at the Eastern Treatment Plant failed to meet one air discharge parameter under the EPA Victoria licence.
- Slower than expected acceptance and promotion of water-sensitive urban design concepts by councils.
- Delay in beginning the broad environmental study of Western Port due to slow resolution of project management issues.

KEY CHALLENGES

- Continuing to reduce the total load of nitrogen entering Port Phillip Bay to achieve target levels, even with population growth and average rainfall years.
- Implementing the environmental upgrade of the Eastern Treatment Plant to improve the quality of the effluent discharge to Bass Strait.
- Continuing to form partnerships to improve stormwater quality management and influence greater adoption of water-sensitive urban design into new developments.
- Using the research findings from the Western Port environmental study to better understand sedimentation and the decline of seagrass meadows.
- Meeting community expectations regarding effluent discharge standards.
- Ensuring that changing sewage practices at the Western Treatment Plant do not impact on birdlife and other important native and visiting animals.
- Increasing investment, infrastructure and community acceptance of recycled water to help implement major schemes and meet the target of recycling 20 per cent of treated effluent by 2010.
- Working with EPA Victoria to respond to issues relating to water quality in the revised Wastewater Reuse Guidelines.

Lagoons at the Western Treatment Plant in Werribee. A major upgrade at the plant will help protect the health of Port Phillip Bay.

Port Phillip Bay

Most of Melbourne's waterways flow into Port Phillip Bay. Since European settlement, agricultural, industrial and urban development has significantly changed the quality of water flowing into the Bay.

We commissioned the four-year Port Phillip Bay Environmental Study, which found that stormwater is a major source of toxicants, pathogens, litter and sediment discharged into the Bay and a significant source of nitrogen loads. The CSIRO study, completed in 1996, recommended reducing nitrogen entering the Bay by 500 tonnes a year through catchment management initiatives and 500 tonnes a year through a major upgrade of our Western Treatment Plant. In response, Melbourne Water developed the Healthy Bay Initiative to secure the long-term health of the Bay.

Transforming sewage treatment

Melbourne Water's Western Treatment Plant at Werribee receives and treats most sewage generated in Melbourne's western and northern suburbs, including most of the city's industrial waste. The plant operates in an environmentally sensitive area, declared a Wetland of International Importance under the Ramsar Convention. The plant treats about 500 million litres of sewage a day, and discharges treated effluent to Port Phillip Bay, under EPA Victoria licence, from four points between the Werribee River and Point Wilson.

We are transforming the plant's treatment processes by discontinuing the unsustainable land and grass filtration processes. These will be decommissioned by 2005 and replaced by lagoon treatment systems enhanced with activated sludge technology. In lagoon treatment, sewage travels slowly through a series of connected ponds which contain high concentrations of naturally occurring bacteria. The plant has three modern lagoon systems.

Environment improvement plan

In August 2000, EPA Victoria granted Melbourne Water an accredited licence in recognition of the plant's excellent environmental performance. This licence comprises concise statements on discharge limits, an audit program, an environmental management system and an environment improvement plan.

We developed an environment improvement plan with EPA Victoria and the Western Treatment Plant community liaison committee, incorporating the improvements needed to meet licence conditions. The plan, which was published in September 2000, includes enhanced lagoons, water recycling, monitoring programs, and a conservation management plan.

In May 2002, Melbourne Water began reviewing the plan to establish progress against set targets.

Reducing nitrogen loads

Under the improvement plan, new lagoon technology is being installed to reduce the nitrogen load to Port Phillip Bay by 500 tonnes a year, and to provide high quality effluent for on-site and off-site water recycling schemes. This $124 million upgrade will be completed by December 2005.

During December 2001, we commissioned the first activated sludge plant in the 55 East lagoon system. The activated sludge process enhances nitrogen removal by growing and retaining large numbers of naturally-occurring bacteria that convert dissolved nitrogen to nitrogen gas.

The upgraded lagoon has operated successfully, producing effluent quality that meets design targets. In doubling the lagoon's capacity and trebling its nitrogen removal capability, the activated sludge technology has allowed us to convert 35 per cent of the land previously used for sewage treatment to land set aside for irrigation using recycled water. The increased nitrogen-removal capability will meet about 80 per cent of the required reduction from the plant.

We also began designing the second activated sludge plant, which is planned for the 25 West lagoon system.

Managing stormwater

Projects such as constructing pollution-reducing wetlands to improve the quality of stormwater flowing into the Bay are a significant part of the Healthy Bay Initiative. Aquatic plants established at these wetlands trap and filter contaminants before discharging stormwater to the Bay. We designed 10 wetlands and constructed nine wetlands. Seven of these wetlands are specifically designed to reduce nitrogen entering Port Phillip Bay. When the aquatic plants in these seven wetlands reach maturity and the water flow is balanced, they will reduce nitrogen loads to the Bay by 17 tonnes a year.

These wetlands are part of a project that aims to create a water-sensitive drainage system in Melbourne's south-eastern growth corridor. This is a regional scale stormwater management project involving partnerships with councils, EPA Victoria, developers and community groups.

Wetlands were also approved or constructed in 20 estate developments. A further 18 estates included water quality improvement works such as litter traps or sediment traps.

Lynbrook Estate in the City of Casey is a working demonstration of water-sensitive urban design.

Water quality assets and wetland management plans

Melbourne Water manages and maintains 89 stormwater assets, including litter and sediment traps, wetlands and pollution-control ponds.

The most common maintenance is removing rubbish from litter traps and silt from sediment traps. Plants needs to be replaced and weeds controlled so that wetlands continue functioning according to their design capacities. We completed management plans for eight key wetlands.

Working with councils

Melbourne Water works closely with councils on improving stormwater quality. In particular, we support councils in developing stormwater management plans. These plans outline ways to reduce stormwater pollution, through sediment and litter traps, wetlands built into new housing estates, modern street-cleaning practices, and community education programs.

Eight plans were initiated. Of the 32 councils in our operating area, 20 plans are now in place, 11 are being developed and only one council declined to participate. The project is due to be finalised by June 2003.

Best-practice developments

We have established the Lynbrook Estate residential development in the City of Casey as a demonstration site for water-sensitive design and a major monitoring site for urban stormwater research.

Our partners in the project are the Urban and Regional Land Corporation and the Cooperative Research Centre for Catchment Hydrology. Innovative stormwater treatment includes shallow grassed depressions to collect rainfall, and an underground system of gravel and perforated pipes that takes water to wetlands.

Current best-practice objectives require load reductions of 45 per cent in total nitrogen, 45 per cent in total phosphorus and 80 per cent in total suspended solids. An interim report during the year said that the Lynbrook Estate system is achieving 60, 80 and 90 per cent respectively.

What is the Ramsar Convention?

The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an inter-governmental treaty that provides a framework for national action and international co-operation for the conservation and wise use of wetlands.

There are 130 parties to the convention, and 1,108 wetlands totalling 87.25 million hectares are on the Ramsar List of Wetlands of International Importance. Edithvale-Seaford is Australia's 57th Ramsar site.

The Ramsar Bureau said: "The Edithvale-Seaford Wetlands are of exceptional significance as examples of cost-effective management of wetlands in an urban setting to provide conservation benefits, manage stormwater, and encourage environmental research and education."

Further developments

We worked with the development industry to incorporate water-sensitive urban design concepts in more than 30 development proposals.

Wyndham Waters Estate, Waverley Arndell Park, the Waverley Park redevelopment, and the Taylors Road Estate are residential developments where wetlands and other treatment systems are proposed to improve stormwater quality.

An extension of the Watergardens Shopping Centre in Taylors Lakes is a commercial development where water-sensitive design initiatives within the car park are planned to improve water quality in Taylors Creek.

Working with VicRoads, we implemented water-sensitive urban design elements into the Craigieburn Bypass, Eastern Freeway extension and Hallam Bypass projects. For example, the Hallam Bypass project protects waterways, the local environment and the Bay from road runoff and other pollution.

Projects being planned or designed, including the Clyde Five Ways Road, Scoresby Freeway and the Doncaster Park and Ride project, are considering these design elements.

We commissioned research to better understand community and consumer responses to residential developments incorporating water-sensitive urban design. Some 300 people were surveyed at four new residential estates around Melbourne. Nine out of 10 were positive about the inclusion of water-sensitive features such as wetlands in their estates despite limited awareness of their design and function.

Port Phillip Bay monitoring

Melbourne Water worked with the Department of Natural Resources and Environment and EPA Victoria to finalise the Port Phillip Bay Environmental Management Plan. The plan is required by the Port Phillip Bay schedule to the Waters of Victoria State Environment Protection Policy. It describes accountability for reducing the nitrogen load entering Port Phillip Bay, in particular our role in reducing nitrogen through the upgrade of the Western Treatment Plant and stormwater management.

We provided $49,000 to help conduct the first year of a water quality monitoring program of Port Phillip Bay. We are working with the Department of Natural Resources and Environment on this program.

Biological investigations

We received interim reports from biological monitoring programs assessing the impact of the discharge from our Western Treatment Plant on fish, aquatic plants and shellfish. The monitoring found that nutrient and heavy metal concentrations around the Murtcaim outlet are within concentrations recorded for other areas in Port Phillip Bay, and that toxicant accumulation in commercially and recreationally harvested flathead and mussels was well below guideline levels. Final reports are expected in early 2002/03.

Protecting world-class wetlands

The Edithvale-Seaford Wetlands, a 260-hectare remnant of the old Carrum-Carrum Swamp, were named wetlands of international significance. The wetlands, which purify stormwater before it enters Port Phillip Bay, were recognised under the Ramsar Convention.

The recognition follows a successful and long-standing partnership between Melbourne Water and the Friends of Edithvale-Seaford Wetlands to plant trees, protect birdlife and provide community education at the wetlands.

The wetlands are home to 190 species of birds and up to 7,000 birds at a time, including migratory waders that fly from north-east Asia, Siberia and Japan. The birds feed on crustaceans, worms, insects, invertebrates and some fish in the wetlands.

Surrounded by the southern bayside suburbs, the wetlands also include an extensive walking and bicycle track, and a bird hide and information display.

Preserving conservation values

Our Western Treatment Plant has significant environmental values, including habitat for rare birds and animals. The site is internationally recognised and is part of the designated Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site. Land alongside the Werribee and Little rivers and Port Phillip Bay also has environmental values. The plant's management is consistent with the "wise use" principles of the Ramsar Convention aimed at protecting significant wetlands.

Changing sewage treatment practices as part of the environmental upgrade of the Western Treatment Plant has implications for waterbirds and shorebirds, nationally threatened species and listed migratory species.

Melbourne Water completed a draft Ramsar and Conservation Management Plan as part of a submission to Environment Australia on the implications of the environmental upgrade. This draft plan followed extensive consultation with a range of stakeholders including the Western Treatment Plant Wildlife Consultative Committee. This draft plan, which is a public document, also covers the Spit Nature Conservation Reserve next to the southern coast of the Western Treatment Plant and incorporates actions outlined in the 2000 Conservation Management Action Plan. The draft plan provides the basis for monitoring and managing the ecology and maintaining the environmental values of the area.

We undertook several environmental investigations at the plant as part of the development of our submission, targeted to address the Environment Protection and Biodiversity Conservation Act. These included studies on the use of managed habitats, lagoons and filtration paddocks by a range of birds. In addition, we conducted a plant-wide survey for the Warty Bell Frog, for which the plant is considered to be a site of national conservation significance. We also continued our weed, fox and rabbit control programs throughout the plant.

Western Port

Western Port relies on a healthy marine environment to sustain a range of recreational and tourist activities. We are responsible for managing streams entering Western Port. Our aim is to minimise the impact of these waterways to help manage Western Port in a sustainable manner. A major environmental challenge is to understand how sediment flows from these streams into Western Port and the impact of sediment, especially on seagrass meadows.

Mangroves in Western Port.

Sediment study

The aims of this three-year project are to determine the major sources of sediment and sediment-bound nutrients flowing into Western Port, and to establish the timing of sediment contributions to the bay. The CSIRO, Melbourne Water and EPA Victoria are partners in this study.

Research was undertaken on sedimentation rates and processes in the bay, and samples of sediments and suspended solids were analysed. Geological changes, erosion hotspots and catchment land-use patterns were also assessed. Results were used to build a sediment generation model for the catchment.

The research is helping to improve understanding of how sediment is transported to Western Port, and to what extent erosion in streams and in the catchment is contributing to the problem.

The final phase of the project, in 2002/03, will identify sources of sediment and associated nutrients in the catchment. Important outcomes include identifying priorities for erosion control works in the catchment, and potential areas for seagrass replanting.

Environmental study

We have committed $100,000 to a major inter-agency environmental study of the biological, chemical and physical processes in Western Port as part of developing sustainable management practices in the bay and surrounding catchments. A co-ordinating group reviewed a specification for the initial stage of this study.

Bass Strait

Melbourne Water's Eastern Treatment Plant at Bangholme treats sewage predominantly from households and businesses in the south-eastern suburbs, including a small proportion of trade waste. The 1,000-hectare plant uses an activated sludge treatment process, with sludge from this process digested on-site, dried and stockpiled as biosolids.

Effluent is discharged to Bass Strait at Boags Rocks via a 56-kilometre pipeline from the plant. Businesses along the pipeline recycle about one per cent of the effluent.

The EPA Victoria discharge licence specifies the quality of effluent discharged by the plant and also describes other requirements relating to off-site impacts such as air quality and litter, and site research such as monitoring and improvement investigations.

Environmental upgrade

In December 2001, Melbourne Water submitted a sustainable resource management plan to EPA Victoria for approval to undertake a $170 million upgrade of the Eastern Treatment Plant based on economic, environmental and social considerations. These works, which followed extensive scientific research and community consultation, will significantly reduce the impact of effluent on the marine environment at Boags Rocks by:

- reducing flows into the plant through water conservation and further reducing the discharge to the marine environment through increased water recycling,
- improving effluent quality by introducing tertiary filtration and enhanced disinfection. This will further improve microbiological water quality and ensure that beaches near Boags Rocks are able to achieve the highest ranking all year under draft World Health Organization guidelines for recreational bathing waters.

The sustainable resource management plan also addressed sustainably managing biosolids generated in the treatment process, minimising greenhouse gas emissions and improving energy management. EPA Victoria was due to respond to the plan in July 2002.

Ammonia reduction project

A $47 million ammonia reduction project that aims to improve effluent quality discharged into Bass Strait continued. The project is expected to reduce ammonia in the effluent by 75 per cent. It involves incorporation of a treatment process, called nitrification-denitrification, into the existing system. It is expected to take about four years to permanently upgrade all the aeration tanks at the Eastern Treatment Plant.

The project follows a successful six-month research trial in one of the plant's six aeration tanks. The aim of the trial was to assess ways to reduce ammonia, and to improve energy efficiency. Initial aspects included wastewater sampling and modelling to establish the preferred tank configuration. The $5 million trial involved construction work between December 2000 and April 2001, with commissioning and performance analysis from March 2001 to January 2002.

The project was in response to research carried out in the two-year CSIRO Effluent Management Study, which found that ammonia was affecting the marine ecology around Boags Rocks. The study, completed in 1999, also found that treatment improvements to reduce ammonia would result in a reduction of far-field impacts and may allow some recovery at the rocky platforms near Boags Rocks.

Monitoring study

A wide-ranging program designed and co-ordinated by the CSIRO is continuing to monitor the impacts on the environment around Boags Rocks. The long-term environmental monitoring program, which began in May 2001, comprises effluent monitoring, toxicity monitoring, mixing zone compliance, biological monitoring, contaminant accumulation and recreational impacts.

Effluent continued to show low toxicity due to lower ammonia levels. Biological surveys of the subtidal and intertidal reefs provided a baseline for measuring any future changes caused by the ammonia reduction project. Mussels collected and tested showed no significant contaminant accumulation.

Melbourne Water also continues to engage Water Ecoscience to undertake water quality testing at shoreline and offshore sites near Boags Rocks and Gunnamatta Beach. Results are updated weekly on the Melbourne Water website. Samples of seawater are collected to determine levels of *E.coli* and

The CSIRO undertakes long-term monitoring around Boags Rocks. Scientists Guy Burne (left) and Arnold Dekker survey seaweed east of Boags Rocks as part of the program.

enterococci, which are then used to assess the acceptability of water quality for swimming.

Monitoring is also continuing at sites around Gunnamatta Beach comparing water quality with draft World Health Organization guidelines for recreational bathing waters. Results are being evaluated by the Department of Epidemiology and Preventive Medicine at Monash University.

Studying the effluent discharge

We conducted research into issues relating to effluent discharge from our Eastern Treatment Plant, including foam, soap balls, odour and colour of the plume. The study, completed in March 2002, included a literature review by the CSIRO, investigation and laboratory testing of foam-causing organisms by La Trobe University, and testing of sand filtration.

The research found that tertiary filtration alone would not have a major influence in reducing the colour of the effluent plume. However, when combined with significant reductions in suspended solids and turbidity, plume visibility should be reduced. We plan further investigation of these issues.

Managing litter

During 2000/01, we commissioned an independent review of operating procedures in response to a litter incident at St Andrews Beach near Boags Rocks. The review revealed that microscreens used to prevent litter from entering the outfall pipeline had been bypassed in response to high levels of incoming sewage due to wet weather. We amended plant procedure, withdrawing the discretion to bypass litter screens regardless of weather conditions.

We also upgraded screens in the pre-treatment area to reduce litter flowing through the treatment plant. Litter captured by these screens is disposed of in an EPA Victoria-approved facility. Further minor work to complete the site clean-up and improve screen efficiency was completed by September 2001.

Water recycling

Melburnians used 462,322 million litres of drinking water during the year. Much of this could be replaced by recycled water to reduce the discharge to the marine environment, conserve drinking water supplies and create economic growth. Melbourne Water's target is to recycle 20 per cent of treated effluent by 2010.

Issues and barriers include substantial infrastructure costs, seasonal demand for recycled water, human health and environmental considerations, the need for consensus on water quality standards and practices, and pricing reform.

During the year, Melbourne Water developed a range of recycling projects to help achieve our target.

Werribee Tourist Precinct

Significant opportunities for water recycling initiatives exist in Melbourne's west because of its low rainfall and concentrated land ownership. The Werribee Tourist Precinct project, which is part of the Victorian Government's Werribee Plains Vision, is Melbourne Water's first off-site water recycling project in the western region.

Melbourne Water completed planning and design work for a scheme to supply up to 160 million litres a year of recycled water to the Werribee Park Golf Club and the National Equestrian Centre from our Western Treatment Plant. The scheme will begin in late 2002 with a 12-month implementation phase. Ultimately, 400 million litres a year of recycled water could be supplied to the precinct, which also includes the Werribee Mansion and Victoria's Open Range Zoo.

The scheme will reduce extractions from the Werribee River and underground aquifers and free up additional drinking water for potential upstream use, alternative agricultural use and for the benefit of the environment.

Western Treatment Plant

On-site recycling at the Western Treatment Plant could potentially use up to 16,000 million litres a year (five per cent of total effluent) by 2002/03, which could increase to 35,000 million litres a year (10 per cent) by 2005. The first significant flows of recycled water became available in 2001/02 to support cattle and sheep farming at the plant, with 5,683 million litres used.

Other initiatives included:

- completing infrastructure to enable delivery of recycled water off-site,
- using recycled water in wash-down areas,
- beginning an extensive 12-month sampling program of final effluent to show potential customers and interest groups the expected effluent quality that can be supplied.

Eastern Irrigation Scheme

We continued developing a scheme to supply recycled water to Cranbourne and further east via a pipeline from our Eastern Treatment Plant. We undertook market assessments and prepared plans to deliver 5,000 million litres (four per cent of Eastern Treatment Plant effluent) a year for horticultural, agricultural and recreational use by potential customers. These include the Sandhurst Club, a residential development of 1,850 homes and two golf courses built around natural and constructed water features, which could use 1,200 million litres a year of recycled water. Other potential customers include golf courses and other recreational open spaces, and agricultural users.

We assessed volume and water-quality requirements for recycled water use for numerous golf courses in the "sandbelt" region using recycled water from our Eastern Treatment Plant. The results are expected in November 2002 and will be used to develop markets and strategies with councils.

Frankston and Peninsula region

The Eastern Treatment Plant has been selling recycled water since 1995, when its 12 customers used 0.005 per cent of the plant's output. During the year, our 33 customers bought some 1,156 million litres of recycled water, or 0.86 per cent of plant output. They used their recycled water for agriculture, horticulture, vineyards or to irrigate golf courses and sporting fields.

These customers use recycled water from the outfall pipeline running from the Eastern Treatment Plant at Bangholme to Boags Rocks, between St Andrews and Gunnamatta beaches. Other potential customers include orchards and vineyards in the Moorooduc area, the horticultural irrigation area around Boneo, golf courses and council reserves.

Resource replacement

On-site recycling involves extracting and treating sewage to produce recycled water while returning waste back to the sewerage system.

Building up a picture of water quality

A year-long research project is helping Melbourne Water develop a database of information over a full year to assess how much effluent quality fluctuates in the Western Treatment Plant lagoons. Monthly samples are assessing microbiological and toxicity parameters to help identify what, if any, further treatment is required for the effluent to achieve "Class A" standard under EPA Victoria guidelines. Special attention will be paid to algal levels over summer.

The project, which is being carried out by independent laboratory Water Ecoscience, began in May 2002.

The research, initiated with EPA Victoria and the Department of Human Services, will show whether disinfection of the effluent will make it suitable for a range of water recycling schemes including irrigation of parklands (below). If it is found to be suitable for a wider range of purposes, a broader recycling market could be supplied without the expense of additional water treatment such as filtration.

In a three-month demonstration trial, water was pumped directly from a sewer main in Domain Road, South Yarra, to a treatment plant using the latest membrane technology. The treated water was then used to irrigate a section of the King's Domain gardens. The water was treated beyond what is required by EPA Victoria's "Class A" requirements - the highest class of water specified under EPA Victoria wastewater guidelines and suitable for high-contact uses such as residential garden watering.

The trial used up to 30,000 litres a day or one per cent of flows from the South Yarra Main Sewer. It is envisaged that up to 2,500 million litres or 1.5 per cent of the flows that would otherwise go to our Western Treatment Plant could be used to irrigate parks and gardens around Melbourne. These include the Royal Botanic Gardens, Royal Park and Fitzroy Gardens. Similar projects could be used to irrigate Melbourne's sandbelt golf courses, racecourses, public gardens and other open spaces.

Melbourne Water developed the King's Domain project with the City of Melbourne and the Department of Infrastructure. Other organisations involved included EPA Victoria, Parks Victoria and the Royal Botanic Gardens.

Aquifer storage and recovery

Salinity has degraded some groundwater reserves in Victoria because water has been drawn beyond an aquifer's recharge rate. Artificially recharging wells using recycled water can replenish overdrawn aquifers and improve groundwater availability and water quality.

Recharging is also an alternative to surface storage where land is limited, catchment areas are developed, algae may compromise stored water quality, or evaporation rates are high.

We sought expressions of interest to investigate opportunities for using recycled water for aquifer storage and recovery.

Guidelines

We used the latest draft of the EPA Victoria Wastewater Reuse Guidelines to develop plans and to manage new and existing recycling schemes. The revised EPA Victoria guidelines had not been published at the end of 2001/02.

Gardens welcome recycling trial

The Royal Botanic Gardens in Melbourne could be using recycled water for irrigation within the next five to 10 years, according to Director Philip Moors (above). Dr Moors said he could see a point in the medium term when technological developments and the price of drinking water made recycled water economic.

The Royal Botanic Gardens supported the trial of on-site water recycling at the nearby King's Domain gardens as part of its commitment to conservation. The trial demonstrated the feasibility and functionality of the concept. "The outcome was positive and there's no doubt that mining sewer water is not only theoretically but practically possible," Dr Moors said.

Water quality was an issue for the Royal Botanic Gardens, given the potential impacts on various types of plants and trees of nutrients and dissolved salts in the recycled water. "But the trial proved that the recycled water could achieve the fairly narrow range of specifications that we require," he said.

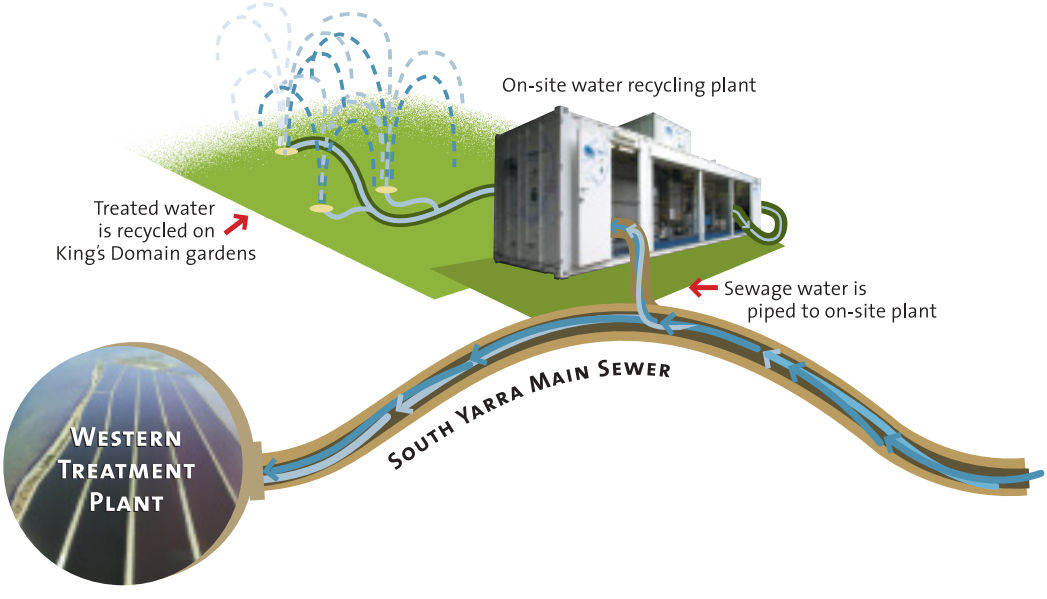


Diagram of on-site water recycling.

Protecting our waterways

Melbourne Water is responsible for managing waterways throughout Melbourne.

Our roles include:

– providing environmental releases from reservoirs and weirs,

– monitoring the health and water quality of waterways,

– developing streamflow management plans,

– licensing and managing diverters who draw water from the Yarra and Maribyrnong catchments.

Our waterway assets include 3,974 kilometres of waterways, 677 kilometres of modified waterways and channels, 50 natural and constructed wetlands, 153 monitoring stations on waterways and drains, 123 sediment and 24 litter traps and 27 recreational lakes.

We aim to improve the quality and environmental health of waterways as a key part of our commitment to sustainably manage Melbourne's water resources and the environment.

We work to protect and enhance the health of waterways across Melbourne, including the Merri Creek.

ACHIEVEMENTS

- Spent $36.3 million on projects to improve our waterways and drainage system, including a strong focus on willow removal.
- Expanded our Stream Frontage Management Program from 120 to 339 participants, built 100 kilometres of fencing and planted 111,225 trees and shrubs to protect rural waterways.
- Released the first draft streamflow management plan (for Hoddles Creek) for public comment and made significant progress on several others. These plans are blueprints for a long-term, sustainable future for waterways.
- No sewage spills occurred.
- Completed Melbourne's first census of frog populations, which are an indicator of stream health.
- Platypus populations increased in areas of improved stream habitat and were found in the artificial habitat created in the Hull Road Wetlands, Lilydale.
- Worked closely with VicRoads to integrate stormwater treatment into the Hallam Bypass project and protect waterways, the local environment and the Bay from road runoff and other pollution.
- Met our daily environmental release requirements below reservoirs and weirs at 19 out of 20 sites.

DISAPPOINTMENTS

- Some of the waterways we manage did not meet long-term water quality targets set in State Environment Protection Policies.
- On one day, we failed to meet our requirements for environmental water flow below the Thomson Reservoir.
- Our progress on streamflow management plans continues to be slower than expected.
- Many waterway rehabilitation projects were delayed by weather conditions.
- Delay in beginning works on priority urban litter traps because we have not yet developed suitable options for sites.

KEY CHALLENGES

- Maintaining sewage containment during average rainfall years.
- Developing an integrated approach to waterway management within the context of the Victorian River Health Strategy, State Environment Protection Policies and the Regional Catchment Strategy.
- Balancing competing demands for water, including environmental flows.
- Completing streamflow management plans to provide blueprints for the future use of waterways in the Yarra catchment.
- Ensuring that farm dams do not adversely affect streamflow or condition.
- Continuing research projects to better understand the impacts of stream health on aquatic life.
- Completing the litter initiatives in the Moonee Ponds Creek catchment, and priority urban litter traps.

Managing water allocations and environmental flows

Environmental flows are a key component of waterway health. We manage them by licensing private diverters to use water from our rivers and streams, and through the management of water harvesting for domestic purposes in our reservoirs.

Yarra River

Melbourne Water's management of environmental flows in the Yarra River is subject to significant regulation, which requires that "to the extent practicable" flow does not drop below 245 million litres a day at Warrandyte. The closest the flow at Warrandyte fell to during the year was a low of 247 million litres a day on 14 July 2001.

Due to drought conditions, we applied level one restrictions on 25 January 2002 and level two restrictions on 25 March 2002 for diverters in the Yarra catchment, consistent with the Yarra River drought response plan. Restrictions were removed on 13 May 2002 when flows returned to above-trigger levels.

Thomson River

We are required to satisfy minimum environmental flows in the Thomson River:

- immediately downstream of the reservoir,
- five kilometres downstream at the Narrows,
- 23 kilometres downstream at Coopers Creek.

We recorded one non-compliance with these environmental flow requirements, on 19 April 2002. A power surge damaged equipment at the hydro-electric power station. Though quickly rectified, the incident caused the 9am flow rate at the Narrows to fall to 46 million litres a day. The minimum required instantaneous flow rate (including permissible tolerances)

is 70 million litres a day. After repairs, we immediately increased downstream releases from Thomson Reservoir to enable the average Narrows 24-hour flow to recover to 92 million litres a day. Despite the malfunction, we satisfied minimum flow requirements at the dam wall and Coopers Creek sites on this day.

We met environmental flow requirements at all other sites during the year.

Streamflow management plans

During the year, we continued to develop streamflow management plans across the Yarra catchment. These plans define the total amount of water in a catchment and describe how it will be shared between the environment and water users. The plans aim to recognise the needs of licensed water users while maintaining or improving waterway health by ensuring environmental flows.

Under these plans, we bring together all stakeholders, including diverters, through a working group to develop a blueprint for a long-term, sustainable future for the waterway.

In April 2002, the Victorian Parliament amended the *Water Act 1989* to provide legislative status to streamflow management plans. The new legislation sets out guidelines and policies for developing these plans, including project timelines and composition of committees.

The working groups released the draft Hoddles Creek plan for public consultation in June 2002 and planned to release the draft Diamond Creek plan in July 2002. The Plenty River working group expects to begin public consultation in October 2002. Plans for Olinda and Stringybark Creeks are to begin in October 2002, and for Pauls, Steels and Dixons Creeks in January 2003.

Bulk entitlements

Bulk entitlements define rights to water harvested in reservoirs for domestic supply and irrigation use, and water for environmental purposes. Generally, Melbourne Water manages river flows to ensure adequate environmental conditions in waterways below the reservoirs and harvesting weirs. On average, we release into waterways about 35 per cent of the water that flows into reservoirs. Under our bulk entitlement arrangements for the Thomson and Maribyrnong rivers, we release water from the reservoirs connected to these rivers under regulatory requirements or agreements with relevant agencies. During the year, we operated in accordance with these bulk entitlements.

We are also required to report on various aspects of our operations and develop water resource management plans to be prepared and submitted to the relevant Minister. These plans formally link individual licences and their management of bulk entitlements.

During the year, we continued to work with the Department of Natural Resources and Environment and other stakeholders to further develop bulk entitlement arrangements for Melbourne Water's use of water from the Upper Yarra Reservoir to release into the Yarra River.

The Yarra River, near Warrandyte.

A learning process

Orchardist David Finger believes that entire communities need to accept responsibility for the painful solutions that may be needed to improve their local waterways. Mr Finger is a diverter representative on a community working group that has developed a draft streamflow management plan for Hoddles Creek – the first in the Yarra catchment.

The process had demonstrated how valuable water is to the environment, business and the Yarra Valley community. "This is a long-term plan for our waterways – there are no quick fixes," he said.

Being part of the working group had also improved his understanding of the waterway, on which his Launching Place apple-growing business depends. "I've learnt a lot about the range of aquatic life and the way flows are related to stream health, and runoff, groundwater and catchment reservoirs, and that we cannot make decisions in isolation," he said.

Thomson Bulk Entitlement

Melbourne Water has rights to 94 per cent of the water flowing into Thomson Reservoir, out of which we provide our environmental releases. We are also entitled to utilise the full storage capacity of Thomson Reservoir, less 45,000 million litres which is reserved for Southern Rural Water to store its entitlement for downstream irrigation.

Melbourne Water does not manage diversions below Thomson Reservoir and is not required to prepare a water resource management plan for the Thomson River, but it must comply with the conditions attached to its bulk entitlement.

Maribyrnong Bulk Entitlement

We have rights to 9.5 per cent of the total capacity of Rosslynne Reservoir. Water is released from the reservoir to meet downstream diverter needs in Keilor on the Maribyrnong River. Under the Maribyrnong bulk entitlement, Melbourne Water has issued 44 licences for irrigation and domestic and stock needs totalling 1,090 million litres. We also issued two off-stream winter-fill dam licences totalling 37 million litres, in accordance with the 2001/02 bulk entitlement order.

Maribyrnong diverters were restricted to 34 per cent of their allocation on 10 January 2002. Restrictions were removed on 13 May 2002 when flows returned to above trigger levels.

Entitlement to water in Thomson Reservoir as at 30 June 2002

	Volume million litres
Water taken by Melbourne Water to supply Melbourne	108,887
Water released for flood control	0
Water released for hydro-electricity generation*	0
Melbourne Water releases to meet environmental flow requirements	33,680
Melbourne Water's share of storage capacity	567,386
Inflows attributed to Melbourne Water for the year	175,525

* Environmental flow and irrigation releases were made via the Thomson hydro-electricity station. However, no releases were made specifically for hydro-electricity generation.

Entitlement to water in Rosslynne Reservoir as at 30 June 2002

	Volume million litres
Releases made from the reservoir on Melbourne Water's behalf to supply our licence holders	302
Melbourne Water's share of storage capacity	189
Inflows attributed to Melbourne Water for the year	102
Transfer and operating losses within the system	151
Melbourne Water's releases to meet environmental flow requirements	55
Water taken by licence holders from the Maribyrnong River to satisfy entitlements	365

Excludes domestic and stock licences, which are currently unmetered.

Maribyrnong Water Resource Management Plan
The Maribyrnong Bulk Entitlement requires Melbourne Water to develop a water resource management plan. Melbourne Water has prepared a plan jointly with Southern Rural Water (which licences diverters in the upper catchment). After receiving submissions from the community, Melbourne Water is working with the Department of Natural Resources and Environment to finalise the plan.

Resource Manager for the Maribyrnong River Basin
On 29 June 2001, Melbourne Water was appointed resource manager for the Maribyrnong Basin. The three-year appointment dates retrospectively to August 2000 when the bulk entitlements were gazetted. Responsibilities include monitoring bulk entitlement holders to ensure that they comply with their entitlement conditions and reporting on compliance to the Victorian Government at the end of each financial year. The first water account for the Maribyrnong Basin is being prepared for the 2001/02 year.

Farm Dams legislation
Legislation was introduced into State Parliament during the year to improve the management of farm dams. As a result, the Government developed a Farm Dams strategy and Melbourne Water was given a licensing role as part of our waterway management responsibilities. Our role involves dealing with commercial farm dam users to ensure the licensing or registering of existing water use is consistent with the requirements of the revised *Water Act*.

Protecting aquatic life

Our broad objective for waterways is to establish a healthy balance between the natural and built environments, given the highly modified condition of urban and rural catchments. This balance should be based on stable beds and banks, maximum coverage by native vegetation and diverse and healthy aquatic habitats.

Rehabilitating waterways
Melbourne Water has a major program for rehabilitating 3,500 kilometres of waterways.

We undertake projects to modify channels, control erosion, erect fencing, revegetate streamsides and remove willows.

Willows are a serious waterway weed that can compromise water quality, habitat and flow and, in severe infestations, can cause waterways to cut new courses. Willows are estimated to have a significant impact on 20 to 30 per cent of the waterways managed by Melbourne Water. We controlled willows along 20 kilometres of waterways.

Stream Frontage Management Program
Melbourne Water runs this program in partnership with landowners to fence out cattle and restore rural waterways. We spent $1.4 million on works including fencing, weed control and revegetation in a significant expansion of this community partnership. Now some 4,000 kilometres of streams in the Port Phillip/Western Port catchment are fenced off, with native trees and shrubs planted to protect banks. Since the program began in 1996/97, more than 312,000 trees and shrubs have been planted and 280 kilometres of fencing erected. During 2001/02, more than 111,000 trees and shrubs were planted.

Corridors of Green
The Corridors of Green program was established in 1999 when Melbourne Water and Landcare Victoria approached Amcor to fund an environmental program aimed at rehabilitating Melbourne's waterways. The program focuses on replanting native shrubs and trees along Melbourne's waterways to protect banks from erosion, improve water quality, provide wildlife habitat and enhance landscape and recreational values. More than 56,000 shrubs and trees were planted.

Seeking new ways to control a serial pest

Melbourne Water is working on a long-term research project to use biological agents such as insects to stamp out invasive willows.

Scientists at the Department of Natural Resources and Environment's Keith Turnbull Research Institute are studying the feasibility of biological control of the six most invasive and widespread willow species, most of which originate from Europe.

The study has identified several fungal pathogens and two sawflies already attacking willows in Australia, and a large number of fungal pathogens, mites and insects have been recorded on target willows in the northern hemisphere. The study found that 252 species of overseas insects have the potential to control willows in Australia.

A number of platypus surveys were conducted during the year with positive results reflecting the improving health of our waterways.

Sites of Environmental Significance

Work began at 11 sites owned by Melbourne Water and designated as having conservation significance. Projects included rehabilitation of habitat and vegetation at the Edithvale-Seaford Wetlands and rehabilitation works at Old Joe's Creek Retarding Basin, Boronia, and at Galada Tamboore, Thomastown.

Improving habitat

Replacing woody debris

In the past, large woody debris - trees and branches that have fallen or been washed into Little Yarra River - have been removed because they were believed to contribute to flooding. More recent studies reveal that such debris does not usually significantly increase flooding, but maintains the stability of stream beds and is critical habitat for aquatic life.

Large woody debris had been removed at the Caulfield Grammar School site in Little Yarra River near Yarra Junction, resulting in significant scouring of the sand bed and erosion of the stream over some 1.5 kilometres.

During January 2002, Melbourne Water reintroduced about 600 cubic metres of fallen timber and logs into the stream over a 2.2 kilometre reach along the Caulfield Grammar property. This project used stockpiled debris next to the stream, which was placed according to a method developed with the Cooperative Research Centres for Catchment Hydrology and Freshwater Ecology. This is expected to improve bed and bank stability and instream habitat for native fish such as black fish, platypus and Yarra River crayfish.

Monitoring was undertaken before and after the works. Monitoring will include information on fish, platypus and aquatic macroinvertebrates, and will be used as a business-wide education tool.

Aquatic populations

We monitor aquatic populations to help indicate stream health and prioritise waterway rehabilitation works.

Platypus

We continued our successful partnership with the Australian Platypus Conservancy. New platypus surveys were conducted on reaches within Labertouche Creek, Tarago and Upper Yarra rivers and Lower Pats, Monbulk, Running, Diamond, Watery Gully and Arthurs creeks.

Known platypus populations were monitored in Upper Cardinia and Monbulk creeks, two reaches of the Yarra River (including below the Heide Gallery), Lower Plenty River and Olinda, Lower Corhanwarrabul and Dandenong creeks. The monitoring aims to reveal the factors that influence platypus numbers in creeks around Melbourne.

Olinda Creek was monitored upstream of Lillydale Lake and around Hull Road wetlands in Lilydale. Platypus numbers near Lilydale appear to be responding positively to environmental improvements along Olinda Creek. Eight adult platypus and a record 10 juveniles were found in this waterway, upstream of Lillydale Lake.

The wetlands system near Hull Road, constructed by Melbourne Water in 1999, was designed to reduce the risk of local flooding and eventually to create extra platypus feeding habitat. It was most encouraging that two adult platypus were found in the wetlands.

Reintroducing platypus

We rehabilitate streams to improve habitat conditions and, in some cases, to foster increasing populations of platypus. We earmarked Cardinia Creek as a potential site to reintroduce platypus, but the Australian Platypus Conservancy advised that it needed more time to identify juvenile platypus for relocation. This will now proceed in the summer of 2002/03 using platypus from a stream in the Bunyip catchment.

Frog census

Melbourne Water introduced a frog census in partnership with a community water quality monitoring organisation, Melbourne Waterwatch, and the Amphibian Research Centre. The census aims to increase community awareness of frogs, and improve understanding of the distribution of frogs, particularly the location of rare frogs, for environmental planning. Frogs are an important indicator of stream health.

The census, held in November 2001, involved community volunteers recording frog calls at sites near local waterways. These recordings were sent to the Amphibian Research Centre for identification.

More than 100 volunteers participated in the census, and a website, www.frogs.melbournewater.com.au, was created to communicate the findings and other information on frogs. The census created great media interest and some interesting findings regarding frog populations emerged, including the first recording in the Koo Wee Rup area of the rare growling grass frog.

We plan to continue the surveys each year during spring (November-December) and autumn (April-May) to cover the breeding seasons for Melbourne's frogs.

Native fish

We undertook a fish survey in Gardiners Creek and three of its main tributaries - Back, Scotchmans and Damper creeks - in January and February 2002 as part of a broader stream health assessment to help plan waterway rehabilitation and maintenance works. Nine species of fish were found, including four native species. Two species of native fish, the broad-finned galaxias and common galaxias, were recorded as far upstream as Gardiners Creek, Blackburn, and Scotchmans Creek, Mount Waverley. Their presence this far upstream is remarkable considering the high level of stream modification, particularly a two-kilometre underground concrete pipe section of Scotchmans Creek.

Helping fish to migrate and breed

An Australian grayling was caught above McNabs Weir in the upper reaches of the Maribyrnong River at Keilor. It is believed that the fish, the first recorded that far upstream for 20 years, would have needed to climb at least three of the river's four fish ladders, or fishways.

These devices, built by Melbourne Water in the past four years along the Maribyrnong, are designed to enable fish to pass man-made barriers - mostly reservoirs, weirs and road culverts - to migrate upstream.

We also rehabilitated a large fish ladder on Cardinia Creek at Thompsons Road, south of Berwick, to open the upper reaches of Cardinia Creek to migratory species such as grayling.

Protecting water quality

We monitor the health of aquatic organisms to gain an assessment of overall ecosystem condition, and to help set priorities for waterway management. Poor water quality, along with degraded habitat and modified flows, are key factors that can affect urban ecosystems.

Water quality studies

Water quality studies, in addition to routine monitoring, were carried out in Merri, Darebin and Hoddles creeks. A total of 24 sites were sampled for a range of indicators. Information from these studies will feed into Melbourne Water's waterway activity, stormwater management and streamflow management plans.

Water quality tended to be very good within the Hoddles Creek catchment, a rural tributary of the Upper Yarra River, with little change since the mid-1980s. Reducing nutrient and *E.coli* levels within Hoddles Creek, particularly near Launching Place, would help enhance water quality in the Yarra River.

Water quality within Merri Creek, a heavily urbanised waterway, is in fair condition. Despite noticeable improvements in water quality over the past 30 years, nutrient levels are still slightly elevated at some sites. Litter was also a concern along the length of Merri Creek. Lack of streamflow due to the extended drought, and inputs from stormwater drains were identified as key issues.

Melbourne Water's David Fisher and Tim O'Brien from the Department of Natural Resources and Environment at a fishway at McNabs Weir, Keilor.

The headwater site within Darebin Creek at Epping, on the outskirts of suburban Melbourne, was in poor condition. The seven other sites (within the urban reaches) were in better condition, although nutrient levels were slightly elevated, and litter was also a problem. Stormwater drains are believed to be the main source of deteriorating water quality. Overall, water quality in Darebin Creek, from Bundoora to Alphington, is considered to be fair, with noticeable improvements over the past 30 years.

Sediment monitoring

Research showed that polluted sediments in some Melbourne water bodies are toxic to aquatic invertebrates. Further research, scheduled for 2002/03, will identify the contaminants producing the toxicity and actions will then be prepared to reduce stream toxicity.

We are working with the Centre for Environmental Stress and Adaptation Research at La Trobe University to investigate the sensitivity of a bloodworm to urban sediment pollution. This small animal can adapt to heavy-metal pollution in wetland sediments but investigation has shown that this adaptation reduces its rate of development and makes it more sensitive to other types of environmental stress. It appears that species adaptation may be an excellent indicator of toxic

The Northern Diversion Sewer, for which planning commenced this year, will help to protect Merri Creek during wet weather.

pollution and further research to evaluate this approach will take place during 2002/03.

Studies in the Merri and Darebin creeks showed that industrial stormwater runoff was the primary source of toxicity in surface waters and sediments in these waterways. Outcomes from the project are a trial of an innovative toxicant treatment facility and the need for further investigations of primary pollution sources in industrial estates.

Biological monitoring

This is one of four monitoring programs undertaken to assist decision-making and environmental reporting. The program samples macroinvertebrates in streams to provide an indication of stream health.

Each year, we target new catchments in the program with surveys repeated within five to eight years. Catchments sampled included 19 sites in Upper Yarra tributaries, four sites on the Mornington Peninsula, and six sites on Gardiners Creek. In addition, 16 sites in the Dandenong Ranges will be incorporated into a broader Cooperative Research Centre for Freshwater Ecology project assessing the impacts of urbanisation on stream ecology.

Information from this monitoring will be used to:

- report on compliance with State Environment Protection Policies,
- contribute to the Index of Stream Condition and State of Asset reports,
- help waterway management decision making,
- enhance databases used in our research.

Preventing sewage spills

Melbourne Water aims to have no sewage spills as a result of operational failures.

In heavy rain, stormwater can infiltrate sewers leading to overflows when sewer capacity is exceeded. Such overflows are directed through "emergency relief structures" to minimise their impact on the environment and public health.

We have a rigorous program to achieve our one-in-five-year rainfall event flow containment standard. This involves upgrading our infrastructure to eliminate sewage spills caused by overflows, and targeting spill points with the most potential for environmental impact. No sewage spills occurred during the year.

We are working with Yarra Valley Water to address capacity problems in the Ringwood catchment. This will reduce pressure on the sewage system during periods of high rainfall and reduce wet-weather spills.

We also began investigations required before implementing works on the Northern Diversion Sewer. This project will overcome sewer capacity problems that can lead to wet-weather spills into the Merri Creek from Yarra Valley Water and Melbourne Water sewerage systems. The $45 million project is due for completion by 2008/09.

The $15 million Upper Moonee Ponds Sewer Augmentation Project will achieve similar outcomes and is due to be completed by 2008/09.

Spill performance

	1997/98	1998/99	1999/00	2000/01	2001/02
Operational failure	22	1	1	0	0
Hydraulic deficiency (less than one-in-five-year rainfall event)	19	2	2	1	0
Extreme rainfall (non-compliant wet weather spills)	5	0	3	7	0
Total	46	3	6	8	0

Data on the website

Water quality data from Melbourne Water's waterway monitoring network is available online. The 72-site network covers greater Melbourne and shows broad-scale changes over time. All sites are sampled monthly for indicators such as water temperature, pH, dissolved oxygen, salinity, water clarity, nutrients, *E.coli* and metals.

Index of Stream Condition

The Index of Stream Condition provides an integrated measure of the environmental condition of streams. It amalgamates information on the naturalness of the flow regime, water quality, condition of the channel and its banks, and the invertebrate communities living in the stream.

The index contains five sub-indices and summarises the extent of change from natural or ideal conditions for each of these:

- physical form - stream bank and bed condition, presence of, and access to, physical habitat, artificial barriers to fish migration,
- streamside zone - quality and quantity of streamside vegetation and condition of billabongs,
- hydrology - flow volume and seasonality of flow,
- water quality - key indicators compared with Victorian Government environment protection policy objectives,
- aquatic life - aquatic macroinvertebrates.

Each sub-index is scored out of 10, so that the overall score for the index will vary between zero and 50. Stream condition

is then allocated to one of five classifications: excellent, good, moderate, poor or very poor.

The Department of Natural Resources and Environment developed the index to provide a high-level reporting process on the state of Victorian streams. Melbourne Water modified the index methodology to incorporate relevant data for the urbanised context of some catchments, and to include extra monitoring data for water quality.

Index assessments along waterways we manage indicate slightly more streams are in excellent or good condition than are in poor or very poor condition. This result is largely due to the proportion of pristine waterways in our water supply catchments. About one-third of waterways are in moderate condition, while many of the highly urbanised waterways (such as the Moonee Ponds, Gardiners, Dandenong, Darebin and Merri creeks) are in poor to very poor condition. Rural areas also have a large proportion of streams in poor to very poor condition.

Alert levels

Water quality alert levels were agreed between EPA Victoria and Melbourne Water in 1994. Alert levels are generally well above water quality objectives and represent instances of particularly undesirable water quality. We report all alert level exceedances that occur within our operating area to EPA Victoria.

Water quality performance is affected by weather conditions and catchment activity. The most probable reason for the lower number of exceedances was low rainfall, resulting in less runoff from catchments into waterways.

The parameters that exceeded alert levels most were nitrates and total nitrogen. These nutrients can be harmful to waterways by encouraging the growth of algae. The streams with the most exceedances were Brushy Creek, Watson Creek, Stony Creek, the Yallock Outfall, Andersons Creek and Mullum Mullum Creek.

	Alert level exceedances
1998/99	462
1999/00	492
2000/01	511
2001/02	246

Index of Stream Condition as at 30 June 2002.

Reducing litter

Melbourne Water spent $519,000 removing litter from traps installed in waterways, and more than $600,000 removing debris, vegetation, other leaf litter and rubbish from litter traps, pits, grates and other structures to ensure drains are not blocked. This work is especially important following heavy rain to protect properties from flooding.

We spent a further $1 million managing the Moonee Ponds Creek Litter Initiative, which is a collaborative project that is also funded by Environment Australia, the cities of Hume, Melbourne, Moonee Valley and Moreland, the Victorian Stormwater Action Program and EcoRecycle Victoria. The initiative aims to reduce litter throughout the Moonee Ponds Creek Catchment.

Our work on this initiative includes a wetlands system at the Jacana Retarding Basin in Broadmeadows, and a litter trap on the Moonee Ponds Creek at Racecourse Road, Kensington. By the end of the year, we had finished constructing about 60 per cent of one part of the Jacana wetlands and substantially completed design work for the other. Both wetlands include litter traps. We also completed design of the Racecourse Road litter trap.

Priority sites were identified throughout Melbourne for installing litter traps as part of stormwater management plans developed by councils, and we helped initiate a pilot project involving six councils to improve construction site practices. Councils have consistently identified these sites as significant sources of stormwater pollution, including building site waste and litter.

Construction sites are a significant source of stormwater pollution.

Waterway water quality monitoring results. See next page for site index.

Waterway water quality monitoring results

Melbourne Water monitors waterway water quality at 72 sites in greater Melbourne and reports performance against Victorian Government targets established in State Environment Protection Policies. The following tables show this performance and the map shows the location of the monitoring sites. All results in the following tables are annual medians, except for *E.coli*, which is an annual geometric mean.

Site No	Description	Dissolved mg/L	Turbidity NTU	Suspended Solids mg/L	Total Nitrogen mg/L	Total Phosphorus mg/L	*E.coli* organisms/ 100mL	Lead mg/L	Zinc mg/L
Yarra Catchment - Rural Eastern and Western Waterways									
17	Arthurs Creek at Burkes Bridge, Hurstbridge	7.4	14	6	0.795	0.057	189	0.003	0.009
11	Cockatoo Creek at Tschampions Road, Macclesfield	8.9	20	21	1.340	0.039	115	0.001	0.007
18	Diamond Creek at Cottles Bridge-Strathewen Road, Cottles Bridge	4.2	29	8	1.327	0.070	103	0.004	0.008
15	Stringybark Creek at Melba Highway, Yering	7.6	26	6	0.749	0.051	144	0.001	0.006
8	Little Yarra River at Corduroy Road, Yarra Junction	9.7	15	17	0.754	0.034	521	0.002	0.006
20	Merri Creek at Summerhill Road, Craigieburn	6.9	9	7	1.129	0.054	229	0.003	0.007
19	Plenty River at Plenty Gorge, South Morang	7.2	11	5	1.266	0.080	119	0.002	0.007
14	Steels Creek at Healesville Road, Yarra Glen	7.6	26	6	0.749	0.051	144	0.001	0.006
12	Wandin Yallock Creek at Killara Road, Gruyere	8.5	16	9	1.617	0.050	242	0.001	0.006
16	Watsons Creek at Henley Road, Kangaroo Ground	8.3	6	4	0.578	0.020	121	0.003	0.005
13	Watts River at Healesville-Kinglake Road, Healesville	7.8	7	5	0.900	0.037	655	0.002	0.009
10	Woori Yallock Creek at Macclesfield Road, Yellingbo	8.4	18	11	1.295	0.044	176	0.001	0.007
9	Woori Yallock Creek at Warburton Highway, Woori Yallock	8.8	17	12	1.175	0.036	171	0.001	0.005
Yarra Catchment - Southern Urban Tributaries									
24	Andersons Creek at Everard Drive, Warrandyte	8.3	11	10	3.483	0.260	634	0.004	0.021
22	Brushy Creek at Lower Homestead Road, Wonga Park	7.7	15	7	5.864	0.445	826	0.002	0.039
28	Gardiners Creek at South Eastern Freeway, Hawthorn	9.9	10	4	1.874	0.084	731	0.005	0.092
23	Jumping Creek at Jumping Creek Road, Wonga Park	8.6	15	10	1.292	0.057	1206	0.002	0.014
27	Koonung Creek at Bulleen Road, Bulleen	7.3	14	10	1.539	0.110	3110	0.005	0.088
25	Mullum Mullum Creek at Deep Creek Reserve, Warrandyte	8.1	15	11	3.394	0.325	637	0.004	0.037
21	Olinda Creek at Macintyre Lane, Coldstream	7.5	8	4	0.903	0.027	227	0.001	0.005
26	Ruffey Creek at Parker Street, Templestowe	9.0	10	7	1.953	0.160	1368	0.005	0.070
Yarra Catchment - Northern Urban Tributaries									
31	Darebin Creek at Clark Road footbridge, Ivanhoe	9.4	6	4	1.282	0.091	275	0.003	0.052
29	Diamond Creek at Main Road, Eltham	8.2	21	10	1.129	0.092	728	0.005	0.032
32	Merri Creek at Roseneath Street, Yarra Bend	9.1	7	3	1.283	0.095	290	0.004	0.045
33	Moonee Ponds Creek at Mt Alexander Road, Parkville	8.0	9	7	2.439	0.105	760	0.004	0.055
30	Plenty River at Henty Road, Lower Plenty	7.5	23	17	1.185	0.100	857	0.006	0.028
Yarra Catchment - Yarra Mainstream and Estuary									
6	Yarra River at Chandler Highway, Kew	7.7	22	18	1.226	0.072	360	0.005	0.021
2	Yarra River at Don Road, Launching Place	8.9	9	8	0.572	0.028	485	0.001	0.006
5	Yarra River at Kangaroo Ground-Warrandyte Road, Warrandyte	8.4	12	9	1.192	0.052	227	0.002	0.007
3	Yarra River at Maroondah Highway, Healesville	8.8	15	11	0.744	0.030	227	0.001	0.005
1	Yarra River at McKenzie-King Drive, Millgrove	9.5	7	5	0.564	0.019	222	0.001	0.004
7	Yarra River at Princes Bridge, South Melbourne	6.3	10	12	1.114	0.080	754	0.004	0.024
4	Yarra River at Spadonis Reserve, Coldstream	8.9	29	16	0.952	0.056	482	0.002	0.009

Waterway water quality monitoring results (continued)

Site No	Description	Dissolved mg/L	Turbidity NTU	Suspended Solids mg/L	Total Nitrogen mg/L	Total Phosphorus mg/L	*E.coli* organisms/ 100mL	Lead mg/L	Zinc mg/L
Dandenong Valley Waterways									
38	Corhanwarrabul Creek at Wellington Road, Rowville	7.9	22	11	1.442	0.081	334	0.004	0.036
35	Dandenong Creek at Boronia Road, Wantirna	7.8	14	12	2.140	0.130	615	0.005	0.140
37	Dandenong Creek at Pillars Crossing, Dandenong South	7.5	28	20	1.640	0.110	993	0.007	0.093
36	Dandenong Creek at Stud Road, Dandenong North	7.1	22	14	1.591	0.100	596	0.006	0.072
34	Dandenong Creek at Sheffield Road, Doongalla Forest	8.7	16	18	1.447	0.036	69	0.001	0.008
45	Elster Creek at Cochrane Street, Elwood	7.2	9	4	2.222	0.100	802	0.004	0.260
42	Eumemmerring Creek at Worsley Road, Bangholme	7.3	22	14	2.520	0.200	386	0.004	0.041
41	Hallam Main Drain at South Gippsland Highway, Hampton Park	7.1	22	13	1.434	0.059	329	0.003	0.019
39	Mile Creek at Cheltenham Road, Keysborough	6.9	8	5	1.580	0.080	620	0.004	0.210
40	Patterson River at National Water Sports Centre outlet, Bangholme	7.9	29	24	1.720	0.120	121	0.006	0.061
Mordialloc and Kananook Creeks and Mornington Peninsula Waterways									
46	Balcombe Creek at Uralla Dve footbridge, Mt Martha	7.4	8	4	1.316	0.049	319	0.002	0.025
48	Chinamans Creek at Eastbourne Road, Rosebud West	4.1	7	2	2.307	0.050	179	0.001	0.013
47	Dunns Creek at Marine Drive, Safety Beach	7.8	6	4	0.786	0.038	460	0.002	0.009
44	Kananook Creek at Wells Street, Frankston	6.6	5	24	0.880	0.130	325	0.006	0.045
49	Main Creek at Boneo Road, Flinders	9.2	7	4	0.783	0.025	174	0.001	0.005
51	Merricks Creek at Bridge Street, Merricks	7.3	8	4	1.033	0.038	351	0.002	0.015
43	Mordialloc Creek at Wells Road, Mordialloc	6.3	21	22	2.137	0.240	648	0.004	0.071
52	Warrangine Creek at Frankston-Flinders Road, Hastings	6.4	10	4	1.376	0.059	365	0.003	0.021
50	Watsons Creek at Dandenong-Hastings Road, Somerville	8.0	11	6	13.118	0.385	619	0.003	0.026
Western Port Waterways									
62	Bunyip River at Healesville-Koo Wee Rup Road, Koo Wee Rup	8.7	16	15	0.919	0.045	239	0.003	0.006
61	Bunyip River at Little Road, Iona	8.0	15	8	0.723	0.042	305	0.002	0.006
59	Bunyip River at North Labertouche Road, Tonimbuk	9.2	10	10	0.664	0.020	66	0.002	0.006
60	Bunyip River downstream Cannibal Creek, Longwarry North	8.4	16	9	0.723	0.038	203	0.002	0.006
54	Cardinia Creek at Ballarto Road, Cardinia	8.9	11	4	0.904	0.053	107	0.003	0.008
53	Cardinia Creek at Cadwick Road, Upper Beaconsfield	7.7	13	5	0.665	0.036	137	0.002	0.005
57	Deep Creek at Ballarto Road, Rythdale	5.4	37	24	2.048	0.450	187	0.006	0.016
65	Lang Lang River at Drouin-Poowong Road, Athlone	7.2	11	10	1.832	0.140	450	0.002	0.006
64	Lang Lang River at South Gippsland Highway, Lang Lang	7.9	25	14	2.625	0.190	381	0.003	0.009
58	Tarago River at Morrisons Road, Labertouche	7.7	10	9	0.751	0.047	354	0.002	0.005
56	Toomuc Creek at Ballarto Road, Rythdale	5.0	14	8	0.928	0.056	77	0.004	0.009
55	Toomuc Creek at Princes Highway, Pakenham	7.8	14	5	0.857	0.046	255	0.002	0.009
63	Yallock Outfall at South Gippsland Highway, Monomeith	6.8	32	43	4.997	0.170	254	0.003	0.008
Maribyrnong River and Tributaries and Other Western Waterways									
66	Maribyrnong River at Brimbank Park Ford, Keilor	6.6	8	6	1.193	0.042	75	0.003	0.009
67	Maribyrnong River at Canning Street Ford, Avondale Heights	6.9	10	9	1.172	0.045	90	0.001	0.007
68	Steele Creek at Rose Avenue, Niddrie	9.1	5	4	0.660	0.049	198	0.004	0.047
70	Kororoit Creek at Millbank Drive, Deer Park	5.7	9	5	0.659	0.043	119	0.002	0.011
71	Kororoit Creek at Racecourse Road Ford, Altona	6.7	17	31	1.731	0.170	388	0.009	0.027
72	Skeleton Creek at Ayr Street, Laverton	5.3	11	13	0.767	0.110	323	0.003	0.015
69	Stony Creek at Bena Street, Yarraville	7.0	6	6	3.953	0.610	4239	0.005	0.125

Melbourne Water's core waterways and drainage functions are:

Regional drainage and flood protection
Providing regional-scale facilities to accommodate stormwater flows, undertaking works to reduce the risks of flooding in priority areas, and preventing inappropriate development in floodplains.

Waterway management
Protecting, restoring and maintaining the physical condition and environmental health of creeks, rivers and wetlands, and regulating the volumes of water extracted for irrigation.

Water quality protection
Implementing controls, providing treatment facilities and working with other agencies, councils, industries and community groups to improve stormwater quality and protect waterways, bays and beaches.

The operating charter, developed in 1999, defines the objectives, goals, strategies and specific service commitments for these functions. The charter was prepared in consultation with an external reference committee, taking into account:

- community expectations,
- responsibilities assigned by legislation,
- financial resources available for waterways and drainage management.

The charter sets out 34 service commitments covering specific activities and defining outputs for each year, including annual monitoring and reporting of these commitments.

Detailed performance records for 2001/02 were audited by John Kowarsky and Associates. We have summarised our performance for each of the commitments in the following table. Twenty-nine commitments were achieved fully, three were achieved only partly and there was no significant progress on one. One other commitment is not applicable yet.

Operating charter performance

Commitment as set out in the charter	1999/00	2000/01	2001/02	Summary 2001/02
Asset management Minimal instances of asset failure causing significant flooding, serious damage or personal injury.	✘	✔	✔	No instances occurred. Three reported soil collapses were not associated with any structural deficiencies in Melbourne Water's drains.
Flood mitigation (progress) Annual expenditure on flood mitigation works will be sufficient to reduce the number of vulnerable properties by 800 over 10 years.	✔	✘	✔	The three-year capital expenditure program has been increased to achieve protection for 600 properties after six years. This program is back on schedule.
Flood mitigation (project management standards) All projects undertaken in any one year will comply fully with the project management requirements.	✔	✘	✔	Audit results indicate that projects were consistently managed in accordance with required standards. The demands of keeping explicit and detailed process records were noted.
Flood event monitoring The Bureau of Meteorology will receive the initial notification and subsequent forecast information for all notifiable events on the stipulated waterways.	✔	✔	✔	There were no significant riverine flooding events during the year. The rainfall and streamflow monitoring systems and flood warning duty officer arrangements operated as planned.
Property information statements All urban properties affected by flooding will have up-to-date flooding information available by June 2001 and continuously thereafter.	✔	✔	✔	The initial 2001 target was achieved. Regular updates have been carried out as circumstances have changed or new properties have been created. A tracking system ensures that updates are completed quickly.
Planning scheme updates All municipalities will have up-to-date flood-related information in their planning schemes by June 2002.	✔	✔	✘	Amendments have been exhibited for 26 councils, with four scheduled by the end of 2002 and agreement is being finalised with the last council. Despite our best efforts, this is behind schedule.
Waterway works approvals No works will be approved unless appropriate measures are incorporated to protect waterway values.	✘	✔	✔	An internal audit of works approvals has indicated compliance.
Unauthorised waterways works All significant instances of unauthorised works will be strenuously pursued.	✔	✔	✔	Unauthorised works adversely affecting waterways are being pursued through legal and other means.
Waterway maintenance The program will be completed annually in accordance with targeted priorities and project management requirements.	✘	✔	✔	The program was implemented in accordance with the approved business plan. Internal audits were used to verify compliance with the relevant standards.
Stream frontage protection At least 50,000 plants and 25 kilometres of fencing will be established each year to protect rural waterways.	✔	✔	✔	The targets were met with 100 kilometres of fencing constructed and more than 111,000 plants established.

Operating charter performance (cont.)

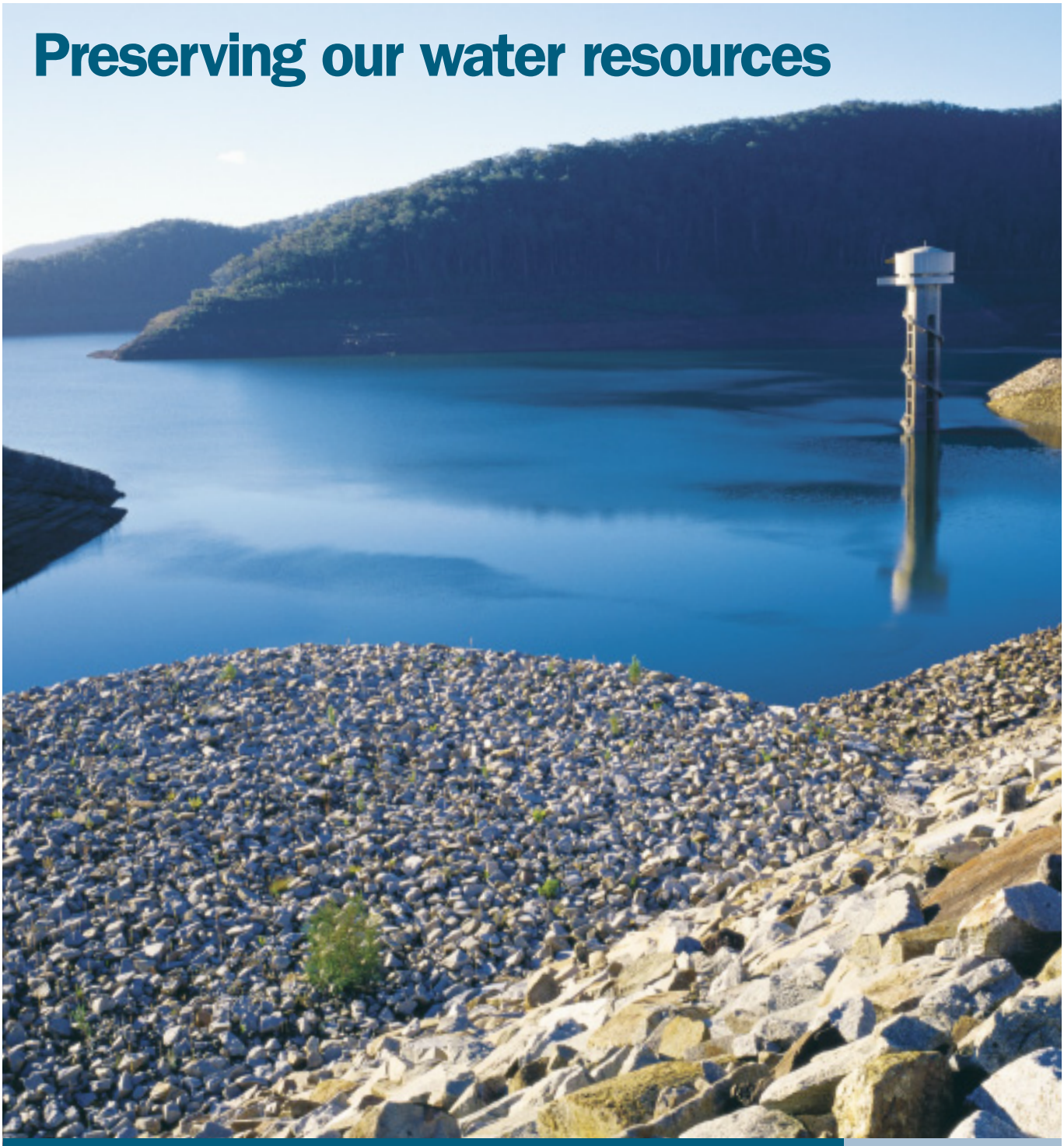
Commitment as set out in the charter	1999/00	2000/01	2001/02	Summary 2001/02
Streamflow management plan preparation Streamflow management plans will be produced each year to achieve full coverage by June 2003.	✔	✘	✘	Good progress was made on Hoddles, Diamond, Olinda and Stringybark creeks and Plenty, Watts and Little Yarra rivers. However, the farm dams legislation has made the process even more complex and the program is still behind schedule.
Streamflow management plan review From June 2003, sufficient previous plans will be revised each year to keep all plans up-to-date (no older than five years).	–	–	–	No plans are yet old enough to require updating.
Waterway capital works Full implementation of the annually budgeted program will be achieved in accordance with waterways and drainage project management requirements.	✔	✘	✔	Progress was made on 125 projects, at a total cost of $5.52 million. Improved auditing of project management, including applying priority-setting principles, showed that all requirements were met.
Waterway condition reports The condition of a proportion of waterways will be reassessed and the results published each year to cover all waterways every five years using the Index of Stream Condition.	✔	✔	✔	Index of Stream Condition data has been collected for all urban and rural waterways downstream of the closed catchments. A map and summary data is published in this Environment Review. The program is ahead of schedule.
Waterway management plans 1. New plans will be produced each year to complete coverage by 2002. 2. Plans will be revised from 2002 to ensure that all waterways have up-to-date plans.	✔	✔	✔	Four more plans were completed, essentially completing coverage. The review of older plans is beginning, and some minor waterways have been added to the schedule of required plans.
Codes of practice – status review The status of Codes of Practice relevant to stormwater quality protection will be reviewed and reported each year.	✘	✘	✘	Work on this commitment was again deferred because of urgent priorities in other areas.
Codes of practice – preparation and revision Melbourne Water will work with other agencies and industry bodies to complete new codes or revise old ones at the average rate of one each year to 2009.	✔	✔	✔	Our people made significant contributions to a large project to promote better management of construction sites. The project is a partnership with EPA Victoria and involves six pilot councils and several industry bodies. Progress is on schedule.
Stormwater management plans Sufficient stormwater management plans will be produced each year to ensure all 32 municipalities are covered by June 2003.	✔	✔	✔	Thirty-one of the stormwater management plans are complete or underway. One municipality has repeatedly declined our offers of funding assistance. Progress is ahead of schedule.
Toxicant control recommendations A technical report and recommendations will be provided on at least one new toxicity issue each year.	✔	✔	✔	Five substantial reports on toxicants and related issues were produced, with recommendations on better managing toxicant issues and the need for further research.
Water quality improvement facilities New water quality improvement facilities will be constructed each year in accordance with the approved program and project management standards.	✔	✘	✘	Wetlands and other water quality improvement facilities were constructed at a cost of $2.4 million, but the approved $4 million program was not achieved because of significant delays to four large wetland projects. Project management standards were met.
Reports – ambient monitoring The results of the previous calendar year's ambient monitoring program and trend analysis will be published by the end of May each year.	✔	✔	✔	A detailed report was prepared in May 2002, and has been published on the Melbourne Water website.
Reports – investigative monitoring Results of the previous calendar year's investigative monitoring will be published by the end of September each year.	✔	✔	✔	Seven reports covering water quality and fish populations in waterways were completed, and will be published on Melbourne Water's website by September 2002.
Data standards Compliance will be achieved with all specified scientific and quality control standards, as assessed by periodic independent audit.	✔	✔	✔	Standards were identified and compliance assurances verified. An audit of field data collection for Index of Stream Condition values verified that standards are met.
Waterwatch strategy A strategy will be developed by June 2000 in collaboration with stakeholders.	✔	✔	✔	The strategy was finalised in May 2000.

Operating charter performance (cont.)

Commitment as set out in the charter	1999/00	2000/01	2001/02	Summary 2001/02
Waterwatch strategy implementation Implementation of the Waterwatch strategy will be reported annually.	✔	✔	✔	A detailed internal report on implementing the Waterwatch strategy was prepared, showing that good progress had been made on all strategy components.
Drainage schemes All new growth areas in development corridors will have drainage schemes in place within three years of significant subdivisional activity commencing.	✔	✘	✔	New drainage schemes were finalised at Edrington Park and Pakenham West. Drainage scheme program is up-to-date.
Property development controls 1. 95 per cent of referrals will be processed within the statutory 28-day period. 2. 95 per cent of agreement applications will be processed within the 60-day period agreed with the development industry.	✔	✔	✔	1. All 8,013 referrals were processed within 28 days. 2. All 4,134 agreement applications were processed within 60 days. This performance is very pleasing, assisted by improved systems for tracking and processing the large amount of work involved.
Research expenditure Research expenditure will be maintained at a level of at least $450,000 a year.	✔	✔	✔	Annual expenditure was $503,000, which included contributions to research undertaken through the Cooperative Research Centres for Catchment Hydrology and Freshwater Ecology.
Research implementation Two significant improvements to work methods will be achieved each year as a result of research findings.	✔	✔	✔	Research results have improved design methods and capability – mostly for stormwater quality management – in several areas.
Community education The approved program will be fully implemented each year.	✔	✔	✔	Some 21 initiatives were delivered, including TV advertising, newsletters and information sheets, adding to the Melbourne Water website, and publishing a smart paint disposal brochure for paint distributors.
Community attitude surveys Results will be reported for at least one new topic each year.	✔	✔	✔	Additional questions focused on which organisation has prime responsibility for waterway management. Twenty-two per cent of those questioned identified Melbourne Water, 19 per cent councils, and 28 per cent didn't know.
Incident response preparation A program of incident response training, and preparation and review of contingency plans will be fully implemented each year.	✘	✔	✔	Program activities were undertaken, although most effort was directed to commissioning a new systems control and data acquisition system – a very large project that underpins most of Melbourne Water's operation.
Incident response performance In each year, the service will operate as planned for all incidents that require emergency response.	✔	✔	✔	A satisfactory response was achieved for all incidents, most of which involved pollution incidents affecting waterways.
Innovation 1. Specific innovation targets will be developed and incorporated in each year's business plan. 2. Achievements against the previous year's innovation targets will be reported each year.	✔	✔	✔	Four projects were identified in the 2002/03 business plan. Good progress was made on three projects outlined in the 2001/02 business plan. These are reported in the Business Review.

✔ = commitments achieved fully
✘ = commitments not achieved or achieved only partly
– = not applicable

Preserving our water resources



Water conservation is about ensuring that we have a continuous supply of safe, healthy drinking water into the future. Conserving water can greatly reduce the demand for new water resources, and defer or even remove the need to build more reservoirs.

Thomson Reservoir, Melbourne's largest water storage reservoir, holds 1,068,000 million litres. In August it fell to 474,613 million litres, or 44.4 per cent of its total capacity - the lowest level for the year.

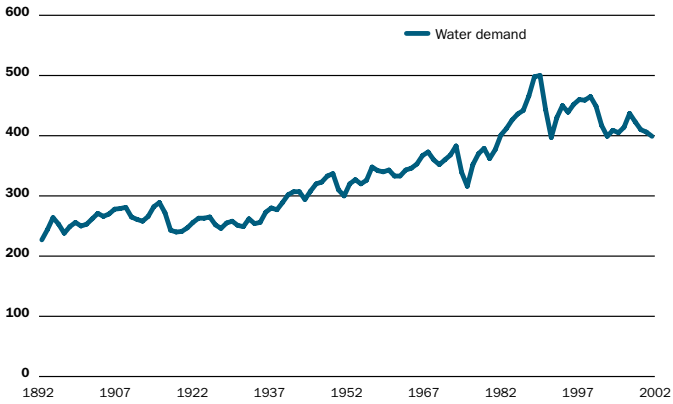
ACHIEVEMENTS

- Continued to play a key role in the Victorian Government's Water Resources Strategy committee, which released a Strategy Directions Report for community consultation.
- Developed an industry program to educate plumbers about water conservation.
- Worked closely with the education community to develop an extensive education program that aims to include water conservation in a range of curricula.

KEY CHALLENGES

- Developing long-term water conservation habits throughout the community to defer or eliminate the need for future reservoirs as part of a robust Water Resources Strategy.

Per Capita Water Demand (litres per person/day)



Sustainable framework

We played a key role in developing the Victorian Government's Water Resources Strategy - a blueprint for managing Melbourne's water resources to 2050 and beyond. Melbourne Water made a financial commitment of $800,000 to this significant project. Other partners included the retail water companies, the Department of Natural Resources and Environment, councils, the Australian Conservation Foundation, the Victorian Farmers' Federation and the Victorian Council of Social Services.

In May 2002, a Strategy Directions Report was released for community consultation. We have committed $50,000 to prepare a final report to the Minister for Environment and Conservation, which is due to be presented by the end of 2002. This report will be the basis for reducing Melbourne's demand for water and implementing water conservation and storage recovery plans.

Recommendations in the Strategy Directions Report included the introduction of water-efficient appliances, smarter water use in the garden, increasing volumetric charges and seasonal pricing on water bills, rainwater tanks and/or water recycling for existing developments, individual properties and new housing subdivisions, water management plans for institutional and council open spaces, and water audits and management plans for industry

Our water conservation initiatives

We implemented a range of water conservation programs with partners including councils, our retail water customers, the Office of Housing, and the education sector.

Among these was a training project for plumbers developed with the Master Plumbers and Mechanical Services' Association and RMIT University. The Green Plumbers - Caring for our Water project educates plumbers on topics such as water-efficient plumbing fixtures, greywater reuse, water auditing techniques and a protocol for reporting illegal connections to the sewerage and stormwater systems. The aim is for plumbers to pass on this information to consumers. More than 200 plumbers undertook the training and a further 200 are expected to complete the course in 2002/03.

Other water conservation initiatives included the Port Phillip Sustainable Living at Home program (with South East Water and the City of Port Phillip). This program is designed to help some 100 participating households reduce their water consumption, and involves fitting water-saving devices in homes. All participating households received education materials about saving water at home and also about sewage and stormwater issues.

The western suburbs-based Cool Communities (with the Western Bulldogs Education and Training Centre, Environment Victoria and City West Water) also demonstrates how to conserve water at home.

With the City of Melbourne and the International Council for Local Environmental Initiatives, we developed a Sustainable Water Management Strategy for the City of Melbourne. This pilot program aims to reduce water consumption in the municipality by 15 per cent by 2020. The strategy includes all aspects of water use including recycling stormwater, and could provide a model for other councils and water authorities throughout Victoria.

We worked with the Office of Housing to support the inclusion of water conservation features such as rainwater tanks in new and existing public housing developments. Implementation will begin in 2002/03.

Education program

We worked closely with the education sector to develop a three-year Prep to PhD education program, which aims to influence future patterns of behaviour by incorporating water cycle education in schools, tertiary institutions and industry. The program was developed following research of the education community and an audit of Melbourne Water's education resources, which resulted in initiatives that engage industry and meet community, business and environmental needs.

Meeting future challenges

At Melbourne Water, we aim to reduce our energy use as much as possible to minimise our impact on the environment and reduce costs.

Lagoon covers capture biogas and reduce greenhouse gas emissions at our Western Treatment Plant in Werribee.

ACHIEVEMENTS

- Began a $30 million project at the Eastern Treatment Plant to generate our own "green" electricity and reduce greenhouse gas emissions and costs.
- Completed an energy and greenhouse data audit from1995/96 to 2000/01 as a prelude to joining the Australian Government's Greenhouse Challenge.
- Documented and quantified actions to reduce greenhouse gas emissions.
- Completed a draft future land use strategy for the Western Treatment Plant.
- Set revised targets to use all biosolids produced at the Eastern Treatment Plant by 2005 and all annual biosolids produced at the Western Treatment Plant by 2010.
- Obtained approval from the Victorian Civil and Administrative Tribunal for using biosolids in a wetland development at the Woodlands Industrial Estate in Braeside.
- Assisted to establish a partnership between EPA Victoria and the peak body for the state's water authorities, the Victorian Water Industry Association, to improve trade waste management.

DISAPPOINTMENTS

- Delay in joining the Greenhouse Challenge (joined in September 2002).
- Delay in developing a sustainable biosolids management strategy.

KEY CHALLENGES

- Meeting increased sewage treatment energy requirements from our own "green" sources.
- By 2005/06, reducing greenhouse gas emissions by 35 per cent and generating the same amount of green energy as electricity we import from the grid.
- Managing and treating trade waste effectively to enable widespread beneficial use of biosolids.
- Developing markets for the use of biosolids that meet environmental guidelines as part of a revised biosolids strategy, and achieving corporate annual targets for the beneficial use of biosolids from our sewage treatment plants.

Energy management

We explore ways to generate our own renewable energy from our water supply and sewage treatment processes. This must all be achieved without compromising our service commitments to customers.

Electricity, natural gas, diesel, petrol, LPG, solar and biogas (methane and other gases) are used to meet our energy needs. We use energy in our offices; for pumping and treating water and sewage; and for transport, construction and other works. Energy represents 11.7 per cent of our operating expenses, with electricity alone costing more than $14 million a year.

Renewable energy

Hydro-electricity

We have identified 14 hydro-electricity generation sites in our water supply system and plan to build the first plant, at Preston Reservoir, by June 2003 subject to appropriate approvals. We expect to complete four more plants by June 2004, another four by June 2005 and the remaining five by June 2006, at a total cost of $11.1 million.

These plants will produce a total of 66 gigawatt hours of electricity a year (the equivalent of the annual power needs of 6,600 households), and will not waste water or affect the water supply. This program will add to existing hydro-electricity plants at the Thomson Reservoir and on the pipeline to Cardinia Reservoir.

Benefits include electricity sales to the grid and reduced greenhouse gas emissions. As a generator of renewable energy through our hydro-electricity and biogas plants, we registered in the Australian Government's renewable energy certificates program. Under this program, organisations generating renewable energy receive certificates for each megawatt-hour they produce, enabling them to sell surplus certificates and raise additional revenue.

Using biogas – Eastern Green Energy Project

Biogas, a byproduct of our sewage treatment process, is a significant greenhouse gas. Using biogas as a renewable energy source prevents methane emissions while reducing costs. The $30 million Eastern Green Energy Project at our Eastern Treatment Plant maximises our use of biogas, minimises the need for diesel fuel, and reduces electricity and maintenance costs. This project is a major upgrade of the power station and outfall pumping station at our Eastern Treatment Plant.

In February 2002, we began upgrading the plant's energy infrastructure including:

- replacing inefficient generators with seven new generators that operate continuously and fully utilise biogas,
- converting three outfall pumps to electricity to use the increased generating capacity efficiently,
- replacing the existing electricity generation control system to fully integrate on-site power generation.

Installing one of seven new generators at the Eastern Treatment Plant, part of the Eastern Green Energy Project.

The project will benefit the environment by:

- reducing the amount of electricity imported, and so reduce greenhouse gas emissions,
- using all biogas produced in the treatment process, reducing the need to burn-off (flare) surplus biogas, which will also reduce greenhouse gas emissions,
- minimising the use of diesel fuel at the plant.

The Eastern Green Energy Project will reduce greenhouse gas emissions from the plant by 24,500 tonnes a year. The project is due to be completed by October 2003.

Using biogas – Healthy Bay Initiative

Our Western Treatment Plant at Werribee, which discharges treated effluent to Port Phillip Bay, is undergoing a $124 million upgrade to protect the long-term health of the Bay. This major environmental upgrade is reducing nitrogen levels by enhancing the modern lagoon system with "activated sludge" processes. This will increase energy requirements at the plant.

These increased requirements will be met by increasing the quantity of biogas captured from the covered lagoons. Under a partnership, AGL Ltd operates facilities that generate electricity from biogas. The total constructed capacity is 3.8 megawatts and we buy all the electricity generated to run the aerators in our lagoons. More than 6.3 million cubic metres of biogas was captured and used, saving about 23,600 tonnes of methane emissions to the atmosphere.

Works are now needed on the biogas handling system to provide reliable and efficient extraction of increased gas from the upgraded 55 East lagoon. Design work has begun, and construction is due to be completed by March 2003.

Cutting energy use and costs

We gathered data on energy consumption for all our sites and predicted future energy generation and use. We used this information in preparing an energy and greenhouse management plan.

The plan includes an energy and greenhouse gas data management and reporting system. This system, to be commissioned in November 2002, is a database that holds all energy consumption, site production and other data necessary to calculate greenhouse gas emissions. It can also store forecasts and targets.

The system, to be installed on Melbourne Water's computer network and available to our people, will help us report against energy and greenhouse gas performance indicators, and improve the energy efficiency of our sites.

Energy-saving projects

We consolidated our offices in East Melbourne, and closed offices at Dandenong, Doncaster, Melbourne, Mt Waverley and Richmond. This will save about 130 megawatt-hours a year of electricity.

We have five energy-saving projects planned for 2002/03.

Project	Completion date	Megawatt hours of electricity saved a year
Somerton pump station	December 2002	130
Microfiltration plant at Yarra Glen	December 2002	75
Microfiltration plant at Frogley	December 2002	75
Microfiltration plant at Cresswell	December 2002	75
Recycle pump station at Western Treatment Plant	December 2002	2,000

Energy consumption trends (terrajoules a year)*

	Actual			Forecast	
	2000/01	2001/02	2002/03	2003/04	2004/05
Electricity imported from grid	677	697	622	527	627
Natural gas imported	65	27	145	243	251
Diesel imported	51	51	1	1	1
Biogas used	324	423	859	933	1,078
Vehicle fuels	32	31	32	32	32
Total energy used	1,148	1,229	1,659	1,736	1,989
Increase on 2000/01		107%	144%	151%	173%

	Actual			Forecast	
	2000/01	2001/02	2002/03	2003/04	2004/05
Eastern Treatment Plant	681	709	750	768	835
Western Treatment Plant	90	140	540	629	816
Winneke Water Treatment Plant	153	170	148	117	116
Water – other	43	38	34	34	34
Sewage transfer	130	122	133	134	135
Minor sites	12	11	12	12	12
Other	40	39	42	42	41
Total	1,149	1,229	1,659	1,736	1,989

*3.6 terrajoules equals 1 gigawatt-hour.
Table includes energy derived from biogas and other renewable sources.

Green electricity generation (gigawatt hours a year)

	Actual			Forecast	
	2000/01	2001/02	2002/03	2003/04	2004/05
Eastern Treatment Plant	0.9	1.1	23.6	32.6	32.9
Western Treatment Plant	3.4	16.1	34.9	39.9	49.8
Existing hydro-electricity plants	28.6	25.1	26.1	26.6	28.7
Proposed hydro-electricity plants	0.0	0.0	11.0	26.0	56.1
Total green electricity generation	32.9	42.3	95.6	125.1	167.5
Total Melbourne Water electricity consumption	191.3	209.8	248.3	242.7	281.1
Green electricity as a proportion of total electricity used	17%	20%	39%	52%	60%

Greenhouse gas emissions

Melbourne Water is contributing to global efforts to reduce the impacts of climate change by reducing its greenhouse gas emissions. Our main greenhouse gas emissions are methane, directly from sewage treatment and livestock, and carbon dioxide, indirectly through electricity we buy to pump and treat water and sewage.

Greenhouse emissions are influenced significantly by external factors such as climatic conditions and regulatory requirements for sewage treatment.

We have plans in place that will cut our greenhouse emissions by 35 per cent by 2005/06 (compared with a 2000/01 baseline). This sizeable reduction, together with our green energy initiatives, puts us among the most environmentally sound energy users in Australia.

Setting a benchmark

We have established an inventory of our greenhouse gas emissions so we can compare the impacts of improvements undertaken as part of a greenhouse gas strategy we developed in 2000. Part of our greenhouse strategy is to participate in the Australian Greenhouse Challenge. The Greenhouse Challenge is a voluntary partnership between the Australian Government and industry to reduce greenhouse gas emissions. This required us to improve the accuracy of our emissions inventory and forecast reductions.

Energy consultants revised inventory data – which are based on energy used and an estimate of direct emissions – to incorporate more accurate energy figures and actual 2000/01 figures. The revised assessment indicated that we emitted 622,242 tonnes of carbon dioxide equivalent during 1995/96 (when Melbourne Water was established in its current form as a water wholesaler), and 600,443 tonnes during 2000/01.

Reducing greenhouse gas emissions

We have developed a range of actions that will significantly reduce our greenhouse gas emissions. These actions include replacing imported electricity by making more efficient use of renewable energy sources such as biogas, changing fuels to those with lower emissions, and discontinuing some sewage treatment processes which produce direct methane and nitrous oxide emissions.

A projection for 2005/06, based on planned activity and capital works, and assuming average flow conditions for water and sewage, found that our emissions would fall to 377,129 tonnes of carbon dioxide equivalent.

Developing a strategy

Initiatives to reduce greenhouse emissions planned during 2002/03 include:

- implementing actions under the Greenhouse Challenge Co-operative Agreement,
- developing an energy and greenhouse management action plan – including an energy data management and reporting application – to provide targets and performance measures for reducing energy consumption and greenhouse gas production and increasing green energy production.

Projected greenhouse emissions (carbon dioxide equivalent, tonnes)

	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07
Electricity (purchased from grid)	275,694	281,755	253,333	214,691	255,425	245,103	248,468
Natural gas (general use)	207	224	224	224	224	224	224
Natural gas (electricity, pumping and heat)	3,856	4,210	9,034	15,273	15,825	14,488	15,669
Diesel transport	169	186	186	186	186	186	186
Diesel (electricity, pumping and heat)	3,790	4,018	0	0	0	0	0
Liquefied petroleum gas	73	78	79	80	81	81	82
Petrol	2,020	2,397	2,397	2,397	2,397	2,397	2,397
Methane (total direct emissions)	274,639	212,308	227,179	234,317	47,715	49,307	51,735
Nitrous oxide	6,678	7,028	6,166	6,411	5,260	5,526	5,853
Carbon dioxide sink (trees)	-3,560	-4,260	-4,960	-5,660	-6,360	-7,060	-7,760
Biogas (total captured)	36,875	47,701	48,867	49,073	66,346	66,876	67,408
Total	600,443	555,646	542,506	516,993	387,100	377,129	384,263

Green electricity

Energy is a significant operating expense and emission source. We are a leader among Australian water authorities in generating green energy using byproducts of our treatment processes. Our performance also compares well with international benchmarks. By 2008, we plan to offset all our electricity consumption by generating an equivalent amount of "green" electricity.

We have also developed a performance indicator linked to the carbon dioxide produced per million litres of water supplied to show our performance in reducing emissions associated with a key service delivery target.

	2001/02	2002/03	2003/04	2004/05	2005/06
Carbon dioxide emissions in kilograms per million litres of water supplied	1,132	1,096	1,037	771	746

Developing land use strategies

Western Treatment Plant

We completed a draft land use strategy to provide long-term direction for the management of the extensive land and infrastructure holding at our Western Treatment Plant.

The fundamental change to the treatment process effective in 2005 will mean the application of raw sewage to land will be replaced by treated effluent. This will achieve 10 per cent recycling of treated effluent and provide opportunities to more effectively manage the agricultural and land resource.

The urban expansion of Melbourne and Geelong and improvements to traffic management on the Princes Highway (to which the plant has a 13-kilometre frontage) means that there are opportunities for the plant to accommodate changed land uses including agriculture, horticulture, water-intensive industry, tourism, residential and recreation. The draft strategy will be finalised and used to guide future land use at Western Treatment Plant.

Dandenong Treatment Plant

EPA Victoria is reviewing its pollution abatement notice issued for the 186 hectare Dandenong Treatment Plant site following Melbourne Water's site assessment and plans for site remediation. There has been extensive environmental investigation of the site and a comprehensive remediation strategy is being developed.

The Dandenong Treatment Plant was taken out of service in 1996 after 66 years of operation as a sewage treatment plant. The majority of the plant infrastructure remains in place since the plant was decommissioned.

Investigations carried out of the site have established that a small area is contaminated. A comprehensive monitoring program is in place to ensure there is no adverse effect or impact on the surrounding area.

As a result, substantial remediation of the site is required prior to redevelopment for industrial and residential purposes.

Melbourne Water is committed to undertaking this remediation in an effective and open manner.

Managing biosolids

Management of sewage sludge or biosolids – the stabilised sludge that remains after sewage treatment – is strictly regulated by EPA Victoria. Finding acceptable environmental and economic ways of using biosolids is a long-term issue. Biosolids are stored at our sewage treatment plants and their use is restricted. On average, 25 per cent of biosolids produced at our Eastern Treatment Plant are used. During the year, Hippo Soils, a blended soil supplier near the Eastern Treatment Plant, bought 2,800 cubic metres of biosolids to use in its products.

Developing further opportunities

Melbourne Water participated in a working group to advise the Victorian Government on a state-wide strategy for managing biosolids. The working group, led by the Department of Natural Resources and Environment, also included other water industry representatives and EPA Victoria.

We reviewed our management targets for use of biosolids, and commissioned a study into market opportunities for the use of our biosolids. This information will be used to target new markets for beneficial use.

Our people participated in an international study tour with others from the water industry, CSIRO and consultants to assess biosolids management and technology developments in Europe.

We also obtained approval from the Victorian Civil and Administrative Tribunal for a major project to proceed at the Woodlands Industrial Estate at Braeside. This project will use four years' production of biosolids from our Eastern Treatment Plant to construct a wetland base on pits excavated when the estate was subdivided in the early 1990s.

We will continue to work closely with EPA Victoria, councils and community groups to sustainably manage biosolids, while taking advantage of new technology.

Our targets

Melbourne Water has developed revised targets for the beneficial use of biosolids. These are:

- using 100 per cent of biosolids produced at our Eastern Treatment Plant by 2005,
- using 100 per cent of biosolids produced at our Western Treatment Plant by 2010.

We have developed a strategy for using biosolids in areas such as landscaping and as a component in soil-improvement products. Our goal is, by 2010, to increase annual use to match the production rate from our Eastern Treatment Plant and, quality permitting, from the enhanced lagoons at our Western Treatment Plant.

Initiatives to use biosolids from our Eastern Treatment Plant by December 2005 include:

- using 5,500 tonnes a year of biosolids in soil conditioner (25 per cent of annual production),
- using 100,000 tonnes of biosolids in the project at Woodlands Industrial Estate,
- using 75,000 tonnes of biosolids at the Eastern Treatment Plant to fill a borrow pit after refurbishing the sludge drying pans.

Actions to beneficially use biosolids at Western Treatment Plant include:

- assessing long-term remediation of contaminated stockpiles, including use of new technologies,
- undertaking a market assessment of opportunities in the area.

Managing trade waste

An integral part of the service we provide is managing trade waste collected by the retail water companies from industry. Managing the risks associated with the quality of this waste is crucial because it impacts on the environment and our ability to maximise opportunities for the use of biosolids.

We work with the Trade Waste Acceptance Advisory Committee, an independent expert committee, to review trade waste standards for critical pollutants. Standards for oils, fats and greases and total oxidised sulphur were completed. We asked the committee to review standards for copper, nickel and zinc. These metals determine the suitability of biosolids for beneficial use. We provided a report to the committee on these metals and await its response. Preliminary investigations have also begun for cadmium and mercury.

We also worked with our retail water customers to identify a process to assess high-risk trade waste customers. Risk profiles submitted by these customers are being evaluated to determine the risk to our sewerage system.

A long-term partnership has been developed to improve trade waste management in Victoria. The partnership, finalised in June 2002, is between EPA Victoria and the peak body for the state's water authorities, the Victorian Water Industry Association. It is establishing programs and support activities to help water businesses and trade waste producers achieve reductions.

Filling in the gaps

Biosolids are being used as the foundation for one of the three shallow lakes at the Woodlands Industrial Estate, Braeside (below). The lake, part of a wetland system that is being built at the site, has a foundation of 140,000 tonnes of compacted biosolids from our Eastern Treatment Plant at Bangholme. The biosolids were used to fill one of the pits that was formed when the subdivision was built in the early 1990s. The 122-hectare site was a sewage treatment plant from 1940 until 1980.

The wetlands will treat stormwater runoff from the estate and the adjacent Dunlops Drain, improve the quality of water entering Mordialloc Creek and Port Phillip Bay, provide wildlife habitat and enhance the local environment for neighbouring residents and businesses.

The first lake, which has been constructed and includes about 100,000 indigenous plants, is already home to a large number of waterfowl. Work on the second and third lakes is due to be completed in 2004.

Licence compliance – sewage treatment plants

We operate our sewage treatment plants at Werribee and Bangholme in accordance with the provisions of EPA Victoria licences.

Our Eastern Treatment Plant in Bangholme achieved 100 per cent compliance with effluent discharge parameters in its EPA Victoria licence.

Eastern Treatment Plant

Our Eastern Treatment Plant achieved 100 per cent compliance with effluent discharge parameters in its EPA Victoria discharge licences. However, the plant exceeded its sulphur dioxide limit in exhaust from an engine in the outfall pump station. These pumps will be replaced as part of the Eastern Green Energy Project. EPA Victoria is satisfied with the actions we have taken to manage this breach.

Raw sewage monitoring

The Eastern Treatment Plant treated 42 per cent of Melbourne's sewage. The quality of raw sewage that entered the plant is described in the following table.

Parameter (units)	Median	90th Percentile	Maximum
BOD_5 (mg/L)	270	350	370
Suspended solids (mg/L)	365	488	690
pH (pH units)	7	7.2	7.4
Ammonia as nitrogen (mg/L)	33	36	42
Total combined nitrogen (mg/L)	64	76	110
Total phosphorus (mg/L)	15.5	19.5	26
Anionic surfactants MBAS (mg/L)	5.2	8.85	18
Cadmium (mg/L)	0.0011	0.0032	0.0097
Chromium (mg/L)	0.0345	0.0605	0.069
Copper (mg/L)	0.13	0.16	0.19
Lead (mg/L)	0.027	0.0725	0.18
Mercury (mg/L)	0.00015	0.000225	0.013
Phenol (µg/L)	11	55	57
Toluene (µg/L)	2	8	14
Benzene (µg/L)	0.5*	3*	7*
PAHs total (µg/L)	4*	4*	4*

* These results were less than the detection limit and were calculated at half the given value.

Dioxin and furan analysis

During December 2001, samples of raw sewage and final effluent were taken and analysed for polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). The final effluent result gives a combined international toxic equivalent of 1.25 picograms per litre.

The outfall pumping station at Eastern Treatment Plant is to be upgraded as part of the Eastern Green Energy Project.

Discharge to water

On 12 March 2002, an EPA Victoria licence amendment changed the effluent sample point from the plant's outfall pump station to a point at Truemans Road, immediately prior to discharge at the Eastern Treatment Plant outfall. Accordingly, this year's data was collected at two sites.

At the same time, the biological oxygen demand at five days (BOD_5) standard was changed to carbonaceous biological oxygen demand ($CBOD_5$). This change reflects the progressive upgrading of ammonia removal at the plant.

The following table outlines sample results taken from the final effluent sample point and flow measurements at the outfall from 1 July 2001 to 30 June 2002.

	Median		90th Percentile		Maximum	
Parameter (units)	**Limit**	**Result**	**Limit**	**Result**	**Limit**	**Result**
BOD_5 (mg/L)	20/ns*	19.5	40/ns*	31.8		49
$CBOD_5$ (mg/L)	ns/20*	6.5	ns/40*	14.9		26
Suspended solids (mg/L)	30	11	60	29.7		47
pH (pH units)		7.3		7.5	6 - 9	6.6 – 7.6
Ammonia as nitrogen (mg/L)	30	16		24.5	40	25
Total combined nitrogen (mg/L)		27		32.5		44
Total phosphorus (mg/L)		8	15	9.4		12
Anionic surfactants MBAS (mg/L)	0.4	0.2	0.7	0.3		0.4
Cadmium (mg/L)		0.0002**	0.005	0.0003**	0.01	0.0004**
Chromium (mg/L)		0.006	0.075	0.012	0.15	0.036
Copper (mg/L)		0.017	0.05	0.031	0.1	0.044
Lead (mg/L)		0.003	0.05	0.007	0.1	0.01
Mercury (mg/L)		0.000025**	0.0005	0.000025**	0.001	0.000025**
Phenol (µg/L)		0.5**		2**	100	2**
Toluene (µg/L)		0.5**		2.4**	50	3**
Benzene (µg/L)		0.5**		0.5**	25	2.5**
PAHs total (µg/L)					15	4**
Flow (ML/day)	540	376		451	770	589
Total residual chlorine (mg/L)		0.07		0.13	1.0	0.25
E.coli (org/100mL)	200	17	1000	54.5		16000***
Dissolved oxygen (mg/L)		6.9		7.8	Not less than 6.0	6.3-7.8 (range)

* On 12 March 2002, biochemical oxygen demand at five days ceased as a compliance parameter and was replaced by the carbonaceous biochemical oxygen demand.
** All results found to be less than detection limit were taken as half the given value.
*** This reading was investigated by Melbourne Water. Upstream and downstream samples taken on the same day showed results of 0-2 org/100mL, which is within requirements.
Note: Outfall flow data corrected for internal plant use of effluent.

Discharge to land

This table details the quality of effluent discharged to land on site at the Eastern Treatment Plant, at the final effluent sample point and the treatment plant's reuse sample point from 1 July 2001 to 30 June 2002. The sample point and biological oxygen demand standard changed on 12 March 2002.

Parameter	**Unit**	**Median**	**90th Percentile**
*E.coli**	Org/100mL	53.5	1590
Electrical conductivity**	µS/cm	945	998
BOD_5**	mg/L	18.5	32
$CBOD_5$**	mg/L	6	15

* From Eastern Treatment Plant reuse sample point.
** From Eastern Treatment Plant final effluent sample point.

Bacteriological monitoring – beach samples

Samples of receiving water were taken at six sites along the Gunnamatta and St Andrews beaches and analysed for *E.coli.*
The sample points are:
1. The first bluff (Bellisleptia), east of the discharge point.
2. Gunnamatta West beach, opposite the amenities block.
3. Gunnamatta West beach, opposite the surf life saving clubhouse.
4. Gunnamatta East beach, about 350 metres east of point number two.
5. Le Lievres beach, 110 metres west of the discharge point.
6. Rye back beach – main swimming area.

All results are posted weekly on the Melbourne Water website.

	Geometric (log) mean (org/100mL)* SEPP (Waters of Victoria) objective: 200 org/100mL					
42-day period ending	**Beach 1**	**Beach 2**	**Beach 3**	**Beach 4**	**Beach 5**	**Beach 6**
9 August 2001	3.6	4.0	3.6	3.4	3.7	1.1
21 September 2001	3.4	1.1	1.7	1.3	6.2	2.5
29 October 2001	2.2	1.1	1.1	1.0	2.6	1.0
13 December 2001	1.3	1.3	1.1	1.0	3.2	1.5
24 January 2002	3.9	1.3	1.6	1.3	3.0	1.0
4 March 2002	1.7	1.1	1.0	1.0	4.1	1.0
17 April 2002	3.2	1.6	1.1	1.3	4.3	3.3
31 May 2002	1.1	1.0	1.1	1.1	3.0	1.3
24 June 2002	2.0	1.0	1.2	1.0	1.2	1.0

* Samples of zero *E.coli* were assumed to have a level of 1.0 to determine the geometric mean.

	80th percentile (org/100mL) SEPP (Waters of Victoria) objective: 400 org/100mL					
42-day period ending	**Beach 1**	**Beach 2**	**Beach 3**	**Beach 4**	**Beach 5**	**Beach 6**
9 August 2001	6	4	6	4	8	0
21 September 2001	8	0	2	0	16	2
29 October 2001	4	0	0	0	8	0
13 December 2001	0	0	0	0	6	0
24 January 2002	12	0	2	0	6	0
4 March 2002	2	0	0	0	8	0
17 April 2002	6	2	0	2	16	4
6 June 2002	0	0	0	0	4	0
24 June 2002	4.4	0	0.8	0	0.8	0

Discharge to air

Melbourne Water exceeded its limit for maximum concentration of sulphur dioxide emission from an outfall pump station engine. Sampling on 30 June 2002 measured maximum concentration at 46 milligrams per cubic metre against a limit of 40. The outfall pumping engines will be replaced as part of the Eastern Green Energy Project.
Discharge licence limits and the test results are compared in the following table.

	Maximum rate (g/min)		Maximum concentration (mg/m³)	
Parameter	**Limit**	**Result**	**Limit**	**Result**
Nitrogen oxides	500	91	2600	1212
Carbon monoxide	300	73	2600	967
Sulphur dioxide	7.5	3.5	40	46
Hydrogen sulphide	0.5	<0.013	2	<0.17
Volatile Organic Compounds	20	0.4	100	5.1

Western Treatment Plant

Environmental regulation

Our Western Treatment Plant achieved 100 per cent compliance with effluent discharge parameters in its EPA Victoria discharge licence.

Raw sewage monitoring

Our Western Treatment Plant treated 54 per cent of Melbourne's sewage. The quality of raw sewage that entered the plant is described in the following table.

Parameter (units)	Median	90th Percentile	Maximum
Flow (ML/day)	495	535	789
BOD_5 (mg/L)	475	610	2,600
Suspended solids (mg/L)	360	420	500
Ammonia as nitrogen (mg/L)	32.5	37	41
Total nitrogen (mg/L)	57.1*	63.3*	85.1
Total phosphorus (mg/L)	11*	12.2*	14
Colour (Pt/Co units)	150	16	200
Anionic surfactants MBAS (mg/L)	5.85*	6.78*	7.6
Silicate (mg/L)	14	14.9	15
Electrical conductivity (µS/cm)	2,000	2,200	2,400
TDS (mg/L)	1,100	1,300	1,500
Cadmium (mg/L)	0.0005*	0.0008*	0.001
Chromium (mg/L)	0.0405	0.0544	0.064
Copper (mg/L)	0.18	0.226	0.25
Lead (mg/L)	0.015	0.0189	0.022
Mercury (mg/L)	0.00035	0.00172	0.0029
Nickel (mg/L)	0.021	0.0356	0.04
Zinc (mg/L)	0.21	0.336	0.38
pH (pH units)	7.1	7.2	7.6
Benzene (mg/L)	0.001*	0.0039*	0.004
Toluene (mg/L)	0.003	0.0058	0.006
Phenol (mg/L)	0.49*	1*	1
Total PAHs (mg/L)	0.004*	0.0129*	0.041

* At least one result was below the limit of detection, but the limit of detection value was assumed in the calculations.

Licence compliance

The following tables show the plant's compliance performance. In these tables, "limit" is the required performance as stated in the licence and "result" is how the plant performed. The plant-wide limits for all discharge parameters in the licence are based on a weighted average calculated using the formula:

Sum (flow from each discharge point multiplied by the concentration of the waste indicator) divided by
Sum of flow from each discharge point.

There is a daily plant-wide limit of 700 million litres a day averaged over the year. The environment improvement plan has a target of 3,200 tonnes a year of nitrogen by 2005.

Annual and average daily discharges

Outlet	Annual discharge (million litres per annum)	Average daily discharge (million litres per day)
15 East	102,468	281
145 West	19,772	54
Lake Borrie	12,152	33
Murtcaim	11,758	32
Total	146,150	400

Annual discharge to Port Phillip Bay

Flow-weighted parameters

Parameter (units)	Median		90th Percentile		Maximum	
	Limit	Result	Limit	Result	Limit	Result
$CBOD_5$ (mg/L)	25	6*		9*		13
BOD_5 (mg/L)		13*		26*		53
Suspended solids (mg/L)	100	25	130	36		44
Ammonia as nitrogen (mg/L)	25	6*		16*	40	17
Total nitrogen (mg/L)		17*		27*		35
Total phosphorus (mg/L)		9	15	10		11
Dissolved oxygen (mg/L)		6.7		7.6		8.5
pH (pH units)		7.9		8.1		8.2
Colour (Pt/Co units)		96	600	177		180
Anionic surfactants MBAS (mg/L)	0.5	0.2*		0.21*	1.0	0.22
Silicate (mg/L)		14		15		15
Electrical conductivity (µS/cm)		2,612		3,300		9,719
Cadmium (mg/L)	0.005	0.0002*		0.0005*	0.01	0.002
Chromium (mg/L)	0.05	0.007*		0.013*	0.15	0.014
Copper (mg/L)	0.05	0.010		0.018	0.1	0.022
Lead (mg/L)	0.05	0.003*		0.007*	0.1	0.011
Mercury (mg/L)	0.0005	0.0001*		0.00017*	0.001	0.00019
Nickel (mg/L)	0.05	0.021		0.0356	0.15	0.04
Zinc (mg/L)	0.1	0.017*		0.033*	0.25	0.036
Benzene (mg/L)		0.001*		0.001*		0.001
Toluene (mg/L)		0.001*		0.001*		0.006
Phenol (mg/L)		0.048*		0.048*		0.048
Total PAHs (mg/L)		0.004*		0.004*		0.004
E.coli (org/100mL)		974*		5,312*		36,099**

* At least one result was below the limit of detection, but the limit of detection value was assumed in the calculations.

** The higher than usual maximum *E.coli* result occurred in October 2001 due to heavy rainfall causing runoff from paddocks where land filtration was underway. Land filtration using untreated sewage is being phased out at the plant.

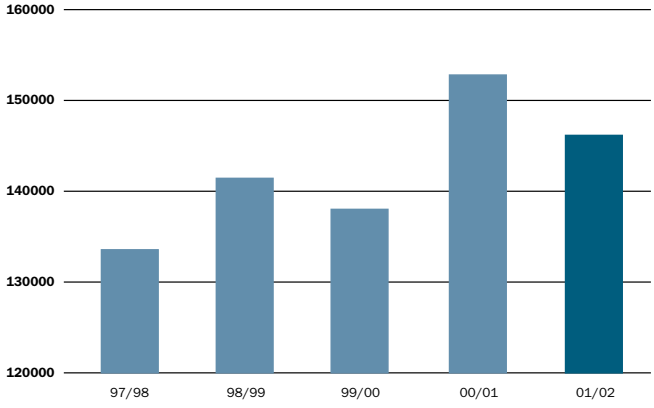
Parameter	Units	Target	Result
Total annual nitrogen load	Tonnes	3,200*	2,661

* This is the environment improvement plan target for 2005.

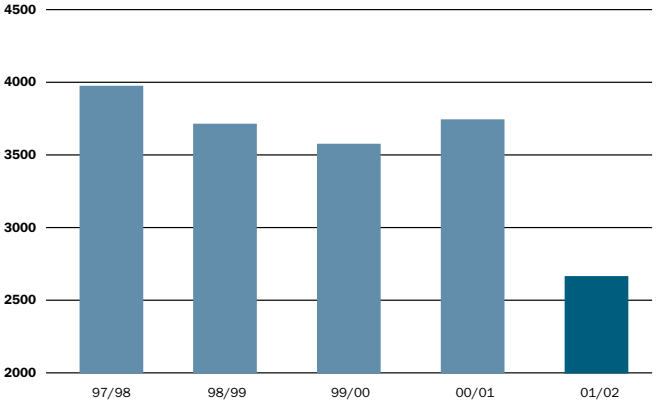
Annual nitrogen load to Port Phillip Bay

The reduction achieved is attributed to operating the 55 East activated sludge plant, water recycling and a lower annual inflow.

Annual discharge to Port Phillip Bay from Western Treatment Plant (million litres)



Annual nitrogen load to Port Phillip Bay from Western Treatment Plant (tonnes)



OUTLET PCDD/F AS TOTAL TOXIC EQUIVALENTS OF 2, 3, 7, 8 TCDD

Final effluent at the four discharge points was sampled and analysed for polychlorinated dibenzo-p-dioxins and furans as toxic equivalents of 2,3,7,8 tetrachloro-dibenzo-p-dioxin.

Date Site	October 2001 Murtcaim	January 2002 15E	March 2002 Lake Borrie	April 2002 145W
International total toxic equivalent excluding limit of detection values	0.92	0	0.26	0.15
International total toxic equivalent including half limit of detection values	48.3	12.9	28.9	32.7

(All results in picograms per litre)

Bacteriological monitoring

Every seven days, a sample of seawater is collected in 60-centimetre deep water offshore from Beach Road and 160 South Road. The samples are analysed to determine the concentration of *E.coli.*

	Geometric mean		80th percentile	
42-day period ends	160 South Road	Beach Road	160 South Road	Beach Road
19 July 2001	13	7	22	9
30 August 2001	75	4	150	10
11 October 2001	25	1	10	2
22 November 2001	27	70	20	150
2 January 2002	8	27	20	40
13 February 2002	20	70	30	10
28 March 2002	7	4	10	10
8 May 2002	16	6	38	10
20 June 2002	4	5	9	10

(All results are organisms per 100 millilitres of seawater)

Legend

BOD_5	biochemical oxygen demand at five days
$CBOD_5$	carbonaceous biochemical oxygen demand at five days
I-TEQ	international total toxic equivalent
LOD	limit of detection
MBAS as LAS	a measure of surfactants
PAHs	polycyclic aromatic hydrocarbons
pH	a measure of acidity or alkalinity
mg/L	milligrams per litre
µS/cm	microsiemens per centimetre
Pt/Co	units-platinum cobalt units (a measure of colour)
µg/L	micrograms per litre
org/100mL	organisms per 100 millilitres

Verification Statement

SIRIS

SMEC

VERIFICATION STATEMENT

Melbourne Water commissioned jointly the Sustainable Investment Research Institute (SIRIS) and the Snowy Mountains Engineering Corporation Victoria (SMEC Victoria) to verify the data and content of this Annual Environment Review 2001/02 (the 'report'). Melbourne Water has the responsibility for the preparation of the report and this statement represents the auditor's independent opinion. Neither SIRIS nor SMEC Victoria was responsible for preparation of any part of this report.

Verification scope

There are currently no statutory requirements or generally accepted standards for the preparation, public reporting and attestation of non-financial stakeholder reports. In the absence of such standards, our approach to verification is based on emerging international best practice, and accordingly this statement is constructed based on the recommended approach by the Global Reporting Initiative's *Sustainability Reporting Guidelines*.

The verification scope included:

- a review of the report for any major anomalies;
- an examination of Melbourne Water's measurement and reporting processes, background documentation and data collection and reporting procedures; and
- an execution of an audit trail of selected claims and data streams to determine the level of accuracy in collection, transcription and aggregation processes.

The scope of the verification process this year has been extended to include separate verification of each of the environment, social, and business (non-financial component) reviews by the auditor.

Verification process

The report verification was undertaken in September 2002, using an audit process that is based on annual rotation of assessing parameters and sites. The audit involved:

- a series of interviews with key personnel responsible for collating and writing various parts of the report in order to ensure selected claims were discussed and substantiated.
- a review of Melbourne Water's policies, objectives, management systems, monitoring and reporting procedures and examination of selected data sets including the initial and final drafts of the report; and
- an examination of the aggregation and derivation of, and underlying evidence for, data presented and statements made in the report.

Our Opinion

- A high level of data accuracy is presented within the report. However, there were a small number of anomalies that were attributable to human transcription errors, or misinterpretation of information in report writing.
- Each of the data trails selected was easily identifiable and traceable and the personnel responsible were able to reliably demonstrate the origin(s) and interpretation of data.

Overall the auditor is satisfied, based on the past five years experience in verifying Melbourne Water's public reports and associated systems, that:

- the report is a fair and honest representation of the organisation's policies, management systems and performance. The report is fairly presented and materially not mis-stated;
- the report is a good reflection of management commitment towards environmental performance, and a fair description of environmental performance achieved during 2001/02;
- the systems and processes in place to generate the numerical data presented in the report are sound; and
- the written statements made in the report accurately reflect the results and progress achieved during the reporting period.

General Findings and Recommendations

The following observations and recommendations are made as a result of the verification process to assist in further improving the standard of reporting:

- The report provides a balanced view of the environmental condition as a result of Melbourne Water's operations.
- Melbourne Water's stakeholder reporting process has evolved over the past six years and this year is moving closer to a triple bottom line reporting framework.
- A more complete set of data and information was not available for verification earlier. This created some inefficiency in the verification process resulting in the necessity of cross checking contents of the earlier and later versions of the report. However, it is expected that this will not continue to be a source of concern in future reporting periods as the process of report preparation continues to improve. Emphasis should be placed on allocating responsibilities in generating data and information and their internal review.
- Further analysis of key business issues from a triple bottom line perspective is recommended. This is necessary to continue developing a relevant and responsive performance measurement and reporting mechanism that comprehensively addresses Melbourne Water's triple bottom line aspects and impacts.
- Increasing the level of stakeholder engagement throughout the reporting process would result in a more stakeholder-oriented report.

The above findings represent a summary of a more detailed assessment report presented to Melbourne Water.

On behalf of the audit team
27th September 2002
Melbourne, Australia

Terence Jeyaretnam
Accredited Auditor
Principal, SIRIS

Glossary

Algae
Large group of generally aquatic, non-flowering plants, many microscopic, and generally containing chlorophyll.

Ammonia
Compound consisting of a single nitrogen atom coupled with three hydrogen atoms. It is a nitrogen source for algae.

Aquatic
Living in, growing in or frequenting water.

Biogas
A byproduct of the sewage treatment process, that is a mixture of carbon dioxide and methane. Melbourne Water uses biogas as a renewable energy source.

Biosolids
Treated and stabilised sewage sludge; may be in semi-liquid or dried form (see sewage sludge).

BOD
Biochemical Oxygen Demand. Measure of the amount of oxygen required by bacteria and other micro-organisms engaged in breaking down organic matter.

Catchment
(or water supply catchment) A natural drainage area, bounded by sloping ground, hills or mountains from which water flows to a low point. Melbourne's water supply catchments are in the Yarra Ranges. Water flows to streams and then to reservoirs for distribution to the community.

Chlorophyll
Green pigments of plants that capture and use the energy from the sun to drive the process of photosynthesis.

CSIRO
Commonwealth Scientific and Industrial Research Organisation.

Dam
Technically, the dam is the wall that holds the water in, and the reservoir is the water. (see reservoir).

Denitrification
Conversion of bound nitrogen to gas.

Drainage
The system of local and regional drains, retarding basins, wetlands, pollution traps and other features designed to contain, convey and manage stormwater to prevent flooding and protect the environment.

Drains
Pipes or channels, usually underground, used to manage stormwater.

E.coli
(Escherichia coli) Bacteria/bacterium found in the stomachs of mammals (for example, humans) and used as an indicator of recent faecal contamination.

Ecology
The study of the inter-relationships between living organisms and their environment.

Ecosystem
A term used to describe a specific environment, to include all the biological, chemical and physical resources and the interrelationships between those resources.

Effluent
(or treated effluent) Water discharged after processing of sewage at a treatment plant.

Enterococci
Round-shaped bacteria adapted to the gut of warm-blooded animals and an indicator organism in seawater.

Environmental flow
The minimum designated flow in a stream or river needed to satisfy specified ecological requirements.

Greenhouse gas
One of a number of gases (the most abundant of which is carbon dioxide) found in the atmosphere. These gases, created by burning fossil fuels such as oil, coal and gas, absorb heat from the sun and create a warmer atmosphere.

Heavy metals
General term for cadmium, chromium, copper, iron, mercury, nickel, manganese, lead, zinc, arsenic and selenium.

Model
Mathematical equation or series of equations that provides a simplified description of a system or situation devised to facilitate calculations or predictions.

Nutrients
Substances such as nitrogen and phosphorus in various forms required for the growth of plants.

Outfall
Pipeline discharging treated effluent.

Pollution
Water pollution occurs when waste products or other substances, such as effluent, litter, refuse, sewage or contaminated runoff, change the physical, chemical, biological or thermal properties of the water, adversely affecting water quality, living species and beneficial uses.

Protected catchments
These catchments have no farms, houses or factories and provide clean water free of the pollutants these and other human activities produce.

Pump station
A facility to transport water or sewage uphill to treatment plants or other destinations.

Receiving water
Waters into which effluent or waste streams are discharged.

Reservoir
(or storage reservoir) A major body of water created in a river valley by building a dam (see dam).

Retarding basins
Open spaces used to store rapidly flowing stormwater, and then release it slowly, preventing flooding downstream.

Retail water companies
The metropolitan retail water companies – City West Water, South East Water and Yarra Valley Water – are our main retail customers. They provide water and sewerage services to Melbourne consumers.

Runoff
Water that flows over the surface from a catchment.

Sediment
Sand, clay, silt, pebbles and organic material carried and deposited by water or wind.

Service reservoir
A water storage such as a tank built to receive bulk supplies of water from major sources before final distribution to the community.

Sewage
Waste from households (from kitchen, laundry and bathroom sinks as well as toilets) and businesses that is sent to a treatment plant.

Sewage sludge
Solid material separated from sewage during processing; remains as a semi-liquid product until further dewatering/drying is undertaken (see biosolids).

Sewage treatment plant
A place where human and industrial wastes are treated before disposal to land or water.

Sewerage
System of pipes (sewers) to transport sewage.

Stormwater
Rainfall that runs off roofs, roads and other surfaces and flows into gutters, waterways and eventually the bays. This water can carry contaminants such as plastic, detergents, nutrients and heavy metals.

Stream
A general term for a body of flowing water; a natural watercourse containing water at least part of the year.

Suspended solids
Solids that float on the surface or are suspended in water, and which are largely removable by filtering.

Sustainability
Sustainable activities are those that can continue into the future, reduce impacts on the environment over time and balance environmental, social and economic factors.

Toxicant
A poison.

Water conservation
Efforts to encourage households and businesses to reduce water use to defer or decrease the need for new water storages or sources. Water conservation campaigns are based on water being a precious resource.

Water cycle
The circulation of water on Earth as it evaporates from the sea and lakes, condenses into clouds and falls again as precipitation (rain, hail, sleet, snow).

Water quality
The physical, chemical and biological measures of water.

Water supply system
All aspects of the system from the water collection point to consumers, including catchments, storage reservoirs, treatment and distribution systems, and consumption.

Water treatment
Techniques to ensure water is suitable for specific purposes including drinking. In Melbourne, 90 per cent of our water (from protected catchments) undergoes minimal treatment comprising disinfection (light chlorination), fluoridation and pH correction. The rest of our water undergoes full treatment, which includes several other processes (for example, sand filtration) to remove impurities.

Waterways
All streams, creeks, rivers, estuaries, coastal lagoons, inlets and harbours.

Weir
A low structure across a river, stream or creek retaining only a small proportion of the mean annual flow.

Wetland
Natural or artificial area of seasonal, intermittent or permanent waterlogged soils or inundated land.

Photography: Noel Butcher, Neale Duckworth, Rohan Young, Boris Hlavica, Lynton Crabb, Stuart Milligan
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