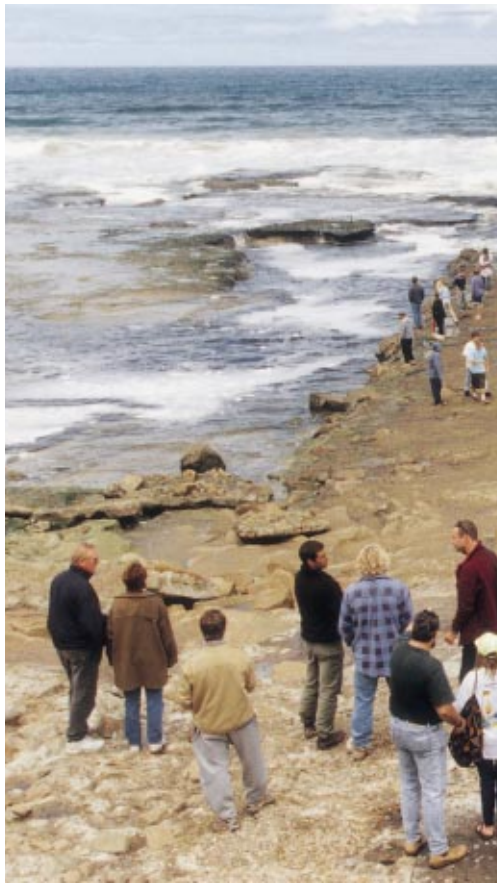
Outfall fallout

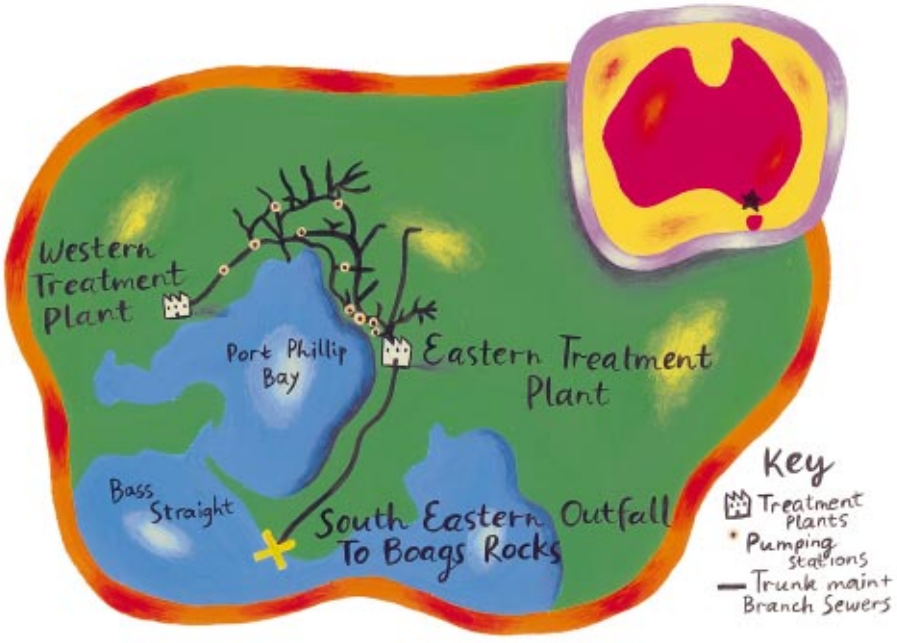


Can Melbourne recycle its wastewater? As concerns about effluent discharge and water availability escalate, increased reuse seems the best option for the long-term. **Denis Faye** reports.

One wet Sunday last November, hundreds of protesters gathered at Boags Rocks, just north-west of Victoria's treacherous Gunnamatta Beach. As the rain pelted down, the group stood on a cement outcrop above a small rock platform and angrily demanded the sewage outfall beneath their feet be shut down. While some of their ideas might have been eccentric, their efforts made the evening television and radio news, as well as the newspapers.

As we learn more about our environment, and our relationship with the ocean, scenes such as this are becoming more frequent. Scientists, administrators and politicians, as well as conservationists, realise that ocean outfalls may not be the last word in wastewater disposal. At Boags Rocks, about 140 000 megalitres of wastewater is dumped into the ocean annually. The disposal system clearly needs upgrading: the challenge lies in determining how.

Sewerage systems made their Melbourne debut in 1892, when the newly-formed Melbourne and Metropolitan Board of Works began building a network of sewers and a treatment farm at Werribee. Although it was an extremely progressive system, using chemical-free lagooning, irrigation and grass filtration, Werribee (or the Western Treatment Plant) couldn't handle Melbourne's burgeoning population. By 1963, 117 000 homes were without sewerage, seeping pollution into just about every river and stream in the metropolitan area, as well as Port Phillip Bay. The Board decided to build the Eastern Treatment Plant at Carrum, with an outfall either directly into the bay at Carrum , or into Bass Strait close to Cape Schanck.



Christina Miesen

They looked towards the cheaper option of Port Phillip Bay, until the unions stepped in, threatening a black ban. The State Government, weary of the unions and mindful of an upcoming election, also vetoed the plan. Suddenly, a Bass Strait outfall seemed a pretty decent idea. In 1975, the Eastern Treatment Plant with its ocean outfall was commissioned.

Today, Melbourne's sewerage system is at another crossroads. Boags Rocks Outfall handles 40% of the city's wastewater, each day discharging some 380 megalitres of chlorinated, secondary-treated effluent. The Environment Protection Authority (EPA) licence for the outfall required Melbourne Water to investigate options for improving the environmental performance of sewage treatment, disposal and reuse.

The move by the EPA coincided with rising concern about the effects of effluent and fresh water on the marine environment, and the flushing into the ocean of thousands of megalitres of potentially reusable water ever year. 'In the late 1960s, the fact that the outfall was not put in the Bay was seen as a great environmental win,'

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Above: Protesters call for the Boags Rocks ocean outfall to be shut down.

Left: Boags Rocks in 1954, more than 20 years before the ocean outfall was commissioned.

Below: CSIRO's Rob Molloy at Boags Rocks. In contrast to the earlier picture, the rock platform is now relatively bare of seaweeds which have been killed off by high levels of toxic ammonia. Severe impacts from the outfall end at this rock platform, according to the environmental impact assessment.

Know your sewage

HERE are a few definitions to help steer you through the sewerage system (figuratively, of course).

Sewage is the wastewater and waste matter carried in the water discharged from homes, offices, shops and factories. It is not to be confused with **sewerage**, the system of pipes through which sewage flows.

This, in turn, should not be confused with **stormwater drains**, the system that collects rain water runoff from surfaces such as roofs and roads, along with drainage from our gardens and open lands. Industrial trade waste, if not detrimental to the treatment process, can also be discharged to the sewerage system.

Sewage from properties connected to a sewerage system flows to a treatment plant where it is treated to a specified quality level.

Primary treatment involves screening the solids from the water and allowing a proportion of the suspended solids and organic matter to settle from the wastewater.

Secondary treatment takes primary treated effluent and with the aid of biological processes breaks down a further proportion of the dissolved or suspended organic matter to a form that reduces its environmental impact if discharged.

In **tertiary treatment** the secondary treated effluent is further treated using various techniques including flocculation, coagulation, clarification and filtration. The main aim is to remove nutrients such as nitrogen and phosphorus and further remove the small amount of organic material and any remaining organisms in the secondary treated effluent.

Water treated to a tertiary level requires another series of treatments to remove any remaining contaminants before it is considered suitable for potable (drinking quality) reuse.

Above: Tube worm cavities at Boags Rocks. The worms are favoured by the high-nutrient conditions created by the effluent outfall and have replaced various red and brown algae, and the seaweeds Neptune's necklace (left) and bull kelp (top left).

EPA chair, Dr Brian Robinson, says. 'But today standards have changed and people know more and expect better environmental outcomes.'

To help sort out the facts about Boags Rock, Melbourne Water enlisted the CSIRO Environmental Projects Office, which released the findings of its Eastern Treatment Plant Effluent Management Study in May, 1999.

For some, the results of the CSIRO study are surprising, if not controversial. It found that the outfall does affect the local ecosystem, but short-term solutions aimed at immediately fixing the problem were deemed unnecessary. Instead, the study suggested long-term solutions aimed at one day making Melbourne's wastewater completely reusable.

To reach this conclusion, the CSIRO team worked in two stages. Stage one was an environmental impact assessment. The first task, the biological monitoring of subtidal habitats in the area, involved investigating flora and fauna based on the current situation and past research. Next, the scientists tested bioaccumulation, collecting local abalone, wrasse (or parrot fish) and sea squirts, and testing the animals for toxicants accumulated in their systems. After this, they ran a toxicity assessment, observing which local species could survive exposure to the effluent. Finally, changes in the quality of sea water around the outfall were tested.

The second stage of the study entailed developing an effluent management plan. Fourteen possible ways of reducing the flow of the outfall, including woodlot irrigation, grey-water reuse and constructed wetlands were studied. After this, the option of extending the outfall further into the ocean to improve dilution of effluent in the sea water was evaluated by use of computer models which simulated effluent dispersion and phytoplankton growth.

During the process, Melbourne Water consulted a number of community and key environmental groups, including Friends of the Earth, Surfrider Foundation and The Australian Conservation Foundation.

Local effects

The environmental impact assessment discovered that high levels of toxic ammonia discharged by the outfall affected the local environment. When diluted, the ammonia acts as a nutrient, further affecting the Boags Rocks ecosystem. Various red and brown algae, and the seaweeds *Hormosira banksii* (Neptune's necklace) and *Durvillaea potatorum* (bull kelp), had been killed off. In their place, the worm *Boccardia proboscidea* had colonised the platform, as well as some species of green algae.

Any severe impact from the outfall ends at this platform. A few other areas, such as Fingals Beach (5 km along the coast), are slightly affected, but the surf beaches surrounding Boags Rocks tend to disperse the effluent once it drifts past the platform. 'Surf beaches, by nature, have very dynamic sand movement,' CSIRO project coordinator, Robert Molloy, says. 'So you're never going to see a lasting impression.'

The CSIRO study did not investigate the effects of the outfall on local surfers and swimmers. However in a parallel project, Monash University undertook a literature review on health effects of ocean outfalls. The conclusions were that, based on the routine *E. coli* sampling that Melbourne Water carries out, and additional sampling for *Enterococcus* spp., surfers appear to be at no additional risk of contracting disease from surfing in the area when compared to other beaches.

Another factor considered in the CSIRO study was the need, identified by Melbourne Water, to consider augmenting Melbourne's water supply beyond 2030. Recycling the wastewater, rather than discharging it, may help to alleviate the situation.

With the need for recycling as well as the ammonia problem in mind, CSIRO recommended two courses of action to Melbourne Water. First, a process of nitrification / denitrification should be incorporated at the Eastern Treatment Plant to reduce ammonia levels in the effluent. As well as helping to restore the Boags Rock's ecosystem, this would bring the plant's output a step closer to potable (drinkable) reuse. CSIRO also suggested that Melbourne Water investigate options for increasing the volume of effluent reuse.

'Wasting water is a long-term issue,' says Molloy. 'Melbourne Water is going to have to start looking for a new resource by 2030, so they need to start considering that now.'

While some hard line groups demand the immediate shutdown of the outfall, CSIRO did not consider this. While the ocean

would be the better for it, Melbourne would suddenly find itself with a great deal of unusable effluent. Even if the technology existed to pass the EPA's stringent requirements for water recycling, public perception wouldn't allow it.

According to a research report compiled by The Open Mind Research Group for Melbourne Water, many Victorians still resist the concept of using wastewater in urban environments, let alone domestically. But the report found the vast majority of the public unresisting to some form of water recycling, especially in rural situations.

'Getting rid of the outfall would probably depend on moving towards potable reuse,' says Peter Scott, Melbourne Water's Manager of Science and Technology. 'And that's a long time down the track. It would not be acceptable with the community at present, but may be in 30-40 years.'

Bill Pemberton, a scientist representing Surfrider Foundation during the consultation process, agrees. 'In 30 years time, people are going to be a lot more educated about these things,' he says.

Noticeably absent from the CSIRO list of recommendations was a call to extend the outfall. Although this would solve the problem of the platform's ecosystem, the $26 to $46 million it would cost to create an extension could be better spent on water recycling. Unfortunately the CSIRO study could not identify any significant opportunities to reuse effluent in the short term.

The CSIRO study recommended that a nitrification/denitrification process should be incorporated at the Eastern Treatment Plant to reduce ammonia levels in the effluent. As well as helping to restore the Boags Rock's ecosystem, this would bring the plant's output a step closer to drinkable reuse.

Effluent alternatives

THE CSIRO study looked at 14 alternative uses for the effluent discharged at Boags Rocks. Here are some of the options and findings.

Water demand management: Encouraging people to use less water is an inexpensive means of reducing effluent. A program in Lismore, New South Wales, achieved a 25% reduction in water use.

Land irrigation: At present 1% of effluent from the Eastern Treatment Plant is used to irrigate turf and various non-edible crops. Expansion of this reuse option is constrained by a lack of commercial acceptability and rigorous government regulation. In several other locations across Australia, however, these obstacles have been overcome.

Aquifer storage: This involves pumping effluent into an existing underground supply and allowing it to seep away over time. But the use of groundwater bores as a water supply in rural areas means that the water must be treated to better than tertiary level in order to avoid contamination. This makes it uneconomic.

Diversion to the Western Treatment Plant at Werribee: This is an expensive option which would increase effluent discharge to Port Phillip Bay unless reuse of effluent in the region is increased.

Indirect potable reuse: The need for an ocean outfall could be eliminated by treating the water to a potable quality and pumping it back up to Cardinia Reservoir south-east of Melbourne where it would be mixed with water harvested from the pristine catchments. The big problem here is a negative public perception to the concept of drinking our waste water, but with education this can be changed. In the Texas town of El Paso in the United States, residents have been drinking reclaimed water since 1985. In Australia, unplanned indirect potable reuse has been occurring along major rivers where towns discharge effluent into the river, which is used as water supply for towns further downstream.

Woodlot irrigation: In Victoria alone, waste water feeds woodlots in Melbourne, Mildura, Portarlington, Winchelsea and Tatura. While this option is being used all over the world, building a woodlot in the vicinity of the Eastern Treatment Plant would be difficult given the high land values near the plant and along the path of the outfall.

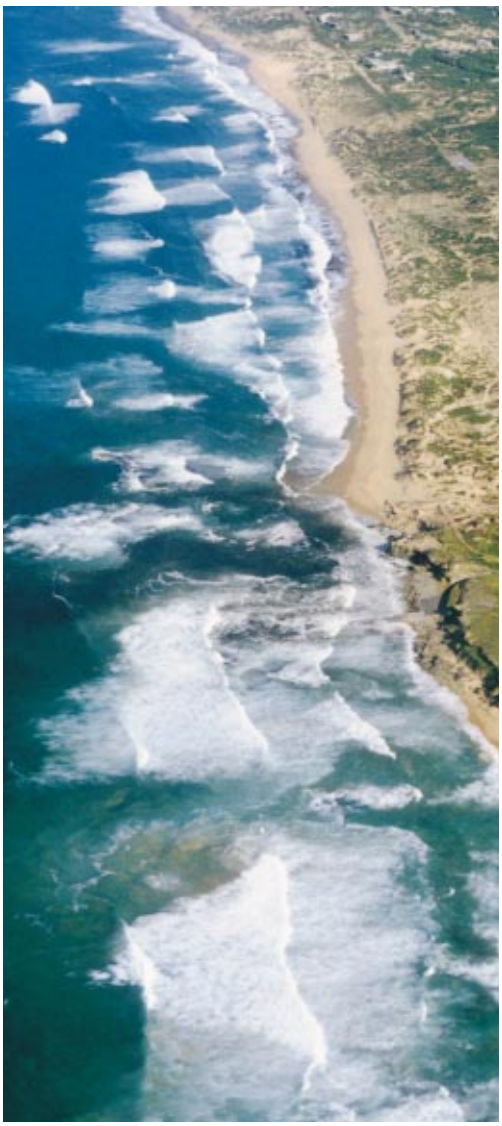
Constructed wetlands: Odour problems and health risks are associated with wetlands in populated areas. Also, leakage could occur in a storm.

Non-potable reuse: By building a third pipe into urban or developing suburban areas, non-potable water could be recycled for gardening and toilet flushing. The cost is moderate and volume reduction is high, but sanitation would require much attention. A number of newer urban developments in Australia have dual pipe systems providing potable and non-potable water (Wagga Wagga and Rouse Hill in New South Wales).

Detention basins and sewer mining with local reuse: Sewer mining entails tapping into sewer pipes and using the water for urban watering of ovals and parks. Detention basins which act as temporary storages to avoid sewer overflows can also be used as storage sources for urban watering. To reduce the public health risk, small treatment plants and disinfection units may be required, making this option expensive.

Sewer inflow/infiltration reduction: Inflow occurs in areas where due to poor drainage, guttering and storm water systems are illegally connected to sewers. Also, old sewer pipes crack, taking on water and manhole covers are rarely water-tight which leads to infiltration of stormwater in periods of wet weather. Increased maintenance of the sewerage system and plumbing standards would assist in reducing these two problems.

Untreated or treated grey water use: Sink and shower water can be reused to flush toilets and garden watering. Untreated grey water still involves some sanitation issues which could be cleared up by installing disinfection units, but the process then becomes uneconomic.



The ocean outfall at Boags Rocks. Increased wastewater recycling may enable the phasing out of such effluent disposal systems.

'Extending the outfall will save one platform,' Molloy says. 'But does it hide the issue? If you extend it, does that mean you won't do anything in the future? That's what Melbourne Water is in the process of figuring out.'

A major factor in Melbourne Water's course of action will be the EPA's input. Although the EPA hasn't officially been handed Melbourne Water's strategy, Brian Robinson feels that the short-term solution of extending the outfall is every bit as important as the long-term recommendations. 'You get a 30-year investment out of (extending the outfall),' Robinson says. 'You can't ignore the short term as you sit around and wait for the long term solutions to become feasible.'

Once the EPA makes a formal decision, Melbourne Water will take the outfall into the next millennium. 'We've come to a view that we endorse the CSIRO recommendations,' Scott says. 'The issue has to go to the EPA and it's up to them as to what sort of licence restriction they put on us. They have to make some decision, and that will drive us one way or another.'

Meanwhile, concerned groups hope that whatever decision is made, it will be a responsible one. 'What we want is not for Melbourne Water to just take on what the CSIRO is saying,' Pemberton, says. 'We'd like to see a more visionary approach: to put in the infrastructure now that will some day make this water reusable as drinking water, or for reinvigorating rivers. Of course, that'll take a couple of decades. But that means it will be ready in 30 years time, when Melbourne runs out of water.'

More about effluent management

Dingle AE and Rasmussen C (1991) *Vital Connections, Melbourne and its Board of Works*, 1891–1991. McPhee Gribble, Melbourne.

Newell B and Molloy R (1999) Effluent Management Study Eastern Treatment Plant. Environmental Impact Assessment and Review of Effluent Disposal Options. Melbourne Water Corporation.

Abstract: A study by CSIRO's Environmental Projects Office has found that ammonia released at the Boags Rocks ocean outfall, which disposes 40% of Melbourne's wastewater, has a damaging effect on the local ecosystem. The study involved an environmental impact assessment and an effluent management plan, and community consultation. It recommended the incorporation of a nitrification/denitrification process at the Eastern Treatment Plant to reduce ammonia levels in the effluent. As well as helping to restore the Boags Rock's ecosystem, this would bring the plant's output closer to potable reuse. The study also concluded that Melbourne Water should investigate long-term options for increasing effluent reuse.

Keywords: wastewater; effluents; effluent discharge; sewage treatment; water recycling; environmental impact; Boags Rocks, Vic.

No single solution for ongoing issue of waste

IMPROVING the efficiency and sustainability of water-use practices in Australian cities is a goal of CSIRO's Urban Water Program.

The program examines technical and managerial alternatives to Australia's existing water systems, and models their potential social impacts. Program director, Andrew Speers, says there is no one answer to wastewater management.

'I'm not convinced that a blanket solution such as discharging to land is better (than to waterways),' he says. 'You can ruin terrestrial environments by inappropriate practices just as you can ruin aquatic environments.

'As long we produce waste – even if it is just natural human wastes – we have to discharge somewhere. There is going to be an impact on the environment, and matching the decisions with the conditions is what's critical.'

Each of the major urban water companies faces a unique set of circumstances. In Adelaide, for example, dry conditions and the impact of abstractions on aquifers and surface water has led to a decision to construct a water re-use system for irrigation and experimentation with artificial recharge of aquifers with stormwater. Speers says this would not necessarily be the best response in other cities where markets for reuse water are more limited and aquifers are unavailable.

In Sydney, deep-ocean outfalls at Bondi, North Head and Malabar were cliff-face outfalls until 1990/1991. While the new facilities are far superior, there is still room for improvement, according to Speers. For example, the major coastal plants – North Head, Bondi and Malabar – are being upgraded to increase solid and grease capture.

At Perth, wastewater is discharged into Cockburn Sound, and 35% of that is only primary treated. Only 60% of Perth's urban, commercial and industrial developments have sewerage system, a situation not dissimilar to Melbourne before the Eastern Treatment Plant was built in the 1970s. Much of the population relies on septic tanks.

Canberra's wastewater treatment is very effective. The 90 million litres of treated effluent that flow into the Murrumbidgee each day is so clean that the Lower Molongo Water Quality Control Centre has been given an extended license. Usually, companies handling wastewater have to renegotiate licences annually.