Don’t waste our wastewater

Everyday, the water we use in our homes flows down sewerage pipes underground to be treated before being released into our oceans and rivers. Far from being ‘waste’, this water can be recycled for a variety of uses, saving precious drinking water and relieving the burden on our aquatic environments.

No one has even added up the total amount of this ‘waste’ water or ‘effluent’ that is discharged from our towns. There are two annual studies that cover three quarters of Australia’s population living in towns of more than 10,000 people (ABS, 2002). In 2000/2001 urban areas discharged more than 1.75 million ML of treated wastewater to our rivers or oceans (WSAA, 2001 & AWA, 2002). Including Tasmania and our smaller towns, the amount discharged is something more than 2.3 million ML (DPIWE, 2002).

This is about 10% of the total amount of water used across Australia, which is just over 22 million ML (ABS, 2000).

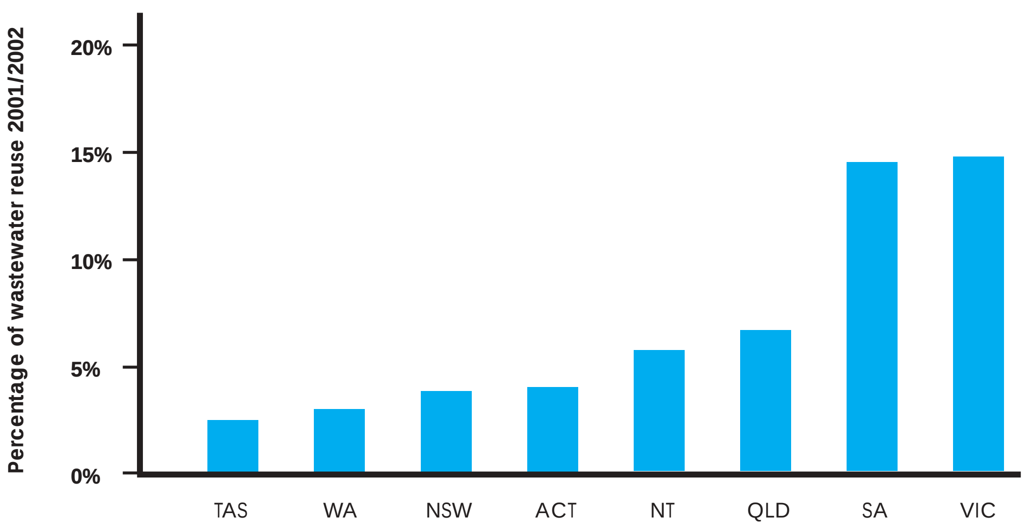
Recycling our effluent is not a new concept. Back in 1915, Walter Burley Griffin, who planned our national capital, said that Canberra could ‘drought proof’ the urban landscape by irrigating with recycled wastewater drawn from sewerage treatment plants (Weirick, 2003). In 1972 another innovative thinker, Francis Sutton of the Central Coast in NSW, detailed a plan to collect the wastewater from the Central Coast region and pump it inland for treatment, storage and reuse.

Many towns recycle most of their wastewater, though nation-wide the figure is just over 9% of wastewater that gets recycled (WSAA, 2001 & AWA, 2002 & DPIWE, 2002).

In Monterey County in California, 4,800 hectares of food crops, such as artichokes, celery and lettuce, are irrigated with treated effluent. This project has been underway since 1998 and uses more than 9,000ML per year. (Israel, 2001)

For the major urban areas the average reuse figure is 7.8%. Some water authorities are doing well; in Victoria, Goulburn Valley Water (centred around Shepparton) recycles 68% of its wastewater, and Coliban Water (centred around Bendigo) recycles 39% (WSAA, 2001). In volume, Melbourne Water recycles the most in Australia with almost 65,000ML per year, Goulburn Valley Water comes second with almost 10,300ML per year; Sydney Water, which collects more than 511,000ML per year, manages to recycle just over 9,700ML (WSAA, 2001).

figure 34 - Effluent reuse by states (Source: WSAA, 2001 & AWA, 2002 & DPIWE, 2002)



Other countries recycle far more:

- Israel (which is mostly arid and about one third the size of Tasmania) recycles 70% of its effluent through about 160 reservoirs, mainly for agriculture (Israeli Govt, 1999).
- The Hashemite Kingdom of Jordan and the Kingdom of Saudi Arabia have a national policy to reuse all treated wastewater effluents and have already made considerable progress towards this end (Pescod, 1992).
- In China, sewage use in agriculture has developed rapidly since 1958 and now over 1.33 million hectares are irrigated with sewage effluent (Pescod, 1992).

Our reclaimed water can be used for a range of applications such as irrigation of parks and gardens, agriculture, growing trees, aquaculture and industrial uses (NWQMS, 1997).

Toowoomba (Fullerton, 2001), Muswellbrook and Orange Councils currently supply recycled water to local mines for dust control and washing purposes (NSW EPA, 2002). In the Hunter Valley, all the wastewater from the Dora Creek treatment facility is used by the Eraring Power Station (NSW EPA, 1995).

Treated wastewater is usually pumped from a treatment facility and delivered to the area of use. A significant cost of water recycling schemes is the pipeline construction and pumping costs.

Wastewater reuse can also be undertaken at the household scale. The wastewater from a house can be treated on site and used on the garden. 'EnviroCycle', 'Biocycle', 'Techtreat', and 'Supertreat' are examples of products using new technologies that are available for household and business premises use. They are efficient treatment systems that treat the wastewater and make it suitable for irrigation (Macq Uni, 2001).

The wastewater treatment project in Virginia, South Australia, where market gardeners are growing vegetables using treated wastewater effluent from Adelaide. Last year they used almost 10 billion litres of water. Leading farmers in the area believe they will double production over the next decade supporting both the local South Australian market as well as exports. (Dillon, 2000)

Sydney Water intends to build a 50km recycled water pipeline from Glenfield to Malabar at a cost of a $146 million. The project has the potential to deliver more than 18,500ML per year of highly treated recycled water for use by industries and manufacturers, as well as for irrigating parks and golf courses and for toilet flushing and gardens in new housing developments. (SWC, 2003a)

figure 35 - Irrigation effluent at Virginia, South Australia (News Ltd)

A treatment facility described as "the biggest water re-use plant of its type in Australia" is being built in Perth to supply key industries in Kwinana. The scheme, costing almost $25 million, has the potential to supply 5,000ML per year. (WA Govt, 2003)

Dry low density cities such as Perth, Adelaide and Canberra, have large potential to increase their effluent reuse through irrigation of parks and gardens. In most cases these are currently watered using freshwater. In wetter cities such as Sydney and Melbourne, the big potential for effluent reuse is in industries and nearby agriculture. (Dillon, 2000)

While effluent flows every day, irrigation water is only required some of the time (for example, not when it's raining). This means the effluent would need to be stored, either in aquifers or surface dams, and pumped when necessary. For reclaimed water to be cost-effective for irrigators, the agriculture would need to be fairly close to the treatment plant, otherwise the cost of pumping would make the water too expensive. Many industrial processes, on the other hand, need water every day.

It has been suggested that reclaimed water from Sydney, the Central Coast and the Hunter could be

Regional Australia boasts some of the highest proportions of water reuse: the East Gippsland, Goulburn, Albury, Dubbo, Narrabri and Brighton water utilities are already achieving up to 100% reuse of wastewater (Dillon, 2002).

figure 36 - Farm forestry eucalypt plantation irrigated with effluent (HWC)

pumped over the Great Divide, for purposes such as mining, viticulture and farming practices (ECES, 2002).

Combined, the Sydney, Central Coast and lower Hunter regions recycle 2.4% of their wastewater and discharge more than 587,000ML of water each year, mainly to the ocean. The vast majority of this, (about 500,000ML), flows down to the Sydney coast, at North Head, Bondi and Malabar. Pumping it over the Great Divide would mean pumping it about 200km, and more than 1,000 metres high (from near sea level to past the high point at Blackheath or Mount Victoria in the Blue Mountains). The cost of the electricity for pumping, ignoring capital costs to build a distribution system, would be far in excess of the price the water. Overall, the proposal is very expensive. Local reuse makes better economic and environmental sense.

Issues

Reclaiming the water from our wastewater and reusing it where it is needed can have many environmental benefits. The reclaimed water can be used instead of freshwater and that means less water needs to be taken from our rivers and streams.

The Rouse Hill Recycled Water Area in Sydney is a housing development that has a dual-reticulated system, a water supply system for recycled water and one for drinking water. The recycled water is used for toilet flushing and outdoor use and is distinguished by lilac coloured taps (SWC, 2003b). The scheme, which was opened on 31 August 2001, has resulted in about 255 ML/year of recycled water flowing to 4,500 homes in the area, reducing these households' demand for drinking water (SWC, 2002a).

Using reclaimed water also means less water leaves the treatment facilities to end up in ocean outfalls or our river systems. For example, the Commonwealth Government has estimated that in 1999/2000, treatment facilities discharged 2,500 tonnes of phosphorus and 8,500 tonnes of nitrogen into Port Phillip Bay; Botany Bay didn't fair much better receiving 1,300 tonnes of phosphorus and 7,600 tonnes of nitrogen (C'wealth SoE, 2001).

The reclaimed water may contain low levels of nitrogen and phosphorus and this could mean that farmers would need less fertiliser.

Colin, Lloyd and Bruce Slape have carried out trials on their dairy farm at Riverton in South Australia into ways that they can utilise shed effluent and manures, while at the same time minimising soil and water pollution. They found that manure and effluent could totally replace bag fertiliser - "These [trial] results have given us the confidence to substitute bagged fertiliser with effluent and manure on our cereal crops," said Lloyd Slape. (Dairyfarmers, 2000)

There are potential problems with using reclaimed water. National guidelines have been developed for the use of reclaimed water that set standards for water quality, the level of treatment, safeguards and controls, and monitoring (NWQMS, 1997). State agencies have also developed guideline documents.

The effluent needs to be treated to a standard that is suited for its use. There are many factors that affect suitability, such as the irrigation method, the crop being grown, the nature of the soil and the possibility of direct human contact. For example, spray irrigation may require a higher standard of treatment than trickle irrigation; some industrial processes require a higher standard than drinking water.

To date, reuse in Australia has apparently been unimpeded by health or environmental incidents, and public acceptance has been high (Dillon, 2000).

The cost of reclaimed water depends on the quality of treatment, the pipes needed and the distance it needs to be pumped. Some water authorities discount the cost of recycling water to offset the benefits of water saving on future augmentation works.

In Sydney, where drinking water prices are about $0.94 per kilolitre, Rouse Hill residents pay $0.275 per kilolitre for their reclaimed water (SWC, 2002b).

Two thousand residences in the suburb of Newington have reclaimed water from an extension of the scheme that has been in use at the Olympic venues since before the 2000 Olympics. Residents pay about 15 cents per kilolitre less than drinking water or $0.79 per kilolitre (SOPA, 2001).

In Perth, the water authority says that the cost to treat and transport the reclaimed water to its point of use could be significant - anything from $0.50 per kilolitre to more than $2 per kilolitre. This contrasts starkly with groundwater, which is available to much of the city for between $0.05 and $0.10 per kilolitre. (WAWC, 2003)

In Victoria, Melbourne Water sells reclaimed water for $0.27 per kilolitre while South East Water provides reclaimed water free. Western Water sells reclaimed water at $0.28 per kilolitre while Barwon Water has a policy to sell reclaimed water at one third of the rate of potable supplies (making it currently $0.23 per kilolitre). (MW, 2001)

A scheme to pump Sydney's wastewater over the Great Divide would cost much more than $600 million to build and more than $300 million to run each year. The cost of the reclaimed water would be more than $700/ML. (HWA, 2003)

On the inland sides of the Great Divide, the current cost of water pumped from rivers for agriculture is less than $10/ML (IPART, 2001). Pumping a large volume a long way is very costly; if the reclaimed water can be used close to the treatment facility it becomes a more attractive proposition.

A final comment...

We're disposing into our rivers and oceans more than 2.3 million ML of wastewater effluent each year. Local schemes to recycle this water need to be looked at and implemented where it makes good social sense to do so.

figure 37 - Spray irrigation of treated effluent (HWC)

Don't waste our rainwater

"The city should have within its defence walls water from natural sources, in adequate quantities, or, if that is not possible, big storage tanks to collect water from rain, particularly in times of siege…
If water is scarce, or if there is a variety of water quality, it is advisable to separate the drinking water from the other waters which can cover other needs"
Aristotle

Approximately 83% of Australians live within 50km by road from the coast (ABS, 2002). Most of these coastal areas receive more than 1,000mm per year in annual rainfall (BOM, 2003). Before our towns developed, rainfall would be absorbed by vegetation, soak into groundwater or meander into creeks and rivers. Now it falls on the roads, carparks, roofs and footpaths and rushes away, usually in pipes or concrete channels to the nearest creek, river or ocean.

It has been estimated that 5 million ML per year of stormwater is piped out of our towns and cities (HWA, 2003). While much of this is needed for our downstream ecosystems, there is a potential to reuse some of the flow.

This rainwater could be captured as close as possible to where it is to be used and be stored in the ground (in an 'aquifer'), in ponds and basins or in underground tanks. It could be used to irrigate parks, sports ovals, golf courses and gardens as well as for flushing toilets and industrial uses.

According to the Australian Bureau of Statistics, we use just over 1.8 million ML in our homes each year (ABS, 2000). While the amount used on gardens and for toilet flushing varies depending on rainfall, temperature, garden type and toilet type, something more than 55% of the household consumption is likely to go on the garden or down the toilet. This is about 1 million ML of freshwater per year. Stormwater can be used for these purposes (HWA, 2003).

An additional 1 million ML of freshwater is used in our towns and cities to irrigate sporting fields and parks and for manufacturing (ABS, 2000). Replacing some of this 2 million ML with stormwater would not only save extracting freshwater from the rivers and aquifers, but would save the cost of treating and piping it long distances into our towns and cities.

Stormwater can also be 'shandied' with treated wastewater effluent for reuse, optimising both reuse applications.

Local communities could manage and control the stormwater reuse. It has been suggested that this will only be achieved through designing urban stormwater systems to be features within the urban landscape and

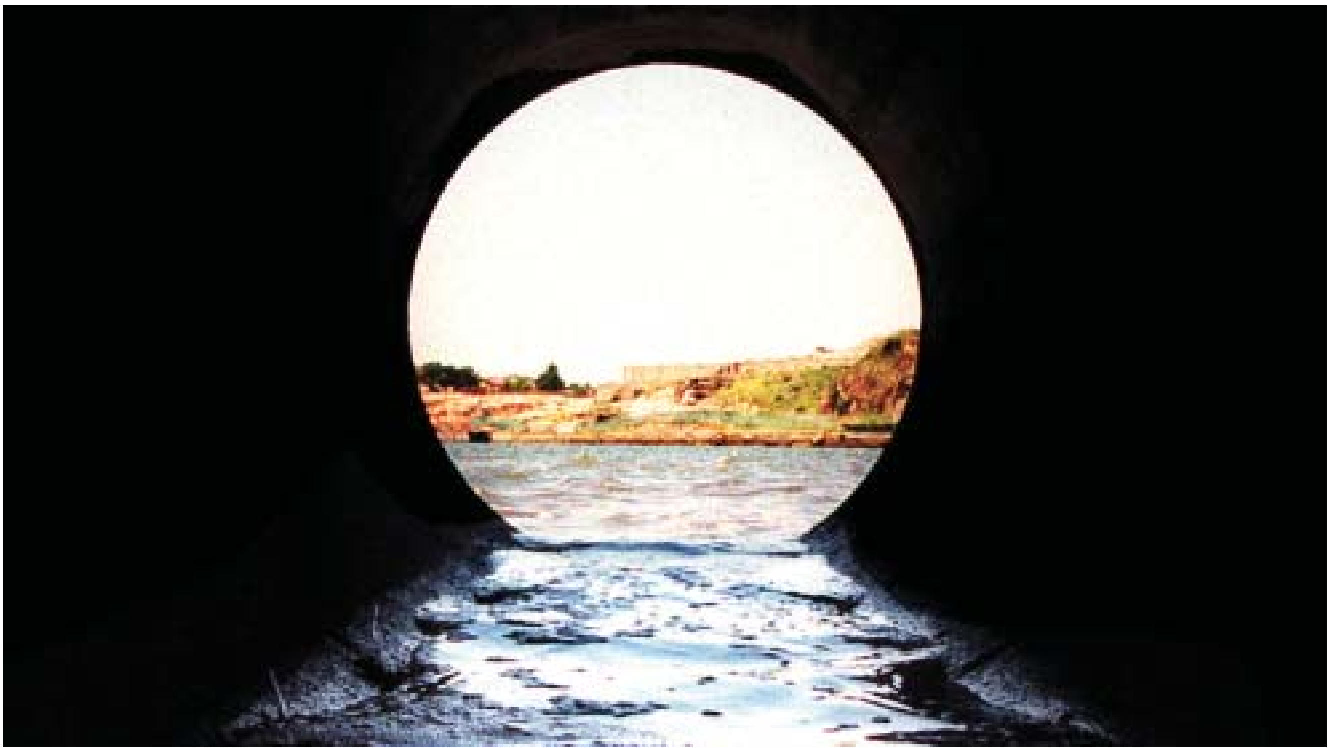


figure 38 - Interior of Sydney Harbour stormwater drain at Birchgrove (News Ltd)

Sydney Olympic Park

The Sydney Olympic Park was designed to save more than 850 million litres of drinking water annually through reuse of stormwater and wastewater effluent. Water is reclaimed from the sewer in Newington and the Sydney Olympic Park and treated at a small facility on the western side of Stadium Australia. Recycled water is then used primarily for flushing toilets, including during the Olympics. Every home in Newington has two water meters, one green for normal drinking water and the other purple, recording recycled water use. In the Games period, 100ML of recycled water was used across Sydney Olympic Park, primarily for toilet flushing. This compares with 122ML of drinking water delivered to customers across Sydney Olympic Park. (SOPA, 2001).

by promoting the inherent values of stormwater, such as ecological, aesthetic, recreation and education. (Wong T & Mein R, 2001)

In Manly, a street has been retrofitted with pervious sub-grade and pavers that allow rainwater to infiltrate and recharge the aquifer. The beachside parking in Manly collects stormwater, treats it and then stores it for reuse to be reused for irrigation of the historic Norfolk Pines at North Steyne. This has also reduced the amount of stormwater pollutants entering the beach. (Manly Council, 2003)

The stormwater reuse system could have benefits in addition to the water savings by integrating it into the landscape. Uses such as wildlife habitat, public open space, recreational and visual amenity as well as natural systems to improve the water quality can be incorporated by 'water sensitive urban design'.

Issues

Storing and reusing our stormwater has many benefits for the environment. Most of the current stormwater systems do not treat the water before it reaches our oceans, and it may contain rubbish, paints, oil and other street refuse. Storing and reusing our stormwater will reduce pollution in our oceans and waterways. It would also mean that we need smaller drains.

Stormwater, in the form of 'flash floods', can cause erosion of creeks and downstream flooding. This would be reduced if stormwater were stored for reuse. It would also be reduced if we had natural creeks instead of concrete-lined channels.

Using rainwater captured locally instead of freshwater piped in minimises the need to build additional water supply infrastructure (pipes, pumps, dams and water treatment facilities) with increasing populations.

The amount of stormwater captured for reuse would need to be mindful of the downstream waterways - many ecosystems rely on flood flows. However, by paving our towns and cities we have increased the speed with which these flows enter our waterways. Allowing more to infiltrate into the ground is a way of restoring the amount of water that would be getting into our soils.

If 10% (200,000ML each year) of urban water use could be harvested from stormwater, then it could be used instead of our treated freshwater. Councils and developers have already started reusing stormwater.

A recent study by Brisbane City Council, a local developer and the CSIRO found that the recycling of stormwater had considerable capital cost savings and considerably better overall environmental outcomes that can be achieved using water efficiency measures and application of water recycling in the local area (WSAA, 2002).

In Tasmania

In Tasmania, local Councils are starting to reuse their stormwater. Brighton Council is collecting stormwater at Bridgewater and diverting it for irrigation to farm lots (Tas DPIWE, 2003). Clarence City Council has constructed an artificial wetland to treat stormwater before it enters Kangaroo Bay. The wetland includes two gross pollutant traps on key stormwater drains upstream of a 5.5ML wetland. Up to 10% of the annual flow from the wetland will be reused to Irrigate the Rosny Golf Course (Tas NHT, 2003).

Whyalla in South Australia on the western shores of the Upper Spencer Gulf generates 1,200ML of stormwater each year, which is discharged to the sea. A study was undertaken which identified 8 potential dam sites across the city, which would yield useful amounts of stormwater. It was also estimated that by utilising stormwater, Council could deliver stormwater to parks and other users for $0.70/kL (Whyalla City Council, 2002). The current price for water is $0.40/kL for the first 125 kilolitres and then $0.97/kL (SA Water, 2002).

A final comment...

We have the opportunity in future decades to save up to 10% of our freshwater consumption by using stormwater to water our gardens, flush our toilets and provide water for our industries. It makes most economic sense when it is investigated for new developments and redevelopments of large urban sites.

Don’t waste our house water

All of the water we use and ‘throw away’ in our kitchens, bathrooms and laundry could be recycled and reused to water our gardens and flush our toilets. This water, called ‘greywater’ needs little or no treatment before it can be used for a variety of purposes. Currently, greywater is merged with our toilet waste or ‘black water’, which needs a high level of treatment at the central processing plant. By separating and reusing our greywater, we save treatment costs and precious drinking water.

Greywater accounts for approximately 45% of water used by households, or about 82,000 million ML per year. Greywater can be used for many purposes, such as irrigation for gardens and toilet flushing. About 1 million ML of freshwater is used per year on the backyard garden or for toilet flushing, which could be substituted by our greywater. (ABS, 2000)

Many people who are not on sewer systems practice greywater reuse daily to save water. Tipping washing water on the garden is one simple example of greywater reuse that we all can do.

Greywater reuse systems vary from small personal systems to new central treatment systems. In the home, apart from the manual ‘bucketing’ of water onto the garden normally in dry times, simple systems can be installed that screen oils, greases and solids from the greywater via small trench systems (WA Department of Health, 2002). Figure 39 pictures a simple backyard system using a planter box to filter the greywater before reuse.

Greywater reuse systems can be produced on a large scale for whole towns or neighbourhoods. A recent report by the CSIRO assessed different scales of greywater recycling systems for their cost effectiveness. Five options were analysed, ranging from 12 through to 120,000 households. This option involves a separate pipe system to transfer greywater to a local treatment plant, where it is returned to the houses to be used in gardens, for toilet flushing and laundry. The optimum range fell somewhere between 1200 and 12,000 households connected to the same system. The estimated costs compared favourably with the cost of drinking water delivered to most homes in Australian cities. This doesn’t take into account the positive environmental effects of less demand on drinking water and on the sewage treatment facility. (CSIRO, 2000)

In the ACT a model for greywater reuse has been established. Aerobically processing all shower, bath and laundry water for 70 residential units, the greywater is filtered, then biologically treated for 6 days in a tank. It then passes through a sand filter bed removing particles that may clog the on-site sub surface irrigation system. Depending on need, it is used straight away or held in a 120,000 litre underground storage tank for later usage. To keep the water fresh, it is recirculated over a small waterfall and through a subsurface wetland where reeds and rushes also assist in removing excess nutrients from the water. (Integrated Eco-Villages, 2003)

Sustainable City Living

Sydney man Michael Mobbs installed an independent grey-water reuse system in his sustainable terrace house. The water recycling and sewerage disposal system in the small terrace house processes around 100,000 litres of sewage each year, preventing it from entering the Pacific Ocean.

All the dirty water from the house (toilet, shower, bath, dishwasher, washing machine, sinks and tubs) drains into a single sewer pipe that empties into an underground concrete tank. Food scraps and other biodegradable waste (both theirs and the neighbours), are added through a hatch in the deck. The water exiting the other end of the tank is clean enough to be reused in the house as grey water to flush toilets, wash clothes and water the garden. Any excess overflows into a dry reed bed. (ABC, 1998)

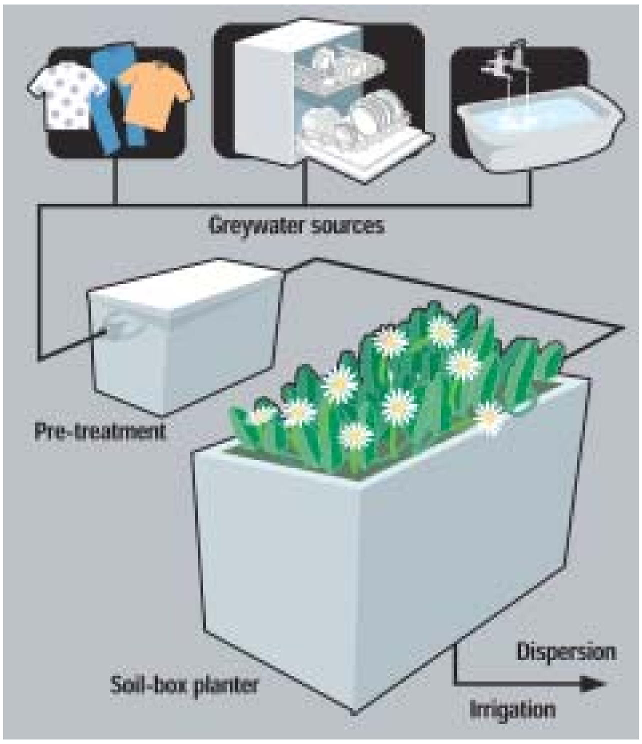


figure 39 - A household greywater system
(Carl Lindstrom, adapted by News Ltd)

Issues

Recycling water is just as important as saving water. Reusing water from our homes would save 4% of fresh water needed in our natural ecosystems to maintain river ecology and for uses which require pure water.

The use of greywater does require proper management to ensure there are no unacceptable environmental effects or health risks to people. Greywater contains bacteria that may include disease-causing organisms. Care needs to be taken to ensure there is no possibility of connecting greywater to the drinking water supply.

Greywater also contains a number of pollutants including organic matter, nutrients, salts and detergents. These pollutants can damage the environment if greywater is not recycled responsibly.

Recycling our water will make us more conscious of what we put down the sink, thereby encouraging more environmentally friendly products and practices.

Health regulations differ in each state in regards to greywater reuse, however all states require permission to install a personal greywater reuse system.

Less energy and chemicals are used if a greywater reuse system is installed due to the reduced amount of both freshwater and wastewater that needs pumping and treatment. For those providing their own water or electricity, the advantage of a reduced burden on the infrastructure is felt directly. (Lindstrom, 2000)

Households could almost halve their water usage from public systems by recycling greywater. The amount of water available will vary according to use. For example the total volume of greywater potentially available each day from the average Queensland household is 356 litres, representing 60% of the total wastewater generated (Emmerson, 1998).

Cutting water usage also delivers cost savings to water authorities. Reducing mains water consumption helps to defer the construction of very expensive dams (Yarra Valley Water, 2003). In Victoria, water conservation measures have resulted in a present day saving of approximately $75 million on capital works for Melbourne alone (Emmerson, 1998).

Greywater systems could be incorporated into new housing developments with little additional cost (Emmerson, 1998). Greywater systems can be installed in a home for a couple of thousand dollars (ECO Design Sustainable Housing, 2003).

A final comment...

We have the opportunity to almost halve our household water usage by using greywater to water our gardens and flush our toilets. The place to start is with new developments where it makes economic sense to do so.

Treat our wastewater where it is needed

Recycling wastewater usually means piping it to a central treatment plant where it is treated and piped back to where it can be used. One option for reducing energy costs of pumping is by treating wastewater on the site you intend to use it. This process has become known as 'sewer mining'.

Fencepost received several suggestions for sewer mining. Tony Dight and John Springbett of Sydney particularly saw potential for use in the 200 or more golf clubs in Sydney which usually sit directly over sewer mains, and which use up to 4ML of drinking water per day to keep their greens green.

Urban wastewater comes from waters released from households, commercial facilities and industries. Household wastewater is more than 99% water because by far the greatest volume comes from showers, baths and washing machines. The average person produces 200 litres of wastewater every day, which usually is returned to rivers or oceans (WAWC, 2003). This scheme treats and reintroduces the water back to the water cycle on-site while saving high quality drinking water.

Sewer mining involves tapping into a sewer main upstream of a treatment plant and extracting wastewater to be treated in a small on-site treatment plant for nearby use. Resulting sludge is returned to the sewer for further processing. Reclaimed water can be used wherever drinking water is not required; to irrigate playing fields, municipal parks, gardens, pastures and orchards. If there has been rain, the sewer mining facility can leave the wastewater to continue to flow to the central treatment plant. Sewer mining is now being used by an increasing number of water authorities.

figure 40 - Southwell Park sewer mining treatment plant (photo courtesy of ACTEW)

At Southwell Park in the ACT, wastewater is extracted from a sewer and treated to a high quality for irrigation use. Within a short distance of Canberra CBD, surrounded by residential and motel development, this on-site treatment plant has been in operation since 1995 for the purpose of irrigating surrounding playing fields with treated wastewater. The project cost was approximately $2.4 million and it has an annual operating cost of about $100,000. It has a plant productivity of 300kL but it can be operated up to 600kL without compromising health guidelines. (Environment Directory, 2003)

Melbourne is looking towards expanding sewer mining as a way of water conservation and recycling. Cranbourne sewer mining facility near Melbourne has been in operation since 1974. The average daily flow is 1,300kL, all of which is used for irrigation and other purposes (South East Water, 2000).

Melbourne Water trialled a sewer mining system in the Kings Domain gardens in 2002. The 'small footprint' plant was housed in a portable shipping container and delivered 30,000 litres of high quality recycled water every day. The plant used 18kW of electricity at a cost of $1.80 per hour. (MW, 2002) A sewer mining plant in Melbourne to irrigate gardens and grounds is scheduled to become operational in 2004. Known as a 'Multiple Water Reuse' technology, the plant will produce 100,000 litres a day of clean water from Melbourne's sewer at a cost expected to be similar or less than potable water in Melbourne. (CRC WMPC, 2003)

On-site treatment plants are relatively small, and fully self-contained with odour and noise management with minimal impact on the surrounding environment (George et al, 2003).

Proper sewer mining requires that the treatment process used must be capable of meeting the specific water quality standards for the intended use. There are detailed guidelines, regulations, standards and codes of practice in place relating to different uses of recycled water aimed at safeguarding public health and the environment.

Issues

At present, Sydney releases over one billion litres of treated wastewater a day into rivers and the ocean (NCCNSW, 2000). Other Australian cities have lower volume releases. More of this could be used on-site to irrigate parks, gardens, playing fields, golf courses etc. This would save water taken from rivers and save costs of treating and distributing through the system

Diverting water away from the sewer prevents it from being discharged into our waterways, thereby reducing impacts on receiving water environments, such as increased nutrients, which can lead to algal blooms. These waterways are often used for recreation or downstream as a source of water.

Treating wastewater at the source reduces energy costs of pumping treated effluent from the centralised treatment plant back to the site for re-use. It alleviates the need for a separate pipe system to be constructed to pump treated effluent to where it can be used. It also allows waste sludge to be returned straight into the sewer main to the wastewater treatment plant. The energy requirements for a sewer mining process are proportionally the same as a central treatment plant (HWA, 2003).

Based on recent surveys, the amount of wastewater effluent that is discharged from our towns and cities each year is something more than 2.3 million ML (WSAA, 2001 & AWA, 2002 & Tas DPIWE, 2002). Some of this water could be treated and reused locally. A feasibility study commissioned by Melbourne Water last year looked into the option of sewer mining as an irrigation water source for a cluster of golf clubs. The clubs usually use between 0.5ML and 1ML per day in summer to keep their fairways green. A treatment plant to provide 0.8ML a day for a single golf club will mean a cost of approximately $1,800/ML for water supplied to the 'front gate'. Alternatively, a 2.5ML/day plant to supply a cluster of golf clubs will cost approximately $1,200/ML. There will be some additional costs associated with actually piping the recycled water from the trunk sewer to the property boundary but this will be on a case-by-case basis. (George et al, 2003)

This cost was in comparison to the option of reusing wastewater from the central treatment plant, which would cost between $650/ML and $700/ML. However, the capital costs of this system would be greater at $6 million to $6.5 million compared with the $2.4 million at the Southwell facility in the ACT. The current 'winter' price for water to the golf clubs in Melbourne through the normal system is $780/ML. (George et al, 2003).

A final comment...

Treating wastewater where it is needed is increasingly being used by water utilities, usually in conjunction with a wastewater recycling system. For particular uses in urban or town settings, it is a sensible water saving strategy.

figure 41 - Trial sewer mining site at Windsor, NSW (CRC for Waste Management and Pollution Control)

Store our water underground for later

The idea of storing our water in times of plenty (rainy days) for use when it's needed (dry days) seems obvious. The idea of putting it underground and pumping it back out when it is needed is perhaps considered novel. The proposal encompasses options to store drinking water, stormwater or treated wastewater effluent in aquifers for later use.

A proposal sent to the *Fencepost* by Marcia Allen from Sydney involved building huge underground tunnels or drains all over Australia that would take water in flood time and pump it out in times of drought. Aquifer recharge is the same idea, storing water in the ground, except without the tunnels.

The advantages are that the groundwater can meet our water needs when it is most needed and can also be an emergency water storage (WA WRC, 2002a).

Deliberately putting water into the groundwater for later use has become known as 'Aquifer Storage and Recovery' or 'ASR'. ASR is widely practised in the United States, Israel and the Netherlands (SA DEH, 2001)

In the US, the EPA has regulated that any aquifer storage and recovery system must not endanger underground sources of drinking water, which means that the water injected into an aquifer needs to be of drinking water standard (US EPA, 2002).

A study for Wisconsin Department of Natural Resources noted that the chemical composition of the stored water, if it is different from the existing water, could induce geochemical changes to the aquifer solids as well as to the water itself. The study also noted that even the storage of drinking quality water may cause problems as a number of chemicals that occur commonly as by-products of drinking water disinfection have been demonstrated to cause cancer and other adverse effects in laboratory animals at high doses. (Bahr et al, 2002)

The American Water Works Association conducted a survey in 2001 and found that there were operational ASR systems in 15 states, with feasibility studies underway in another 6 states. The survey found that 60% of the ASR systems sourced their water from surface water, 21% from groundwater, 11% from a combination of the two and 7% was treated wastewater effluent. The storage zones were typically sandstone, limestone or sandbeds. (AWWA 2003)

figure 42 - Reedbed planting and protective bird netting at Salisbury aquifer recharge
(Stuart Lane, Salisbury City Council)

The longest operating site for stormwater recharge into an aquifer is at Mount Gambier, South Australia, which has been recharging the groundwater via drainage wells for over 100 years The drainage wells were originally constructed due to the lack of naturally developed surface drainage in the Mount Gambier area. (SA DWR, 2002)

The method of putting the water into the groundwater depends on the geology of the area. If the area is highly permeable soils (such as sand), then the water can be spread and allowed to seep into the aquifer. If the water-bearing formations are deep below ground (like the Great Artesian Basin), then injection wells are commonly used. (WA WRC, 2002a). The greatest risk associated with artificial recharge is the potential contamination of groundwater when the water used is not of suitable quality (WA WRC, 2002b).

The City of Salisbury, 25km north of Adelaide, has constructed several square kilometres of wetlands to detain floodwater, provide a recreational asset and wildlife haven and clean its stormwater. In the Parafields project, the cleaned stormwater is being used by local businesses, including a wool processing company, saving 1,100ML per year of mains water. It is intended that surplus water be injected into the underground aquifers for later extraction. (Salisbury, 2003)

In some cases it is less expensive to store water underground than to construct surface dams. A large advantage is that there are no water losses from evaporation. The existing water in a confined aquifer is also protected from pollution from overlying cities. In arid or semi-arid areas or monsoonal regions, aquifers can be recharged with surplus water in wet periods and recovered in dry periods, when the demand for water is high. (CSIRO, 2003)

Guidelines to provide a framework for protecting groundwater from contamination in Australia have been developed under the National Water Quality Management Strategy (NWQMS, 1995).

Issues

Aquifer storage of reclaimed water provides a mechanism for storage where irrigation water needs are seasonal. However, there are major potential problems with infiltration and injection of reclaimed water, particularly from clogging due to suspended solids and biofilms, and potential impacts on the quality of natural groundwater in receiving and adjacent aquifers. Due to these potential problems, further research into the economic viability of the project must be considered. (Centre for Groundwater Studies, 2002)

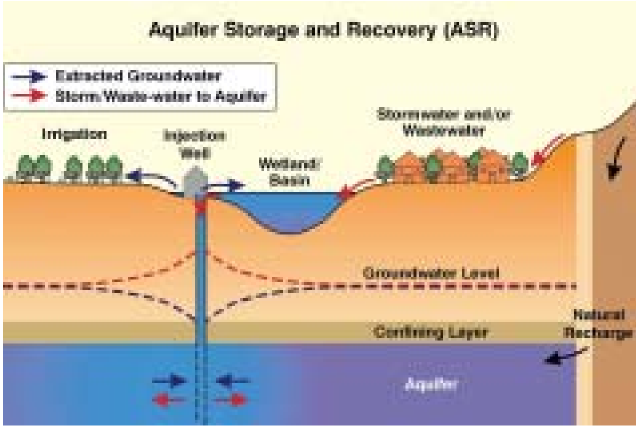


figure 43 - Aquifer recharge
(CSIRO, adapted by News Ltd)

Potential problems with aquifer storage and recovery systems can be categorised in two groups: those relating to the geology and hydrology of the aquifer and those relating to the quality of the water to be stored in the aquifer.

Potential issues relating to the geology and hydrology of the aquifer include the damage to wetlands that rely on the aquifer by disruption of normal wet and dry periods. Depending on the type of aquifer and the water level in the aquifer, the stored water may not be confined and could find its way to our rivers and marine ecosystems. If the aquifer is limestone, the injected water could dissolve the aquifer itself.

Concern has been expressed that the redirection of large amounts of stormwater runoff into shallow aquifers could result in rising water tables and infrastructure damage through water-logging (SA DWLBC, 2002).

Based on recent surveys, the amount of wastewater effluent that is discharged from our towns and cities each year is something more than 2.3 million ML (WSAA, 2001 & AWA, 2002 & Tas DPIWE, 2002). It has been estimated that 5 million ML of stormwater is piped out of our towns and cities each year (HWA, 2003). Some of this 7 million ML of water could be stored underground for later use where there are suitable aquifers available and the potential contamination issues can be managed.

The cost of pumping the water into the aquifer and back out again varies considerably depending on the aquifer depth, the amount of water to be pumped and where the water is to be pumped. An average price may be around $1/kL.

A final comment...

Storing water underground for later use may be an appropriate option, depending on the site. Strict guidelines to ensure no contamination of groundwater would need to be in place.