Evolution of a wastewater system

A Melbourne community has developed an innovative, integrated treatment system for the recycling of wastewater on-site. Keith Jesse from CERES tells us how

Many readers of *ReNew* know of CERES Community Environment Park in East Brunswick, Melbourne, home of the Alternative Technology Association's (publishers of *ReNew)* Solar Workshop. The four hectare site houses a permaculture and bush-food nursery, organic cafe, certified organic farm, demonstration eco-house, community gardens and a weekend market. CERES staff and volunteers also run numerous environmental and cultural education programs for schools, adult education workshops and festivals.

Over a decade ago CERES set the long-term goal of safely and effectively processing and reusing all the wastewater generated on-site (both grey and blackwater). We wanted a system that could be used as a model and allow us to research the multiple aspects of recycling wastewater. With the recent completion of our integrated wastewater treatment system we have come a long way towards achieving this goal.

CERES Green Technology workshop staff and volunteers reconstruct the reedbeds for the new and improved system that recycles water from the cafe and toilets.

Evolution of the system

The development of our wastewater treatment system began with the design and construction of composting toilets. Composting toilets dramatically reduce water usage and recycle valuable nutrients.

The small amount of wastewater generated by this early system—from compost leachate and hand basins—was treated in a simple absorption trench. Through capillary action the wastewater was absorbed into the biologically active layer of the soil. Citrus trees on top of the trenches soaked up excess moisture and the many nutrients (especially nitrogen).

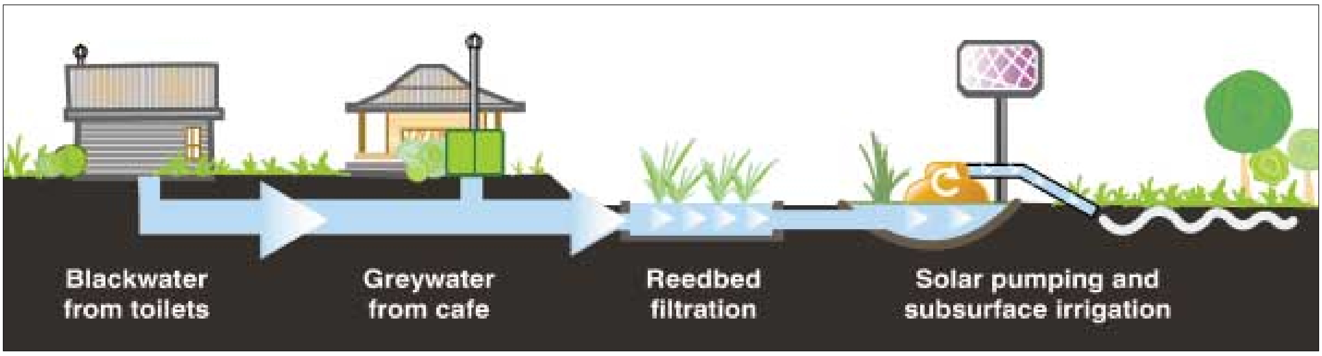
This semi-closed system suited the small volume of wastewater being generated at the time. As the numbers of visitors to CERES grew, and with a small cafe planned, it was clear that it would need to be upgraded and extended.

To treat the wastewater from the cafe a simple grease trap, small septic tank and reedbed were installed, based on a design from the Centre for Alternative Technology (CAT) in the United Kingdom. The reedbed was in turn connected to a series of lagoon-like ponds and the treated wastewater was absorbed into the soil. For many years this simple reedbed system worked well.

Need to expand

By the late nineties CERES had grown dramatically, with over 40,000 school children visiting every year, a popular cafe and a large annual festival. With an increase in waste being generated in the toilets and by the cafe, occasionally we began to notice unpleasant odours coming from the reedbed, caused by the release of ammonia and hydrogen sulphide or 'rotten egg gas'. The grease trap and septic tank failed to process and clarify the wastewater and the entry to the reedbed began to clog up with anaerobic emulsion, threatening to block the system altogether.

At this point we began experimenting with beneficial microbes to help break down the organic matter through fermentation and the production of organic acids. We found that effective micro-organisms (EM) helped clarify the wastewater in the septic tank and



reduced the smell. Not long after the introduction of EM we also had a thriving population of composting worms feasting on the organic matter on the surface of the reedbed. We had literally found some breathing space.

It was now time to redesign the whole system and to develop creative solutions to the specific site conditions and difficulties that we had already encountered. The new system also had to be compliant with Victorian Environment Protection Authority (EPA) requirements and the local council's 'septic tank' approvals.

Improving the toilets

Our first step was to get the composting toilets performing to their full potential. They were sometimes smelly and did not produce an end product that we felt completely confident in applying (sub-surface) to the garden. The large volume of urine in the compost chambers had created an anaerobic, toxic environment—just the opposite of what was needed to breed a healthy population of composting worms!

We had already discovered that compost worms love EM so we began to dose the compost chambers with a diluted solution. At the same time we introduced waterless urinals in the male toilets and improved the drainage so that most of the urine was diverted from the chambers into the wastewater treatment system.

To our surprise the odour from the toilets all but disappeared in a matter of weeks and the number of compost worms increased dramatically. Less than six months after making the modifications we had a healthy population of tens of thousands of worms and an end product of almost pure vermicast (worm poo).

Aerobic bio-filtration of cafe wastewater

The wastewater from the cafe has a high content of both soluble and insoluble organic matter. The high level of particulate organic matter and the emulsion of oils with modern detergents is especially problematic.

Our research suggested that aerobic (oxygen rich) processing would give us the best chance of breaking down these waste products. With the help of our green technology workshop staff we set about designing an aerobic bio-filter.

We built a multi-layered box from recycled plastic sheet with two columns of 'drawers' and five levels each. The top drawers act as a coarse filter, collecting most of the food scraps—up to one kilogram of insoluble organic matter a day—which are put it into a nearby compost bin.

The lower drawers contain various

The CERES designed bio-filter captures and treats the wastewater that comes from the cafe.

and flushing mechanism.

The old lagoon ponds had been difficult to manage and protect, so a new holding pond was built. The wastewater filters through the reedbed into the pond. This is the first (and last) time that the wastewater is exposed and allows for further treatment by the sun's ultraviolet light. The pond is surrounded by a cyclone fence for security and public health and safety reasons.

The wastewater accumulates in the pond before it is pumped out for subsurface irrigation. The pond also has an overflow diversion to the sewer for the (very rare) times when the pond becomes too full—several days of no direct sun, heavy rain or pump failure.

The improved reedbed filtration area and the new holding pond, the last stop for the wastewater before it is pumped out and used to irrigate the Village Green.

materials that filter the cafe wastewater by creating a 'bio-film' (bacterial coating) that breaks down soluble organic matter, such as oil, as it cascades down the drawers.

We have experimented with a number of different substances to filter the water including scoria (claimed to adsorb phosphorus), various wood chips (sacrificial source of carbon) and even recycled plastics with varying success.

The processing of insoluble organic matter has proved difficult because of the short length of time it takes for the water to go down through the layers of drawers. We are continuing in our research and monitoring to find the best material.

Improved reedbed and wetland

The original reedbed design made use of bands of increasingly fine sand through which the wastewater had to travel to reach the ponds. While problems with clogging were due to a lack of processing prior to the reedbed, we felt that the design was not sufficiently robust and was too small for the volume of wastewater.

We doubled the size of the reedbed, used coarse scoria to facilitate hydraulic flow and planted common reed (*Phragmites Australis*) on top. The new design also incorporated a full draining

Solar powered wastewater irrigation

Treating the processed wastewater as a resource, we were determined to use it for irrigation of the adjacent Village Green area to replace the use of tap water.

We coupled an active Mono Solar pump with a Netafim subsurface dripper pipe. Using only one 150 watt solar panel the Mono pump is capable of pumping many thousands of litres a day. The piping evenly distributes wastewater across the whole of the Village Green.

The solar-powered pump is capable of pumping thousands of litres of water daily into the Village Green irrigation system.

The lush, safe and healthy Village Green is a great place for CERES's younger visitors to play.

This is the 'polishing' stage in the treatment process as it effectively and safely distributes the water and nutrients to the roots of the plants. Throughout summer and in the face of water restrictions we have been the envy of many with our lush and legal lawn.

The system today

To date the system has performed beyond our expectations. The compost toilets are working well, especially with the recent addition of the female urine diverters designed by CERES Green Technology workshop staff.

The bio-filter is proving very successful in reducing the amount of organic materials in the system. It has attracted a considerable amount of interest as an alternative to the conventional grease trap and has been granted a trade waste approval certificate from Yarra Valley Water.

The reedbed looks (and smells) great and is growing a healthy crop of reeds. The holding pond now has a resident population of frogs and is a favourite stop off for a pair of black ducks.

When the sun shines the solar pump goes quietly about its business of distributing the processed water to the subsurface drippers. The Village Green truly is green and lush all year round, providing a great space for CERES events and for our many visitors.

Ongoing research

Work continues to monitor, maintain and improve the wastewater treatment system. Monitoring involves the observation of the more readily apparent biological indicators such as the health of plants and animals, odour and other visual cues.

The RMIT School of Civil and Chemical Engineering is helping to monitor key biochemical indicators including suspended solids, biochemical oxygen demand, total nitrogen and phosphorus.

CERES is committed to working with the community and a range of partners to explore the avenues and opportunities for sustainable technologies. We believe that design elements and lessons from our wastewater treatment system can be applied to a wide range of different conditions and circumstances, both domestic and commercial.

We are especially interested in the application of what we have learnt to developing countries and to reduce human waste pollution of surface and ground water. ✲

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