Is it feasible to drink urban runoff?

● A project was undertaken last year in Melbourne to investigate whether urban runoff could be harvested for potable reuse at a community scale. **DAVID HAMLYN-HARRIS** and **FRANCIS PAMMINGER** discuss the findings.

Australia is a dry continent that experiences large variations in annual rainfall. The city of Melbourne in Victoria, for example, can have its annual rainfall vary between 330mm and 970mm. Even though its dams can store up to five years' demand, the city still enforced ten years of restrictions recently to ensure that it would not run out of water.

It is against such a background that Melbourne started to recycle wastewater and stormwater for non-potable use. Rainwater tanks have now also been reintroduced into the urban environment, with approximately 30% of homes in Melbourne now having one. These are used for non-potable use. Despite this, the city still could not meet all of its demand, and chose to construct a 150GL/y desalination plant.

The Victorian government has also been actively exploring alternative ways of supplying water to improve the drought security of the city. One such project focuses on addressing a common view in the community that greater use should be made of the city's stormwater. Data quoted to support this view highlights that the annual stormwater discharge of the city is close to the annual demand presently imported from external catchments.

The largest gap in knowledge, and the greatest opportunity to use stormwater, is to harvest roof or stormwater at a community scale for potable uses. Examples of projects at different scales do exist, but are still few. Singapore harvests stormwater from its city catchment (Singapore's barrage boosts reserves: the new Marina Barrage, *Water21* June 2008, pp38-40), Melbourne has recently constructed a suburban-scale stormwater harvesting scheme at Kalkallo, and Queensland has a sub-urban scale example of roofwater and stormwater harvesting at Fitzgibbon Chase (Stormwater provides a potable solution in Queensland, *Water21* February 2014, pp42-44).

Melbourne Urban Potable Water Harvesting project

The Melbourne Urban Potable Water Harvesting project was initiated to fill a perceived knowledge gap regarding the potential viability of harvesting roof and / or stormwater from existing, highly urbanised catchments for direct potable use through the water supply grid. The project was carried out in May-August 2014 on two urban catchments in inner suburban Melbourne with study areas of 7.9 and 21ha, by first assessing how much water could be effectively harvested, estimating the costs to do so, and evaluating the indirect costs and benefits. All the findings were expressed as levelised financial and economic costs per ML of water supplied, including capital and operating costs and benefits.

Effective water yields determined fromwater balance modelling of between 0.7 and 1.2 ML/ha/year (70 to 120mm) were found for roofwater harvesting, and 1.3 to 2.2ML/ha/yr (130 to 220mm) for stormwater. These figures depended on the catchment scale and density, and the capacity of diversion, storage and treatment infrastructure provided. Infrastructure had to be located below ground in public spaces to avoid loss of community open space. For the small study areas, and taking all financial and economic costs and benefits into account, the levelised cost ranges from AUS$12,000 to $43,000 (US$9000-34,000) per ML for stormwater harvesting up to AUS$22,000 to $84,000 (US$17,000-66,000) per ML for roofwater. These costs need to be compared with the existing cost of drinking water, which in Melbourne is around AUS$1500 (US$1200) per ML for bulk water, with a volumetric retail price of between AUS$2600 (US$2000) per ML and AUS$4500 (US$3500) per ML, depending on the volume used.

The indirect benefits from water harvesting include the potential for deferral of water supply headworks and to save on bulk water fixed charges, reduction in stormwater pollutant loads, which can be valued in terms of stormwater runoff treatment costs avoided, and reduced incidence and severity of nuisance flooding in the catchment. The net economic benefit of indirect impacts was assessed to be around AUS$2000 (US$1600)/ML for both stormwater and roofwater harvesting, i.e. not enough to offset the financial cost.

A typical streetscape in the Fitzroy study area – illustrating the complexity of the environment in which a harvesting scheme would need to be implemented.

The investigation also considered whether water harvesting could be 'scaled-up' to improve its viability. This in itself introduces additional practical difficulties, but does have the effect of reducing costs through economies of scale. Analysis suggests that the 'optimum' scale for urban water harvesting is around 1500 to 2000 lots. At this scale, the levelised cost of water reduces by some 50-70% compared with the small local schemes.

For roofwater harvesting, on-lot works and collection systems represent over half the total cost. The cost of roofwater harvesting can be reduced by up to 20% if the storage and land cost can be removed, as could occur when a natural storage site, such as a lake, exists and land could be donated. However, unit costs remain high at roughly AUS$27,000 to $38,000 (US$20,800-29,200) per ML. With stormwater harvesting, without on-lot and collection systems, the cost could be reduced by up to 85% if favourable conditions can be found to remove storage and land acquisition costs. With lower storage and land acquisition costs, and higher yield, stormwater harvesting begins to look very cost competitive, as low as AUS$2500-$4400 (US$2000-3400) per ML.

While care needs to be taken with these estimates, it can be concluded that, with a large enough catchment, natural storage opportunities and no land acquisition costs, there is potential to develop cost-effective stormwater harvesting schemes in existing urban areas in Melbourne. Local roofwater harvesting schemes could not be identified as cost-effective when compared with the existing centralised water supply system because of the smaller effective catchment area (and therefore yield) and the high on-lot and collection system costs. ●

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Acknowledgements

Thanks to Yarra Valley Water, City West Water, Department of Environment, Land, Water & Planning, Yarra Council and Darebin Council.