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Integrating recycled water into urban water supply solutions

J.M. Anderson

NSW Department of Commerce, McKell Building L13, 2-24 Rawson Place, Sydney, NSW 2000, Australia
Tel. +61 (2) 9372-7811; Fax: +61 (2) 9372-7822; email: john.anderson@commerce.nsw.gov.au

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Abstract

In many parts of the world, growing demands for water are beginning to outstrip available supplies, and there is competition among users for available water. Sydney, the capital city of the state of New South Wales in Australia, is an example where urban water demands have reached the capacity of the existing water supply system. The New South Wales state government has introduced new water sharing rules that require increased water allocations for environmental flows to maintain river health, particularly in low flow periods. The government is introducing new planning measures to achieve 40% water savings in new houses compared to the current Sydney baseline. In the case of Sydney, the government has recently released a Metropolitan Water Plan that will enable Sydney to meet environmental flow requirements and cater to growth for the next 30 years. The new planning requirements significantly increase the opportunities to integrate water recycling into urban water supply systems to increase available supplies and minimise environmental impact. Amendment of the NSW guidelines for urban and residential use of recycled water to allow laundry use would bring down the cost of residential water recycling systems. An example is given as to how a water recycling network could be integrated into the new development areas in Sydney to improve drought security and the environmental outcome by using recycled water for multiple uses including urban, agricultural and environmental. The capital cost, water pricing and energy use implications of such a network are discussed.

Keywords: Integrated water planning; Water recycling; Water pricing

1. Introduction

In many parts of the world, growing demands for water are beginning to outstrip available supplies, and there is competition among users for the available water. Sydney, capital city of the state of New South Wales in Australia, is an example where urban water demands have reached the capacity of the existing water supply system.

The Hawkesbury–Nepean River system is the principal water source for the city of Sydney. The Hawkesbury–Nepean River basin has a catchment

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area of 22,000 km^2, an average annual rainfall of 890 mm/y, and an average annual discharge of about 3,000 Mm^3/y. Like all Australian catchments, the rainfall and streamflow are highly variable. The Hawkesbury enters the Pacific Ocean about 30 km north of Sydney on the east coast of Australia.

Since the Nepean River was first tapped for Sydney's water supply in 1886, the population of Sydney has grown from less than 1 million to more than 4 million. The population is expected to grow by another million over the next 20 years. The major Sydney water storages command about half of the Hawkesbury–Nepean catchment and have average annual inflows of about 1,600 Mm^3. In addition, there is a diversion system to pump water from the Shoalhaven River, 160 km south of Sydney. The current Sydney water supply system has a yield of about 600 Mm^3/y. Water consumption in 2002–2003 reached 635 Mm^3/y. New South Wales has experienced a sequence of severe droughts since 1990, and storage levels are currently below 45%.

In the 20th century the Hawkesbury–Nepean River system was "loved" almost to ruin as a result of land use changes and urbanisation, water diversions and reduced flows. The river has also been affected by sand and gravel extraction, loss of riparian vegetation, rubbish dumping and pollution. The impact is most clearly manifested in declining water quality with the growth of aquatic weeds, blue-green algae outbreaks in the lower reaches, invasion of exotic plants and loss of biodiversity.

2. Water reforms

Since 1995 the current New South Wales state government has embarked on a series of major water reforms with the aim of improving the health of New South Wales rivers.

1. Healthy Rivers Commission: This was appointed in 1995 to conduct inquiries and make recommendations to improve the health of New South Wales rivers. The commission's 1998 inquiry into the Hawkesbury–Nepean system made numerous recommendations to improve river health.

2. The Sydney Catchment Authority: this was created in 1999 with a charter to improve the protection of the Sydney water catchments. The government also introduced new planning controls to manage those developments in the catchments which might have an impact on water quality.

3. Water Management Act: The Water Act 1912 has been replaced with a new NSW Water Management Act 2000. Key elements of the new act are water management for sustainable use, a new water access framework to prevent over-allocation, and water sharing plans to share available water between users and the environment.

4. Agency reform: A new Department of Infrastructure, Planning and Natural Resources was created in 2003 with responsibilty for water resource management and reforms and the implementation of water sharing plans. Catchment management authorities were created for each of the 35 major river basins in New South Wales.

5. Hawkesbury–Nepean River Management Forum: This group was appointed in 2001 to recommend environmental flows and to advise on integrated water management for Sydney. After extensive studies, the Forum has recommended interim minimum environmental flows below the Nepean storage of all inflows up to the 80th percentile flow (20% "transparency") plus a minimum of 20% of flows in excess of the 80th percentile flow (20% "translucency"); and below Warragamba, all inflows up to the 95th percentile flow (5% "transparency") plus a minimum of 20% of flows in excess of the 95th percentile flow (20% "translucency"). In addition some specific contingency flows will be allowed for river flushing/scouring, fish spawning and aquatic weed control. The effect of the interim flows will be monitored with a view to deciding on a final