Chapter 3
The Urban Water Cycle:
Towards Integrated Resource Management and More Sustainable Water Management Systems

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ABSTRACT:

The increasing scarcity of water in the world, along with rapid population increase in urban areas, gives reason for concern and highlights the need for integrating water and wastewater management practices. The uncontrolled growth in urban areas has made planning, management and expansion of water and wastewater infrastructure systems very difficult and expensive. In order to achieve sustainable wastewater treatment and promote the conservation of water and nutrient resources, this chapter advocates the need for a closed-loop treatment system approach, and the transformation of the traditional linear treatment systems into integrated cyclical treatment systems. The recent increased understanding of integrated resource management and a shift towards sustainable management and planning of water and wastewater infrastructure are also discussed.

INTRODUCTION

It is important to see the role of water supply, wastewater management and associated infrastructure within the framework of the entire urban water cycle and the functions required at various points throughout that cycle. The context within which the urban water cycle is managed is dynamic and complex. Recent years have seen advances in water and wastewater treatment technology, a focus on the need for sustainable management of water resources, increasing environmental regulation, the impacts of climate change and variability, and a growing awareness of the interdependencies of the various elements in the urban water cycle (PMSEIC, 2007, Thorstensen et al., 2008, Todini, 2008).

Much of the discussion in this chapter relates to South East Queensland, Australia, which has seen comprehensive change in water planning and management, and is a microcosm for what has oc-

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curred nationally and internationally during the past decade. It is a region which has experienced continued population growth (a characteristic it shares with many other capital cities), and historically low levels of rainfall during the period from 2002 to 2008 (particularly in major water catchments, with a corresponding decline in runoff into the region's major water storage). These events served as a catalyst for unprecedented policy, institutional and infrastructure responses which resulted in a paradigm shift in the planning, operation, management and ownership of the water infrastructure employed in managing the urban water cycle (Cox, 2008; South East Queensland Water Supply Strategy, 2008; Thorstensen et al., 2008).

Rather than seeing this as a regional centric discussion, what follows has relevance to most urban water systems, many of which experience the same pressure to look at more sustainable approaches to the management of water supply, wastewater and drainage systems.

The past five to ten years have seen Australia's capital cities (with the exception of Darwin) experience significant variability in rainfall patterns and declining levels in water supply storages. In South East Queensland, the combined level of the major storages which supply Brisbane and five surrounding local government areas (with a population of 1.68 million people) fell to a combined total of 17% of capacity early in August 2007. In comparison, the combined storages were at 60% of capacity in April 2004 (SEQ Water, 2008). Such historically low levels of water in storage were the mechanism for two responses.

Firstly, on the demand side, a restriction regime was introduced. Higher level restrictions drove a significant decline in per capita usage in the residential sector and corresponding reductions across the commercial and industrial sectors. Water restrictions are mandatory regulations which impose conditions on the way water extracted from the supply system can be used. Restriction regimes become progressively more restrictive as supply security decreases, with stricter restriction levels triggered as water reserves or inflows into storages decline. As well as mandatory restrictions, parallel social marketing drove a significant decline in per capita usage in the residential (reduced to 140 litres per day per person at Level 6 restrictions), commercial and industrial sectors.

In addition, the Queensland State Government and local government actively promoted a number of water conservation measures through the delivery of incentive and education based programs, including: the WaterWise education program, the Home and Garden WaterWise Rebate Scheme, the Home WaterWise Service, the Business Water Efficiency Program, the EcoBiz program, the Climate Smart Living Education Program, and the Rural Water Use Efficiency Initiative (Cox, 2008).

Secondly, and just as importantly, the combination of an extended dry sequence and almost total reliance on climate dependent sources for water supply to large urban populations resulted in a rethink of the supply (as well as the demand) side of the urban water cycle. Drought contingencies such as recommissioning historical storages, extraction of groundwater and substitution of potable with recycled water for use by industry were some of the supply responses pursued. Concern, however, remained around the long term security and reliability of supply – a concern magnified by the increasing discussion and growing understanding of the possible impacts of global warming and climate change.

THE URBAN WATER CYCLE

Drought, the emerging reality of global climate change, meant that the security and reliability of traditional climate dependent water supply systems needed to be fundamentally reappraised. New paradigms were investigated which would essentially change the thinking about how water is harvested, allocated, used and managed.