2.5 Catchment planning practices

2.5.2 Managing the total water cycle

Description

Increasingly, agencies responsible for stormwater management are realising that the issue cannot be managed in isolation from other elements of the water cycle. The new approach to managing water resources in an integrated fashion is known as 'total water cycle management', or 'integrated water resource management', or 'water sensitive urban design' (where stormwater quality, stormwater quantity, water supply and wastewater/effluent are all considered during the design process).

Institution of Engineers Australia (2003) summarised the need for an integrated approach, stating 'it is no longer tenable to consider the various types of urban water flows in isolation. Management should take into account the complete urban water cycle in order to include all water flows, such as water supply, stormwater and wastewater. These flows have quantitative and qualitative impacts on land, water and biodiversity, and the public's aesthetic and recreational enjoyment of waterways.'

A good example of why an integrated approach is required concerns the use of rainwater tanks. Policies that promote the widespread uptake of tanks has the potential to reduce the need for mains water supply, but may also reduce the social and ecological impact of frequent minor flood events, reduce environmental flows in urban areas, reduce stormwater pollutant loads, and create risks to human health that must be managed. Responsible policy decisions involving the widespread use of rainwater tanks would need to consider all of these issues.

Water sensitive urban design that considers the total water cycle aims to minimise the impact of urbanisation on the natural water cycle. Its key objectives are to:

- Manage the water regime:
  - maintain appropriate aquifer levels, recharge, and stream and wetland flow characteristics in accordance with assigned beneficial uses;
  - prevent flood damage in developed areas; and
  - prevent excessive erosion of wetland and waterway slopes and banks.
- Maintain and where possible enhance water quality:
  - minimise waterborne sediment loading;
  - protect existing riparian or fringing vegetation;
  - minimise the export of pollutants to surface water or groundwater; and
  - minimise the export and impact of pollution from sewage.
- Encourage water conservation:
  - minimise the import and use of scheme water;
  - promote the use of rainwater, stormwater and groundwater, where such use does not adversely affect existing environmental values associated with this groundwater (e.g. groundwater dependent ecosystems, or public drinking water supplies);
  - promote the reuse of wastewater/effluent;

  - reduce irrigation requirements; and
  - promote opportunities for localised supply.
- Enhance water-related environmental values.
- Enhance water-related recreational and cultural values.
- Add value while minimising development costs. (Modified from Whelans *et al*., 1994, and Institution of Engineers Australia, 2003.)

Institution of Engineers Australia (2003) highlighted one major impediment to the trend in Australia towards total water cycle management, stating 'the fragmentation of responsibilities for water supply, water quality, drainage and environmental protection, and the need to interface with the development process suggests the need for greater coordination of land use and water decision making, particularly at the strategic level, if water sensitive urban design is to be effective. This is particularly relevant when considering decentralisation of water and wastewater services, seeking recycling opportunities and implementing water conservation strategies'.

Applicability

Resolving the organisational impediments to promote an integrated approach to urban water cycle management is relevant to all regions. It is particularly relevant to those regions:

- facing pressure to improve the management of more than one part of the water cycle, and seeking to harness the synergies that are available from an integrated approach; and
- where responsibilities for parts of the water cycle are fragmented, and the interests of the relevant organisational units are not clearly aligned.

Recommended Practices

To help overcome these organisational impediments to promoting an integrated approach to urban water management, the following actions are suggested as essential:

✔ Ensure there is a clear and consistent vision (or policy) for total water cycle management that is shared by all agencies in the region with a role in water management.

✔ Ensure measurable targets are developed that relate to the management of stormwater quality, stormwater quantity, water supply and wastewater/effluent (including reuse).

✔ Ensure there is strong managerial and political commitment to the vision and targets.

✔ Ensure that all organisational units that manage parts of the urban water cycle are committed to the same vision and their interests are aligned. For example, if an organisational unit's performance is judged on narrow objectives (e.g. 'how much water is sold', 'how much wastewater is reused'), it may constrain an integrated approach to projects where collaboration occurs between all units whose water-related interests may be affected. Such collaboration is required to maximise the probability of finding an optimal outcome for the community in terms of *total* water cycle management.

✔ Ensure responsibilities for managing all parts of the urban water cycle are clear and agreed (e.g. the responsibilities of local government, State government departments and water service providers).

✔ Ensure public reporting mechanisms foster accountability within all agencies responsible for urban water management. The development of measurable targets can assist this process.

✔ Ensure that the total water cycle management philosophy permeates all water-related decisions and projects, such as:

- The design and construction of new government assets (e.g. roads, buildings);
- Development assessment decisions;
- Decisions relating to regional stormwater treatment devices, sewage treatment plants, reuse schemes, rainwater tank subsidies, grant programs, etc.;
- Town planning instruments;
- State and local government policies;
- Development control plans/strategies; and
- Catchment-based water management plans.

Benefits and Effectiveness

The Institution of Engineers (2003) sees the new, integrated approach to urban water management as having significant benefits in comparison to the traditional, 'conveyance-orientated approach' primarily because it has the potential to reduce development costs, reduce water pollution, reduce the consumption of scheme water, and reduce water balance problems by minimising changes to pre-development hydrological regimes.

Many desktop studies and practical demonstrations are now available showing the advantages of taking an integrated approach to urban water systems compared to the traditional approach (Clark, 2003).

Mitchell (2003) believes the most important benefit of taking an integrated approach to the management of urban water systems is that it potentially increases the range of opportunities available to design and deliver more sustainable systems. Speers and Mitchell (2000) support this view, by stating 'in as much as the robustness of ecological systems is increased through diversity, so too will the sustainability of urban water systems be improved if an increased range of options are made available enabling solutions to be tailored to local circumstances' (p. 17).

From case study information, the following quantitative benefits can result from an integrated approach to urban water cycle management:

- Reduction of scheme water consumption by approximately 25 to 30% per cent is possible in a typical household, through the adoption of water efficient appliances and practices. This figure could rise to 65% in the long term through the use of alternative sources of water, as well as demand reduction strategies (Institution of Engineers Australia, 2003).
- Average annual pollutant loads in stormwater can be substantially reduced (e.g. 80% reduction in typical urban TSS loads and 45% reduction in TP and TN loads are objectives that can be met in most circumstances within Australia). For more information, see Institution of Engineers Australia (2003) or Taylor and Wong (2002c).
- In the long term, 100% reuse of treated wastewater effluent is possible within large individual developments or within the region (Institution of Engineers Australia, 2003).

- In terms of hydrological performance, water sensitive urban design can often ensure the peak stormwater discharge is maintained at pre-development levels, while pre-development runoff volumes are also maintained (Institution of Engineers Australia, 2003).

Challenges

The move towards an integrated approach to urban water management has been limited in some regions because of factors such as:

- organisational fragmentation, cultures, inertia and unaligned interests (as highlighted above);
- concerns over post-development operation and maintenance costs (e.g. for structures such as aquifer storage and recovery systems);
- increased complexity in decision-making;
- the lack of an effective regulatory and operating environment at the State or local government level;
- limited quantitative data on the long-term performance of best management practices;
- the current skills within some local governments and water service providers do not yet support the changes required for the assessment, approval, construction and maintenance of development schemes based on water sensitive urban design principles;
- lack of guidance on the life cycle costs of best management practices (including a lack of guidelines on how to undertake such analyses, especially where externalities are included); and
- uncertainties regarding the market acceptance of residential properties with water sensitive urban design features. (Modified from Lloyd *et al*., 2002.)

Cost

Information from case studies on the cost of development using an integrated approach to water management is available in Lloyd *et al*. (2002) and Taylor and Wong (2002c).

The cost of successfully overcoming organisational impediments to integrated urban water cycle management cannot be estimated, due the large number of unknown variables.

Additional Information

In summarising key environmental issues for the Australian water industry, Langford (2000) stated that the objectives of a more sustainable urban water system should be defined by the *total urban water cycle*, specifically:

- Reduced diversions of freshwater from the environment to service growing urban populations.
- Reduced environmental impacts of pollutants from point and non-point sources such as nutrients and sediment.
- Reduced potential for pathogens to adversely impact human health.
- Lower energy consumption.
- Reduced net emissions of greenhouse gases.

- Increased resilience to manage variability in demands and unexpected events.
- Increased cost-effectiveness.

Although new to Australia, the philosophy of integrated water resource management is not new. Beck (2002) quoting Kneese (1967) notes that its history extends back a century when it was used in the Ruhr and Wupper catchments of Germany.

Despite the strength of the arguments for integrated water resource management, it should not be considered to be the 'correct' problem-solving model that will automatically produce sustainable and cost-effective urban water systems. In reality, the approach to managing water resources in urban areas will evolve over time as new ideas, information, drivers for change and technologies emerge. This approach is sometimes called 'adaptive environmental management'.

Examples / Case Studies

Several leading water sensitive urban design case studies for specific developments in Australia are described in Institution of Engineers Australia (2003) and Lloyd (2001).

In terms of *organisational* case studies, the greater Melbourne region provides an example of how jurisdictional fragmentation was managed to achieve positive results. In Melbourne, responsibility for stormwater management is split between Melbourne Water (which manages the trunk drainage network), numerous local government authorities (which manage the minor drainage network), and the Victorian Environmental Protection Authority (which is the lead agent for environmental protection). To help clarify roles and responsibilities with respect to stormwater and to ensure that all organisational units were coordinated, a 'Partnership Agreement' was jointly developed and signed on 26 November 2002 (Clearwater, 2002). This was seen as a major step forward towards improved management of stormwater in the greater Melbourne region.

Another organisational example is Brisbane City Council. Brisbane City Council manages virtually the entire urban water cycle in Brisbane. In 2002, the policy (or 'purchaser') units of Council that were responsible for stormwater quality, stormwater quantity, catchment management, water supply and wastewater were combined to form one branch (the Water Resources Branch). Other initiatives include:

- the development of a citywide Water Management Strategy as a vehicle to define an agreed vision for 2020, and the major projects that will be delivered to achieve this vision; and
- the use of multi-disciplinary project teams to ensure all aspects of the water cycle are considered during major projects.

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