Streetscape Scale Applications of Water Sensitive Urban Design

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Recent Examples from Australian Cities

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An abstract from the full paper: available www.aila.org.au/LApapers

Introduction

- Water Sensitive Urban Design (WSUD) can help us achieve "green streets" in times of water restrictions. Stormwater runoff that usually flows down our drains and out to sea, can be harvested to irrigate street trees and other landscaping. At the same time, runoff can be filtered and cleaned of pollutants before returning it to aquatic ecosystems. The following paper describes current streetscape scale WSUD practices, and their recent application in Australian cities. This includes examples of both:
- Retrofitting of WSUD measures into existing urban streets, and
- Incorporation of integrated stormwater management systems into major urban redevelopment projects.

Streetscape Scale Applications

In recent years, WSUD treatments have evolved from large scale "end of pipe" solutions, such as constructed wetlands, to smaller scale applications which can treat runoff from local catchments "at source", and which can be integrated into the design of urban streets and public spaces (Wong 2006).

These smaller scale applications deliver a range of benefits. As well as protecting downstream waters through pollutant removal and retarding of stormwater flows, they can also harvest runoff for local landscape reuse, reducing the use of mains water for irrigation. They also help increase awareness of the connections between human activities and the water cycle, by making the processes more visible.

Streetscape scale WSUD applications can take a number of forms, however the most popular are bioretention systems, also known as "rain gardens", which can be scaled to confined spaces, and adapted to a range of urban situations. Bioretention systems filter stormwater runoff through a vegetated soil media layer. The filtered water is then collected via perforated pipes and discharged back into the stormwater system, or stored for reuse. Temporary ponding above the soil media, in an "extended detention zone", provides additional treatment by sedimentation. Bioretention systems, however, are not intended to function by infiltration. Treated water is returned to the stormwater system, rather than into the surrounding soil and groundwater. Bioretention systems also typically include a high flow by-pass, to capture the most contaminated "first flush" during rain events, while diverting excess flows to the main stormwater system (City of Melbourne 2005).

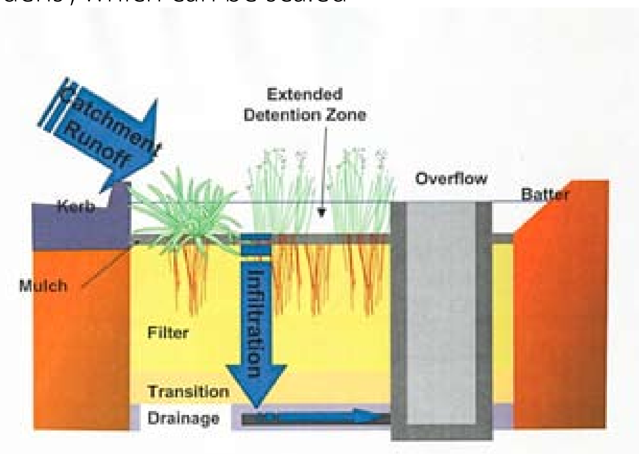

Figure 1
Typical rain garden cross section
Source: Somes & Crosby (2007)

Research

Vegetation growing in the filter media enhances it's function in a number of ways. Plant roots help remove pollutants through a combination of physical, chemical and biological processes. They also prevent erosion of the filter media, and maintain it's porosity through continuous root growth. An appropriate filter media is therefore required, which balances the need for efficient flow through the soil profile, with the need to retain sufficient water in the soil to sustain plant growth. A wide range of plants can be used in bioretention systems, however species which tolerate periods of drought and inundation are preferred to the more aquatic species, as the former act as indicators of system failure due to clogging of the soil media (Somes and Crosby 2007).

Bioretention tree pits are a recent innovation, involving redesign of tree root-zone environments as stormwater treatment systems, allowing the incorporation of stormwater management into confined urban street spaces (Breen, Denman *et al*. 2004; Wettenhall 2006).

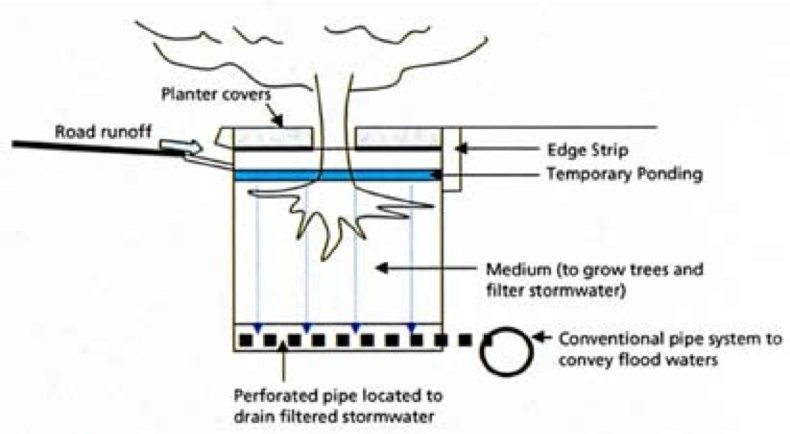

Figure 2
Typical bioretention tree pit cross section
Source: Breen, Denman *et al* (2004)

Bioretention systems can be integrated into the design of new streets, or "retrofitted" into existing streetscapes. Streetscape scale applications, however, present a number of design challenges not faced in larger scale applications. Successful design requires an innovative approach, and a close collaboration between designers, engineers and environmental specialists at all stages of the project. Key design challenges include the following:

Key design challenges include the following:

- The design must provide an appropriate footprint and filtration depth which meets functional water treatment criteria.
- It must then be adapted to the surrounding urban environment, including constraints of confined space, and interaction with existing services. Rain gardens can be integrated with other streetscape elements, to reduce their footprint, for example in traffic calming devices.
- Interactions with street users must also be addressed. Of particular concern is public safety and liability. Rain gardens require an extended detention zone set some distance below footpath level, creating a potential tripping hazard. The required grade change can be addressed in a number of ways.
- Aesthetics and visual appearance are significant factors in gaining community support. Installations in highly urbanised areas may require a more formal, geometrical and hard edged design than in suburban streets. Some early examples of rain gardens used standard civil engineering details and failed to enhance the streetscape or gain community acceptance

Further chapters available in the full paper:

Retrofitting into Existing Streets

Urban Redevelopment Projects

Conclusions

This overview identifies the scope of emerging practices applying Water Sensitive Urban Design measures at the streetscape level. This includes retrofitting into existing streets, resulting in incremental changes to the urban fabric, and incorporation in large scale urban development projects, as part of integrated water management systems. Lessons have been learnt from early projects, which were largely engineering driven. The most successful recent projects exhibit a highly collaborative and innovative approach, achieving a range of social, economic and environmental outcomes.

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