CRC for
Water Sensitive Cities

Program C: Future Technologies | Project C1.1 | Project duration: July 2012 - December 2014

Cities as water supply catchments – Sustainable technologies

Overview

Stormwater has emerged as a viable alternative water resource. In the past few years, stormwater runoff has been increasingly harvested on small scales using mainly non-sustainable, energy-intense technologies. However, technological solutions that could deliver large volumes of harvested stormwater with low-energy and low-carbon footprints still need further research and development. The aim of this project is to both develop new and refine existing stormwater harvesting technologies, building upon the proven concepts of water sensitive urban design (WSUD). Solutions are to be flexible, ranging from lot to regional scales.

Key outcomes

The project is designed to fill knowledge gaps around the removal of pathogens and toxic chemicals by WSUD systems, focusing on stormwater biofilters. The work has led to the development of novel biofiltration media that can passively remove pathogens from stormwater. A range of effective plant species has also been identified, leading to the development of a new generation of biofilters for stormwater harvesting.

This project has included one of the world's first studies on removal efficiency of micropollutants (herbicides, oil and petrol derivatives, disinfectants etc.) by stormwater biofilters. The project has also delivered some preliminary insights into pathogen removal by constructed wetlands. The project has delivered "Adoption Guidelines for Stormwater Biofiltration Systems", which are an updated version of the Facility for Advancing Water Biofiltration (FAWB) biofiltration guidelines published in 2009.

The project has concurrently delivered UrbanBEATS (Urban Biophysical Environments and Technologies Simulator), a modelling tool to assist in the strategic planning of stormwater treatment technologies, which is now being incorporated into the Water Sensitive Cities Modelling Toolkit developed under Project D1.1 (Integration and demonstration through urban design). UrbanBEATS integrates urban planning and urban form with stormwater management infrastructure planning, design and placement. It can be used to engage a multi-disciplinary group of stakeholders in identifying suitable water management opportunities.

Insights into pollutant removal capacity of biofilters and constructed wetlands

A final report on WSUD treatment technologies released in October 2014 summarises the findings from a series of studies designed to investigate biofilters and constructed wetlands – two of the most common WSUD technologies used in Australian stormwater harvesting schemes. Some of the key findings are summarised below:

- Research showed that WSUD technologies, particularly well designed biofilters, are capable of reducing a range of stormwater pollutants, and therefore are an important treatment step that should be incorporated into stormwater harvesting systems.
- It is important to select appropriate design characteristics (for example, system size, filter media composition and depth, vegetation etc.), which are able to achieve specific water quality objectives for the stormwater harvesting and reuse system in question.
- The selection of plant species remains critical, particularly for nutrient removal, and a mixed planting including both effective and ineffective plant species for nutrient removal (minimum 50% effective species) is suggested over a single plant species.
- Biofilters designed according to current best practice were able to reduce the majority of micropollutants to very low levels (for example, heavy metals, oils and petrol derivatives), but were not effective in removal of herbicides.
- Current biofilters are capable of achieving 1 log reduction of indicators of pathogenic organism. They are also performing well in removing key reference pathogens, particularly protozoa.
- Pathogen removal by biofilters that contain the newly developed layered biofilter media is almost 1.5-2 times better than that of conventional designs. These systems are less affected by operational conditions than the conventional designs, making them more robust.
- Constructed wetlands were generally shown to be promising in reducing indicator microorganism concentration, yet a large variance in removal performance remains.
- A constructed wetland receiving pre-treated runoff from an industrial catchment was effective in reducing concentrations of nutrients, metals and the bacterial indicator E. coli, but was less effective in reducing biological oxygen demand and chemical oxygen demand.

An Australian Government Initiative

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Project design

The project has undertaken a series of laboratory studies and tests to refine biofilters and non-vegetated filters to more effectively collect and pre-treat stormwater for subsequent use. The work has included the monitoring of a number of existing field-scale biofilters and wetlands. Modelling has also been undertaken to describe the behaviour of microorganisms and micropollutants in WSUD systems.

In parallel, the project developed model algorithms that simulate the conceptual design and landscape integration process of different WSUD systems for runoff volume and pollution control as well as stormwater harvesting.

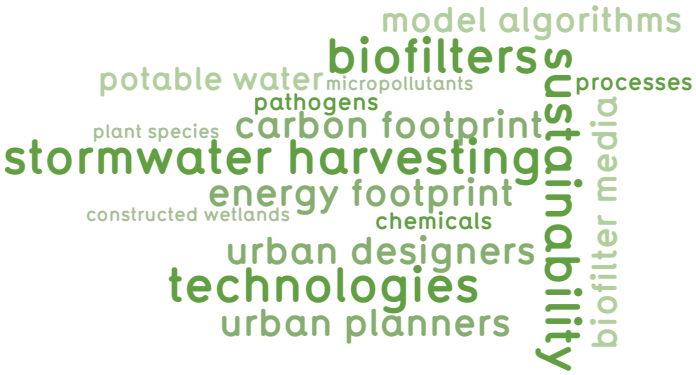
Figure 1. Dosing laboratory-scale biofilter columns using semi-synthetic stormwater (© Monash University).

Outlook

The project has been completed and delivered the following key outputs:

- novel designs of filters and biofilters for pathogen removal in urban stormwater
- models of WSUD treatment performance of faecal indicators and micropollutants.
- UrbanBEATS.

New adoption guidelines for the design, maintenance and operation of biofiltration systems for stormwater treatment and harvesting will be published in early 2015.



About the Cooperative Research Centre for Water Sensitive Cities

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) brings together interdisciplinary research expertise and thought-leadership from Australia and the world to address current urban water management challenges facing our cities and regions. In collaboration with over 80 research, government and industry partners, it develops and synthesises knowledge into powerful tools and influences key players aiming to achieve sustainable, resilient and liveable water sensitive cities.

Further information

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