Case study: Street-side rain gardens, Wellington

Overview

A series of rain gardens along one of Wellington's busiest arterial routes and included as part of a 'shared street' catch stormwater runoff from the roads and pavements and improve water quality by passing it through natural filtering functions before being discharged to the harbour.

Context

Stormwater management is a fundamental aspect of a sustainable land transport system and is a significant environmental responsibility for territorial authorities. Stormwater, which generally has little or no treatment, contains sediments and bacteria, as well as persistent contaminants that accumulate in sediments that eventually end up in the sea. These contaminants affect fish and invertebrates and can have chronic long-term adverse effects on river and coastal ecosystems.

Runoff from roads contributes pollutants, such as heavy metals and hydrocarbons, that can potentially have an adverse effect on streams, harbours or coastal waters.

For Wellington and Porirua harbours there is data showing ecotoxic[1] contaminants carried by stormwater in bottom sediments at concentrations that exceed guidelines for aquatic life. The sources of these contaminants are diffuse.

'The Quays' (Jervois, Customhouse and Waterloo Quays) carry 50,000+ cars a day, making this the second busiest road in Wellington. The city's 'Greening of the Quays' project stemmed from a desire to create an aesthetic streetscape by softening this busy six-lane arterial road with a line of trees. As part of the second stage of this work, 40 rain gardens were installed from the Westpac Stadium along Waterloo Quay to the Railway Station. Another 40 rain gardens also extend along Cable Street to Oriental Parade.

At the same time lower Cuba Street was redesigned as a shared space to provide public space and continue the 'feel' of Cuba Mall to Wakefield Street and Civic Square. Shared spaces are designed to accommodate a range of users - pedestrians, cyclists and drivers - along with street furniture, trees and plants to create a high quality public space. Rain gardens were added at both ends of lower Cuba Street.

The low-impact urban design principles of these concepts challenged a number of traditional engineering views, especially that water and trees are not compatible with the integrity of the road surfaces.

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[1] Ecotoxic contaminants are substances that are capable of causing ill health, injury or death to any living organism – such as heavy metals, polycyclic aromatic hydrocarbons, organochlorine pesticides and antifouling compounds. Carried in stormwater, ecotoxic contaminants can bind with sediment and accumulate where the sediment settles, on the seabed or the bed of a freshwater body, particularly in low energy aquatic receiving environments

Meeting both the requirement for a suitable environment for tree growth and maintaining the structural integrity of the road required an innovative solution that was cost effective and buildable within the constrained road environment.

Strategic approach

There is growing evidence that expectations for national environmental standards are increasing. Stormwater quality, in particular, is an aspect that is attracting increasing regulatory attention in New Zealand in terms of compliance with regional plans and the regulation of discharges from road infrastructure through consent conditions.

Greater Wellington Regional Council has developed a proposed Regional Policy Statement 2009 (RPS) which needs to be acknowledged by regional and district plans and when resource consents are processed. It includes objectives, policies and methods relating to water quality that could affect the way road runoff is managed. Greater Wellington's Regional Plan is currently being revised to give effect to the proposed RPS. The new Regional Plan has a proposed stormwater management rule.

The stormwater management devices and controls policies aim to reduce accumulation rates of ecotoxic contaminants in aquatic sediments. Among other techniques these controls include using roadside swales, filter strips and rain gardens. The rain gardens contribute to working towards and achieving Wellington City Council's Eco City goal and its vision of a vibrant global city.

The City Council has strategic documents, initiatives and policies (i.e. Biodiversity Action Plan, Climate Change Action Plan, Central City Framework etc) to promote and encourage innovation and the provision of green streetscape design and transport infrastructure. Standard engineering drawings have been produced for the roadside rain gardens and are part of the Council's Code of Practice for Land Development and the Public Space Design Guide.

Project approach

Low impact development (LID) offers an alternative to traditional stormwater management practices at a range of scales. LID is a set of concepts around which we design urban environments for environmental, social and economic benefits. In practice, it's about using the same processes that nature does.

For managing stormwater runoff, LID approaches emphasise the use of onsite natural features to protect water quality. If we pave over every last square meter of ground, rainwater has nowhere to go, except into the channels and drains we provide. But bitter experience has shown that these can often be routinely overwhelmed. Water quality is then compromised, and streams and harbour health suffers. Nature has a better idea - allow that rain to soak into the ground where it can be filtered and stored for more gradual, controlled release, nourishing a few trees along the way or let the water flow through planted rain gardens, which trap any remaining pollutants and silt before it enters the sea.

Today, more and more national and local (stormwater) regulations are incorporating — and rewarding — LID management practices, including 'green infrastructure'.

Technical innovation

Stormwater is conveyed to the rain gardens by surface flow to the kerb and channel - then via notches moulded into the kerb blocks. Water slowly infiltrates through the planting medium and in heavy rain is able to pond on the surface. In some of the larger rain gardens high-level overflow is provided by way of a traditional sump unit.

The planting medium is a bioretention soil mix and comprises three layers:

a. Base or drainage layer - a coarse, poorly-graded (that is with a narrow range of particle size distribution) gravel of between 2 mm and 10 mm diameter, placed to encase the perforated drainage pipes (where applicable). A typical thickness of this layer is 150 mm.
b. Transition layer of 100 mm to 150 mm composed of poorly graded sand of between 0.5 mm and 1 mm diameter.
c. Filtration layer placed to the required thickness. The filtration layer must support vegetation growth and provide the design saturated hydraulic conductivity (approximately 36-150mm/hr).

Installation of the bioretention layers was undertaken in accordance with standard landscape compaction methods.

Treatment is provided by filtration through the soil medium together with bioretention provided by the plants. After infiltrating through the soil medium, water is discharged either by infiltration to underlying earth, or is collected in a pipe and discharged to the public stormwater system.

The rain gardens are planted with eco-sourced natives, including plants and grasses typical of the Wellington area, that cope with the climatic conditions. These include:

Aciphylla squarrosa Spear Grass
Apodasmia similis Jointed wire rush
Astelia grandis Swamp Astelia
Carex comans Longwood tussock
Machaerina sinclarii Tuhara
Uncinia uncinata Hook-grass

Results to date

The streetscape along the Quays has been significantly improved by the rain gardens and associated improvement works. The rain gardens and trees on lower Cuba Street also contribute to the quality of the shared space. They enhance ecosystem health, provide amenity and support recreation, strengthen communities and enhance environmental quality, and help offset climate change.

Although the quantity of water being treated is relatively small compared to total stormwater flowing from hard surfaces around the city, it is a means by which public awareness can be raised and the rain gardens considered educational. They are a practical means of addressing ecological and cultural concerns relating to stormwater management.

Issues to consider

Advocates say green infrastructure isn't just about being green - it makes financial sense as well. Its cost-effectiveness depends on how benefits are assigned and valued, and the length of the timescale - but *green* has been shown to be cheaper than *grey*.

The rain gardens improve water quality by removing bacteria, trace metals and sediment from the stormwater runoff. They also offer other additional benefits such as wildlife habitat and aesthetic improvement as well as being an important element in sustainable urban drainage. It could be said the rain gardens are the most cost-effective way to manage stormwater quality, while supporting a range of other benefits.

Key lessons

There have been lessons from the creation of the lower Cuba Street rain gardens. The standard approach to rain garden design for the arterial routes, which includes a kerb with rectangular slots for the water to go in, is acceptable and works well.

However the rain garden detail for narrower streets, based on lower Cuba Street, has to be revised. The future design should include a lip of some sort to prevent vehicles driving into the rain gardens and street sweepers brushing litter in to the rain garden when they sweep around it.

As a result the City Council now has design principles for rain gardens. These include, for example, not installing them directly next to parallel parking spaces, where people will have no choice but to step out of the car and into the rain garden, and not in areas of high pedestrian cross-movement where pedestrians are likely to take a shortcut through the rain gardens.

In order to complete the rain gardens for the opening of the street, the filter media in the rain gardens wasn't given sufficient time to settle and the trees and grasses were planted immediately. As a result the soil has subsequently settled unevenly leaving voids in the surface. Costly remedial work is now required to dig out the plants, allow the filter media and soil to settle and then replant the gardens.

The need for greater communication and involvement between relevant Council units in the planning and implementation stages has been recognised. In the case of lower Cuba Street, the resultant rain gardens would have been well thought-out, easily maintained, sustainable and economically viable in the long term.

Key information

Case Study sponsors: Wellington City Council
Project Coordinator: Nicci Wood
Tel 04 803 8081 Nicci.Wood@wcc.govt.nz
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