

GREEN INFRASTRUCTURE CASE STUDY: STREETSCAPE – RAIN GARDENS WITHIN ROAD CARRIAGE WAYMOUTH STREET, ADELAIDE

Green infrastructure is a green network - of green spaces, street trees and other vegetation (including wetlands, rain gardens, and green walls and roofs) - strategically planned, designed and managed to support the liveability, sustainability and resilience of an urban area. Green infrastructure is integrated, connected and multifunctional. It is integrated with development and other infrastructure, it links existing and new green assets across the public and private realms, and it provides multiple social, economic and environmental functions. Green infrastructure is essential infrastructure for our cities and towns.

This is one of a suite of case studies demonstrating how various types of green infrastructure were planned, designed and delivered, how they're maintained, and the challenges and lessons along the way.

PROJECT OVERVIEW

The City of Adelaide (Council) and the West End Village Association (WEVA) are working together to 'green' one of the oldest and hottest parts of the city. The Council's objective is to create 'great streets' with new street trees strategically located to reduce the urban heat island effect, improve stormwater quality, preserve adequate car parking spaces and protect infrastructure and underground services. These aims have been successfully blended with WEVA's objectives to create an urban forest in the West End whilst calming traffic and increasing safety and security.

Fourteen street trees were carefully planted on top of generations of existing underground services. The majority of trees are planted within eight rain gardens specially designed for optimum tree growth, pollutant removal and water retention. Some trees have been planted within a matrix of structurally supported soil media overlain by permeable paving, which enables infiltration of water and maximum tree growth, whilst supporting the pavement above. This has enabled trees to be grown where they traditionally wouldn't and has retained maximum carriageway and parking space. The trees are passively irrigated by stormwater diverted through the gardens. It is expected that when fully grown the trees will shade the footpath and improve street appeal.

ABOUT THIS SITE

ORGANISATION

City of Adelaide

SETTING

Inner-city streetscape

GREEN INFRASTRUCTURE FEATURES

Street trees, Rain gardens

COST

\$385,000



Completed rain gardens

The Council's experience shows that trees can be planted in highly challenging urbanised environments without adversely affecting existing infrastructure and services.

FINANCIAL PARTNERS

This project was funded by the City of Adelaide with a \$50,000 contribution from the Department of Environment, Water and Natural Resources (Total cost \$385,000).

GREEN INFRASTRUCTURE FEATURES AND DESIGN CRITERIA

The Council's objective is to create great streets for people. Planting street trees and gardens is important to provide people with comfort and amenity. The Council has mapped hot spots and tree canopy cover in the city in order to strategically target areas where trees can provide the most benefit. The northwest, where this project is located, was identified as one of the hottest areas.

The Council aimed to ensure that the new trees planted on Waymouth Street between Shannon Place and Elizabeth Street could grow to full canopy without having adverse impacts on the civil infrastructure and numerous underground services.

The chosen solution was rain gardens within the carriageway, primarily targeted at intersections where there was surplus road space.

The design sought to maximise the available space for root growth. The Council used CityGreen 'Stratacells', a soil structure system comprising recycled plastic modules that assemble to form an interconnected, underground matrix. The structural matrix supports pavement loads while providing a large volume to accommodate soil for tree-root growth.

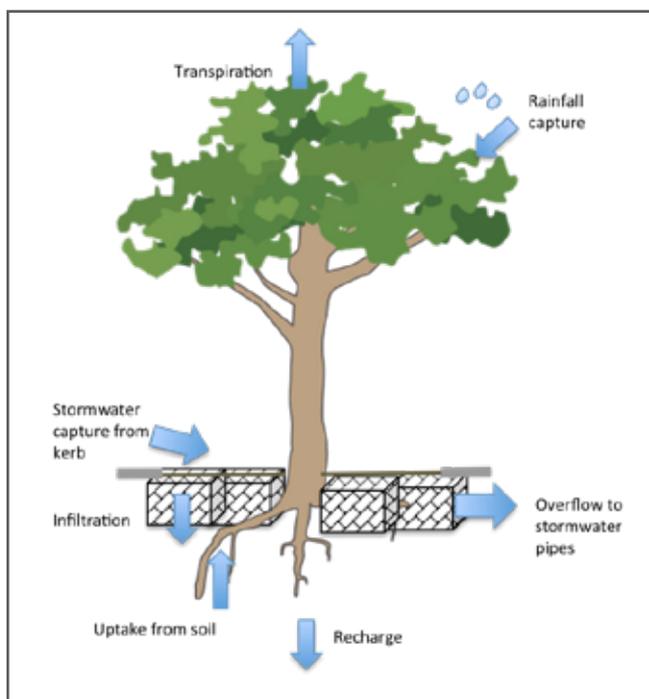


Figure 1: Street tree water cycle showing stormwater capture and enhanced infiltration.

GREEN INFRASTRUCTURE FEATURES

- 14 trees (13 Chinese Pistachios and 1 Water gum)
- 8 Rain gardens (totaling 117m²)
- Aggregate drain discharging surplus water into the stormwater system
- Subsurface Flow Regulator Control determining the level which water enters the stormwater system
- Rain garden plantings (1,094 plants comprising of 29 species)
- Passive irrigation from road
- Enhanced runoff from customised protuberance

All of the rain gardens are connected to the underground stormwater system with most being free-draining. Pipes and valves were installed to enable the regulation of the subsurface water retention levels. Water can be retained in the gardens as needed (by closing the valve) or sent directly to the stormwater system (by opening the valve). Valves are intended to be closed at end of winter or during spring in order to store water for summer. Water levels are monitored via the inspection riser.

The 14 new trees planted consist of 13 Chinese Pistachio (*Pistacia chinensis*) and 1 Luscious Water Gum (*Tristaniopsis laurina*). The deciduous Chinese Pistachio trees were selected for their canopy size and structure to gain maximum shading for the area and tolerance to variable soil moisture conditions. The water gum is evergreen and was planted to trial its performance in the streetscape. A diverse selection of understory plant species was used so that the Council can determine which species grow best for use in similar applications in the future.



Strata Cell matrix under permeable paving

The City of Adelaide and the West End Village Association are working together to create 'great streets' with passively irrigated, shady trees in the hottest and oldest part of the Adelaide CBD.



Completed garden bed with Chinese pistachios.

RAIN GARDENS

Rain gardens work by diverting some of the water running along a street gutter into a garden bed where the water infiltrates into the soil and is filtered before re-entering the stormwater system. The plants, microbes and soil in the rain garden filter out pollutants and take up or cycle nutrients in the water. Rain gardens thereby improve stormwater quality as well as dampening peaks in stormwater flows and passively watering the plants. The plant roots maintain the porosity of the biofilter medium and create an environment for decomposing microbes.

STREETSCAPE BENEFITS

The expected benefits of the street trees and rain gardens include:

- cooling the street footpaths and adjacent buildings via shading and transpiration
- dampening peaks in stormwater flows via rainfall being captured in the tree canopies (noting that the volume captured increases as the tree canopy grows) and the retention of stormwater in the rain gardens
- improving downstream water quality via the rain gardens capturing and filtering stormwater
- providing habitat and
- enhancing the appearance and amenity of the street.

Installing the trees and rain gardens within the road carriageway is expected to have a greater overall benefit than simply using grasses and low-growing shrubs on the verge.

In addition, the rain gardens may provide some groundwater recharge.

CHALLENGES AND LESSONS

- Greening inner city streets with trees requires an innovative design approach. Adelaide has generations of infrastructure above and below ground. Although target areas for installation of shady trees were easy to identify; micro-siting the trees and rain gardens in the heavily developed streetscape was difficult.
- Trees and rain gardens are best installed in conjunction with other street upgrades (e.g. crossings, parking and traffic calming installations) in locations where the community want more trees.
- It was imperative that all new works could be installed without reducing the capacity of the stormwater system to mitigate against future peak rain and storm events, particularly given long term weather and climate predictions for more intense storm events in Adelaide.
- During construction the Council discovered that the valve system could have been simplified by using a stormwater overflow pipe at the top level. Having a passive overflow instead of needing to open valves to drain to the stormwater system means that risks associated with accidentally leaving a valve closed would be avoided, especially during summer storms when the valves would generally be kept closed to retain water for the trees.

The City of Adelaide has found that there are few traditional solutions to greening cities – each project requires a bespoke response and is a new experience.

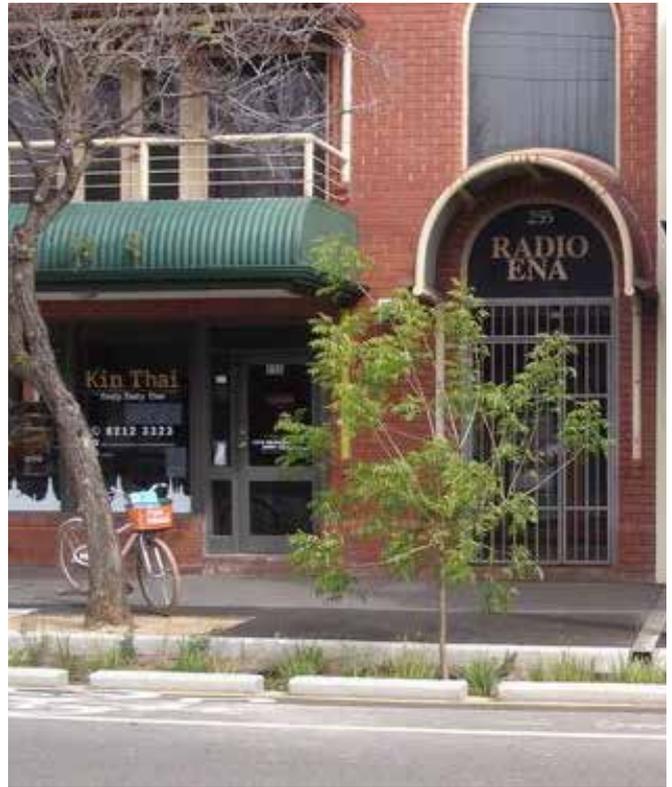
- Not all the existing infrastructure was known at the beginning of the project. Multiple adjustments to the original designs needed to be made along the way to allow for infrastructure that was uncovered (e.g. remnant infrastructure under the pavement). It is imperative that surveys contain a high level of detail to improve accuracy of siting, to optimise proposed solutions for maximum effect and reduce the likelihood of unforeseen construction changes.
- The significant existing road cross fall (9%) created design and constructability constraints between the interface of the rain garden basins and existing road pavement.
- The Council carefully planned the construction of the rain gardens with minimal interruptions to traffic, residents and business. Staging of works was needed to reduce inconvenience and interruptions to trade. For example, during the early stages, parking and two trafficable lanes on Wymouth Street was largely maintained.
- Speed restrictions were needed between 9am and 4pm to minimise disturbance to the public in accordance with the City Works Guidelines.
- Regardless of their diligent planning, unforeseen challenges during construction required council to learn and adapt as they went. Council staff found solutions to each problem as it arose, and have built their internal capacity and confidence to undertake future green infrastructure projects.

The installation of the new trees and rain gardens on Wymouth Street looks simple enough at the surface, but involved much more than just digging a hole in the pavement and planting a tree. The Council's success has come from applying innovative thinking to the design and construction of robust green infrastructure with an adequate budget and commitment from top management through to the design, construction and maintenance teams.

FUTURE OPPORTUNITIES

In addition to the lessons already learned through the design and construction processes, the Wymouth Street rain gardens and trees will be monitored over time to obtain further knowledge that can be applied to future projects.

The Council will continue its focus on improving city streets to create a greener and more liveable city. A high level of design innovation and rigor will be required to achieve these objectives in a complex urban environment.



EDUCATION & COMMUNITY

The community members of the WEVA have been strongly involved in greening the west end of Adelaide since 2013. WEVA's focus is on re-greening local streets to create an urban forest that will mitigate the heating effects of the hard surfaces in this part of the city.

North Street (between Waymouth and Currie Street) stands as a great example of how tree planting can lift the appearance and provide greening in small spaces.

WEVA members have also established a community garden on North Street on a former disused, car park area. Vines have climbed and now cover the 7m high walls on either side of the garden. The pavement was partially excavated to establish fruit trees with abundant companion herbs and flowers. A pergola was added and the retained bitumen pavement provides the surface for three petanque arenas. The University of SA now owns the land and is supportive of the garden, encouraging students and staff to get involved.

The communities desire to green the West End has been a driver of change. The Council invited WEVA to discuss various options for greening different streets and it was agreed that Waymouth Street greening would have the greatest immediate benefit.

The Council worked with businesses in the street to minimise disruption through the construction phase and ensure that works did not adversely affect their business operations. Extensive community consultation enables people to discuss the trade-offs between short- and long-term inconveniences including the loss of parking spaces and having more trees that provide cooling and other benefits.



WEVA Community Garden, North Street.

Disclaimer: While every effort has been made to verify the accuracy of items in the Department for Environment, Water and Natural Resources' case study fact sheets, independent advice should be sought on matters of specific interest.



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PROJECT DELIVERY

CIVIL DESIGN

City of Adelaide and FMG Engineering

LANDSCAPE DESIGN

City of Adelaide

PROJECT MANAGEMENT

City of Adelaide

CONSTRUCTED BY

Kent Civil and Space Landscape

MAINTENANCE

City of Adelaide

CASE STUDY CONTRIBUTORS

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John Kirkwood (WEVA)

MAINTENANCE

Maintenance by Council staff requires twice weekly visits of approximately 2 hours to undertake:

- General inspection of features and infrastructure.
- Monitoring of water levels and operation of valves, as required.
- Occasional removal of plant material to maintain adequate infiltration rates.
- Rubbish and weed removal.

Water levels are monitored via the inspection riser. Valves are closed at end of winter/early spring in order to store water for summer.



FOR FURTHER INFORMATION

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