THE UNIVERSITY OF MELBOURNE

School of Ecosystem and Forest Sciences

Thirsty trees and stormwater runoff
A match made in the street

Summary

In cities, widespread impermeable surfaces such as roofs and roads create large volumes of stormwater runoff following rainfall events. This can result in flash flooding and degradation of receiving waterways[1,2]. At the same time, impermeable surfaces limit the amount of water that infiltrates into the soil for trees to use, which may limit their water supply in times of drought[3]. Using stormwater as a resource to water trees may reduce their exposure to drought while simultaneously reducing the amount of stormwater runoff going directly to waterways.

Established trees use (transpire) large quantities of water[4]. In our study, we calculated that trees could transpire 17% of annual stormwater runoff from the street. A combination of larger trees and less permeable surfaces could increase the percentage of runoff that is used by trees.

Streetscapes fitted with tree-based stormwater control measures could increase the amount of runoff that is transpired from the street, thereby decreasing the amount of polluted runoff that goes to waterways.

Why should we irrigate trees with stormwater?

When rain falls on cities with widespread impermeable surfaces such as roads and rooftops, large volumes of stormwater runoff are created, causing flooding[1]. Historically, we have dealt with this by directing polluted stormwater to waterways (rivers, streams, oceans) through pipes, causing pollution, erosion, and habitat degradation[2]. Climate change threatens to expose many regions to both increased storm events and increased drought[5]. In this context it is imperative that all water resources are utilised efficiently. Trees contribute to urban climate adaption by providing important cooling benefits when they use water through transpiration[6]. However, healthy trees that transpire a lot of water are required to provide such benefits. Growing healthy trees in cities is challenging because impermeable surfaces limit the amount of water that gets to the soil for trees to use[3]. Therefore, redirecting stormwater runoff from the street to the tree through stormwater control measures, could support trees and increase the amount of runoff that is used in the street, reducing the amount of polluted runoff that is directed to waterways.

Aims

This project will determine the potential volume of runoff that could be used by large street trees. This will enable planners and practitioners to make informed decisions when creating streetscapes that use trees for stormwater control.

What do we need to know?

- How much stormwater runoff could trees use?
- Does redirecting stormwater to trees increase their water use?

Approach

With the support of the Office of Living Victoria, City of Monash, and Monash University, we installed infiltration trenches alongside established street trees to irrigate the trees with stormwater runoff from the street. Six trenches were installed in a suburban street, alongside six *Lophostemon confertus* trees, one of the most common street trees in Melbourne. Infiltration trenches were installed in 2014. We measured the amount of stormwater captured by trenches and

the amount transpired by trees from 2014 to 2016.

We compared two different types of inlets that directed stormwater runoff to the infiltration trenches:
1) An industry designed horizontal inlet; and
2) A vertical inlet designed and tested by engineers at the City of Monash.

Thirsty trees and stormwater runoff: Project findings

- Established street trees use a large amount of water (Up to 96 litres per day).
- The amount of water transpired by a single tree each year was equivalent to 17% of total stormwater runoff.
- Infiltration trenches captured more stormwater runoff (24%) than trees could transpire in a year.
- Inlet design did not affect the amount of stormwater runoff that was captured.
- For established trees in the nature strip of a suburban street, irrigation from stormwater did not increase their transpiration rate because trees in the street already had enough water.
- Streetscapes fitted with tree-based stormwater control measures could increase the amount of runoff that is used as a resource in the street, thereby decreasing the amount of polluted runoff that goes to waterways.

Research Outputs

Thom, JK., Szota, C., Coutts, AM., Fletcher, TD., Livesley, SJ. Transpiration from established trees could increase the efficiency of stormwater control measures. Submitted to Water Research 2019

Szota, C., Coutts, AM., Thom, JK., Virahsawmy, HK., Fletcher, TD., Livesley, SJ. (2019). Street tree stormwater control measures can reduce runoff but may not benefit established trees. Landscape and Urban Planning. 182: 144-155. DOI: 10.1016/j.landurbplan.2018.10.021

Conferences: Green Cities Italy, 2017; Stormwater VIC Australia, 2018; Novatech France, 2019

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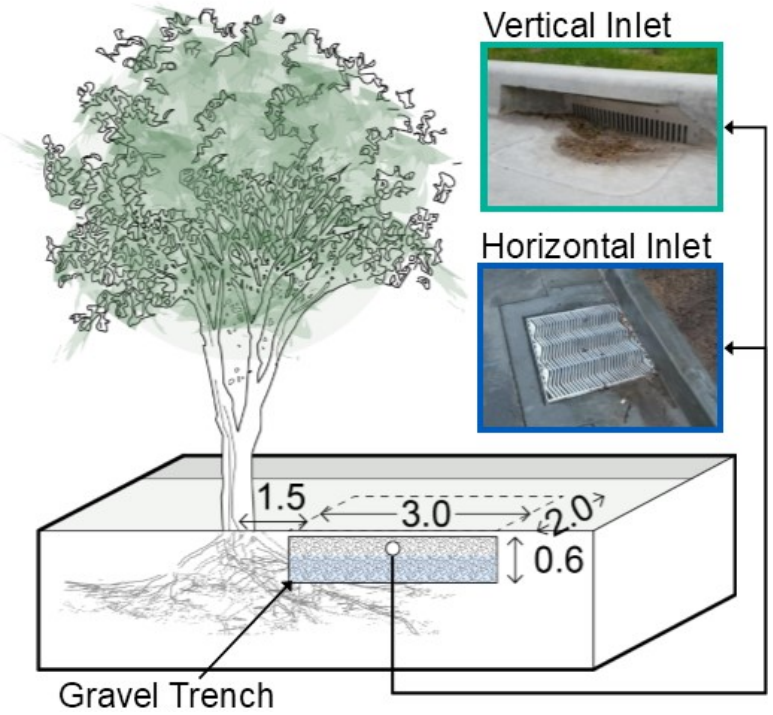

Measurements were made of stormwater runoff captured in trenches via:
1) vertical or
2) horizontal inlets.

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