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Drywells for the future: Managing urban stormwater in a changing climate

Liping Pan[a], **Huade Guan**[a], **Baden Myers**[b], **Harsha Sapdhare**[b c], **Okke Batelaan**[a]

[a] *National Centre for Groundwater Research and Training (NCGRT), College of Science and Engineering, Flinders University, Adelaide 5001, South Australia, Australia*
[b] *Sustainable Infrastructure and Resource Management (SIRM), UniSA-STEM, University of South Australia, Mawson Lakes, Adelaide, SA 5095, Australia*
[c] *Research and Development, Space Down Under, St Marys, Adelaide, SA 5042, Australia*
Email: liping.pan@flinders.edu.au

Abstract: This study investigates the effectiveness of kerb-side inlets and drywells for harvesting and infiltrating street runoff in a catchment with ongoing urbanisation and climate change, highlighting their potential to reduce runoff volumes and peak flows at the catchment scale under future scenarios. A dual-method approach, combining field monitoring with modelling, is used to assess drywell performance under current and projected future scenarios. This research advances understanding of infiltration-based stormwater infrastructure in urban environments and provides evidence-based insights to inform Water Sensitive Urban Design (WSUD) policies. By integrating drywells into existing streetscapes, the study aims to enhance urban water sustainability and resilience to changing environmental conditions.

Keywords: *Stormwater management, water sensitive urban design, drywell, urban flooding*

1. INTRODUCTION

Climate change and rapid urbanisation are intensifying urban runoff volumes and flow rates, placing increasing pressure on conventional drainage systems while emphasising the potential of stormwater as a resource. WSUD offers sustainable solutions, among which include drywells. Also known as leaky wells or soakaways, drywells are underground structures designed to temporarily store and infiltrate stormwater on site - a form of 'source control'. In 2024, 95 drywells were installed along verges in the 47-ha Frederick Street Catchment in metropolitan Adelaide. Continuous flow monitoring at the catchment outlet since 2013 provides a unique opportunity to evaluate urbanisation and WSUD performance.

2. METHODOLOGY AND RESULTS

Twenty drywells have been monitored since August 2024, each equipped with a water level logger to quantify harvesting and infiltration performance. An infiltration test was conducted on one representative drywell within the catchment on 17 May 2024, by artificially filling it with water and recording drawdown rates.

A modelling framework representing the catchment has been prepared using the US EPA Storm Water Management Model (SWMM), incorporating field data to simulate runoff interception, storage, and infiltration of drywells. Aerial imagery from 2023 (Aerometrex, 2023) and historical data (Kemp *et al.*, 2018) allow us to quantify impervious surface growth, and we have also incorporated regional climate projections (NARCliM 2.0) (NCI Australia, 2024) to assess catchment runoff and WSUD performance under altered rainfall regimes. Scenarios include increased imperviousness, more intense storms, prolonged dry periods, and varying drywell densities.

Aerial imagery analysis shows impervious cover increased from 61.0% in 2013 to 69.7% in 2023 due to urban infill development, with an average annual rise of 0.87%. SWMM simulations of the 2023 rainfall series (1 Jan–1 Jun 2023) using both 2013 and 2023 land-use datasets show higher event peak flows under the more urbanised conditions, as illustrated by the flood frequency curves in Figure 1.

The infiltration test on an in situ drywell recorded an initial seepage rate of 50 mm h^{-1} (Figure 2). With a total rainfall of 94 mm between 1 August 2024 and 1 April 2025, the average stormwater harvested volume per drywell was estimated to be 2,387 kL for trench-type and 2,468 kL for pit-type designs (Figure 3).

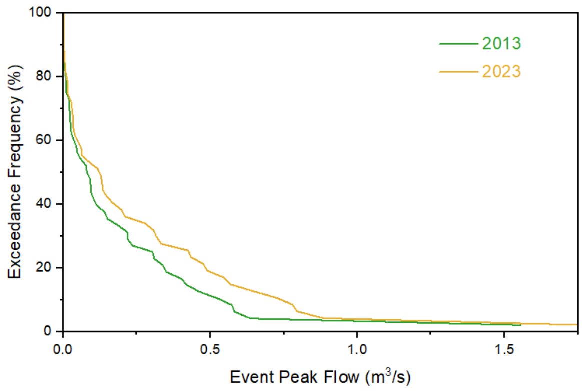

Figure 1. Flood frequency curves derived from event-based peak flows simulated in SWMM for the 2023 rainfall series (1 Jan – 1 Jun) using 2013 and 2023 land -use datasets.

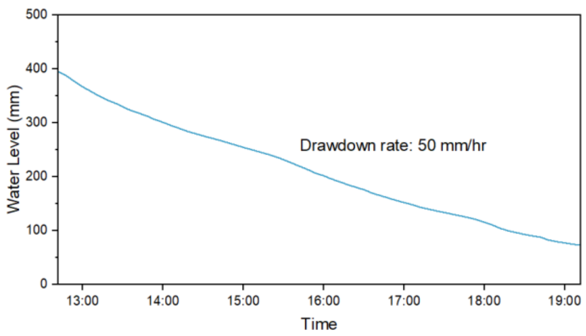

Figure 2. Drawdown of water level during an in-situ infiltration test.

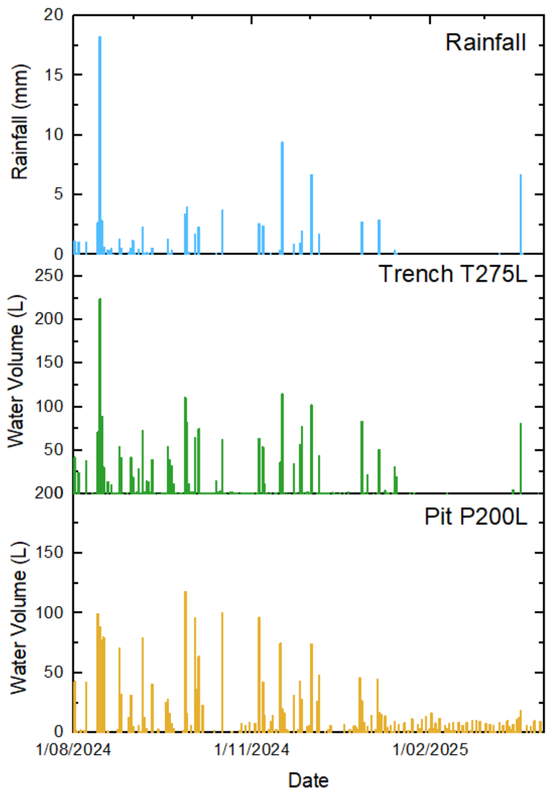

Figure 3. Time series of daily rainfall (top), average trench-type drywell harvested runoff volume (middle), and average pit-type drywell harvested runoff volume (bottom), from 1 August 2024 to 1 April 2025.

3. CONCLUSIONS

Early results suggest that urbanisation has increased peak flows in the Frederick Street Catchment over the past decade, emphasising the role of infiltration devices in mitigating runoff impacts. The measured initial infiltration rate of 50 mm/h offers a preliminary estimate of drywell performance. As shown in Figure 3, both trench and pit configurations can deliver storage and infiltration benefits. However, these findings are based only on the early post-installation months during a drought year. Over time, drywell performance may decline due to clogging or improve through tree root penetration, underscoring the need for long-term monitoring. Integrating these observations into SWMM modelling will enable more robust evaluation under varied climate and land use conditions, supporting assessments of scalability and cost-effectiveness.

This study provides empirical and modelling evidence of drywell performance in an urban catchment, offering practical guidance for WSUD planning. Results will inform strategies for scaling infiltration systems to improve flood mitigation and water retention under future urbanisation and climate change scenarios.

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