



Sponge cities

Number 42, 2023

Part of the [Tranzinfo Hot Topics](#) series, this issue offers a selection of recent material on the sponge city concept. Sponge cities have attracted a lot of attention recently in the wake of flooding in Australia and New Zealand. Originating in China, the term sponge city refers to urban design and construction techniques founded on [nature-based solutions](#), green infrastructure, and technology such as permeable pavements to enable cities to absorb floodwater rather than using concrete to channel it away. China currently has 30 [model sponge cities](#) in a program that began after widespread flooding in Beijing in 2012. The concept is sometimes known as Water Sensitive Urban Design ([WSUD](#)) in Australia.

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What are sponge cities?

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Sagris, T, Arup, 2023

Natural infrastructure is not only extremely effective in managing flood water, but also brings far wider benefits than traditional engineered 'grey' infrastructure and can contribute positively to biodiversity and carbon reduction. While cities have a natural "sponge" quality, this is a baseline absorbcency that can be improved through interventions.

[Nature-based solutions, and how countries like Singapore and The Netherlands are using them to fight floods](#)

Salleh, A, ABC News, 27 April 2022

Successful solutions to urban flooding involve working with nature, not against it, to reduce the risk.

['Sponge cities' can help protect against flooding. Here's how](#)

World Economic Forum, 26 October 2022

Sponge cities use their natural resources to absorb water and release it more slowly into lakes and rivers, helping to prevent flooding. Sponginess is influenced by the spread of features like lakes and grass, as well as soil make-up. Climate change is causing more heavy rainfall and flooding, so taking account of sponginess is vital in urban planning.

[Sponge city: what it is, how it is designed, and real examples](#)

Martínez Euklidiadas, M, Tomorrow City, 24 March 2022

A sponge city is an urban construction model capable of tackling phenomena such as torrents, monsoons, swelling, flooding or other water events, through drainage systems or permeable areas that prevent the accumulation of water on hard surfaces.

[Slow water: can we tame urban floods by going with the flow?](#)

Gies, E, The Guardian, 7 June 2022

As we face increased flooding, China's sponge cities are taking a new course. But can they steer the country away from concrete megadams? The "sponge cities" initiative aims to make urban regions better able to absorb rainfall and release it when needed.

[Could 'sponge cities' help us prepare for our flooded future?](#)

Winkless, L, Forbes, 27 July 2021

Extreme weather, a changing climate, and impervious streets and roads have combined to create an urban disaster, *which* has seen cities begin to re-imagine their relationship with water, with a growing number investing in new ways to manage stormwater.

[Turning cities into sponges: how Chinese ancient wisdom is taking on climate change](#)

Delaney, B, The Guardian, 2018

How does a city cope with extreme weather? For Kongjian Yu, one of the world's leading landscape architects, the answer to coping with extreme weather events actually lies in the past.

[Sponge cities - China's green-blue approach to urban water management](#)

E2Designlab, 2017

A Sponge City is designed to locally absorb, treat, and slowly release captured rainwater to mitigate the impacts of flooding and stormwater pollution. This is achieved via implementing a network of permeable surfaces

and 'green-blue' infrastructure options to help restore the natural water cycle within heavy urbanised areas.

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The Australian/New Zealand context

[How to make our cities more 'spongy' during floods](#)

Sydney Morning Herald, 5 February 2023

The barrage of floods in Australia and record-breaking rain in New Zealand have devastated usually resilient communities, but their severity and frequency have also called into question the design of cities.

Global design firm Arup has studied eight major cities to give them a so-called sponge rating. Sydney's urban centre was the least "sponge-like", or naturally able to absorb rainwater. And while Auckland was the "spongier", based on modelling of its stormwater systems and extensive green space, it too was recently overwhelmed.

[Auckland floods: even stormwater reform won't be enough – we need a 'sponge city' to avoid future disasters](#)

The Conversation, 29 January 2023

The sponge city concept, which uses water sensitive design such as permeable pavements and more green space and trees, would help to mitigate major flooding events, according to planning experts.

[NZ cities urgently need to become spongier – but system change will be expensive](#)

The Conversation, 20 February 2023

Overseas experience, especially in China, suggests building and adapting a city like Auckland to be more "spongy" would require serious financial commitment.

[Yarra uses new technology in road pavement trial](#)

Government News, 7 April 2022

Melbourne's City of Yarra is trialling a permeable road pavement technology designed to reduce stormwater pollutants and minimise urban flooding.

[Sponge city comes to Brisbane at Cannery Creek](#)

Inside Water, 27 June 2022

The development of a sponge city network has commenced in suburban Brisbane. The local community has taken a role in opting for a nature-based wetland for treating overflow water.

Urban Utilities in Southeast Queensland will invest more than \$65 million in a nature-based project to help manage the impacts of extreme weather on the wastewater network.

[How 'sponginess' can help cities like Sydney deal with floods](#)

Arup, 14 October 2022

The urban centre of Sydney is the least 'sponge-like', or naturally able to absorb rainwater, of eight major global cities, according to Arup's [Global Sponge Cities Snapshot](#), which assesses how well a city's existing natural infrastructure helps it to absorb rainfall.

[Cities need to become more 'spongy'. Auckland is leading the way.](#)

Evans, K, BBC Future Planet, 24 August 2022

Auckland was recently named the most spongy global city in a [report](#) by multinational architecture and design firm Arup, thanks to its geography, soil type, and urban design – but experts warn it may not lead the pack for long. As climate change intensifies extreme weather events worldwide, what can other cities learn from Auckland's successes – and failures?

[What makes a successful Sponge City project? Expert perceptions of critical factors in integrated urban water management in the Asia-Pacific](#)

Hawken, S et al., Sustainable Cities and Society, vol. 75, 2021

There is a lack of understanding of the relative importance and performance of the significant factors that contribute to the success of sponge city projects. To address this, we conducted a survey of urban water experts from the two distinctive cultures of Australia and China, to generate insights on 'what makes a successful Sponge City project?'.

[Monash Infrastructure signs \\$3.6 million deal to develop sponge city technologies](#)

Monash University News, 2017

Monash University has signed a multi-year research and capacity-building deal, worth up to \$3.6 million, with Chinese development company Jiangsu Easthigh Environmental Holdings (Easthigh), together with the University of New South Wales, for the advancement of technologies to manage urban water in Chinese cities.

[The role of landscape architecture in sponge city: Case study of Melbourne, Australia](#)

Yang, Q et al., Zhongguo Yuanlin, 4, 2016

The authors argue that sponge city planning, design and implementation requires strategic and specific contributions from the Landscape Architecture discipline. The concept of Water Sensitive Urban Design, its application in Melbourne, Australia, and the leading role of landscape architects, are discussed.

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The technology

[Application of nature-based measures in China's sponge city initiative: current trends and perspectives](#)

Song, C, vol. 2, December 2022

A review of three sponge city technologies in China were compared and discussed. Rain gardens reduce the surface runoff by 25–69% and the peak runoff by 12–71%. Green roofs reduce the rate of ground rainfall runoff by 20 min. Permeable pavement technology minimizes spalling, cracking and uneven settlement.

[Valorization of construction waste materials for pavements of sponge cities: a review](#)

Chen, X et al., Construction and Building Materials, vol. 356, 21 November 2022

Using construction waste recycled materials (CW-RM) to prepare pervious concrete can not only effectively sell the urban solid waste of construction waste, reduce environmental pollution, but also provide a key material for the construction of 'sponge city'. In this paper, the application of CW-RM in pervious concrete is reviewed based on the key control factors affecting the performance of pervious concrete (aggregate characteristics, cementitious material pastes and volume structure parameters).

[Are sponge cities the solution to China's growing urban flooding problems?](#)

Fu, G et al., Wires Water, vol. 10, no. 1, January 2023

Nature-based solutions have been promoted as a sustainable solution for urban stormwater management and they are currently adopted at an unprecedented speed and scale to build sponge cities in China, with a primary aim to solving urban flood problems. However, there are limits to how much rainfall sponge cities can absorb, hence, they are unlikely to be a panacea for flooding problems in cities. We argue that bottom-up community-based measures are essential part of the intervention development framework that is required to transform sponge cities into flood resilient cities.

[Sponge city strategy and application of pavement materials in sponge city](#)

Guan, X et al., Journal of Cleaner Production, vol. 303, 2021

This paper reviews the application and development of pavement materials in the sponge city. Commonly used permeable pavement materials are reviewed including permeable asphalt concrete, permeable cement concrete, permeable brick, and novel pavement materials.

[A new strategy for sponge city construction of urban roads: combining the traditional functions with landscape and drainage](#)

Wei, C et al., Water, vol. 13(23), 2021

Urban roads play a key role in sponge city construction, especially because of their drainage functions. However, efficient methods to enhance their

drainage performance are still lacking. Here, we propose a new strategy to combine roads, green spaces, and the drainage system.

[Sponge roads: the permeable asphalt pavement structures based on rainfall characteristics in central plains urban agglomeration of China](#)

Guo, X et al., Water Science & Technology, vol. 80, no. 9, 2019

Permeable asphalt pavement should be selected according to the rainfall characteristics of the project site, so as to improve the permeable performance and ensure the bearing capacity of the pavement structure. Taking a city in the central plains urban agglomeration of China as an example, the characteristics of the rainstorm intensity distribution and cumulative rainfall are analyzed, and a combination scheme of drainage surface layer asphalt pavement suitable for rainfall characteristics in this area is proposed.

[Flood mitigation by permeable pavements in Chinese sponge city construction](#)

Hu, M et al., Water, 10(2), 2018.

This study evaluated the effectiveness of three types of permeable pavements (i.e., permeable asphalts (PA), permeable concretes (PC), and permeable interlocking concrete pavers (PICP)) on flood mitigation at a community scale in China using a hydrological model.

[Urban permeable pavement system design based on "sponge city" concept](#)

Yu, MM et al., IOP Conference Series: Earth and Environmental Science, 82 012027, 2017

This paper studies the design of permeable pavements from the perspective of road structure, surface materials, and other aspects to determine pavement permeability requirements.

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