The alternatives

# ‘On every roof something is possible’: how sponge cities could change the way we handle rain

Amsterdam is home to 45,000 sq metres of ‘blue-green’ roofs, which absorb rainwater and allow it to be used by building residents to water plants and flush toilets

by Matt Simon

The Resilio project has covered more than 9,000 sq metres of Amsterdam's roofs. Photograph: Resilio

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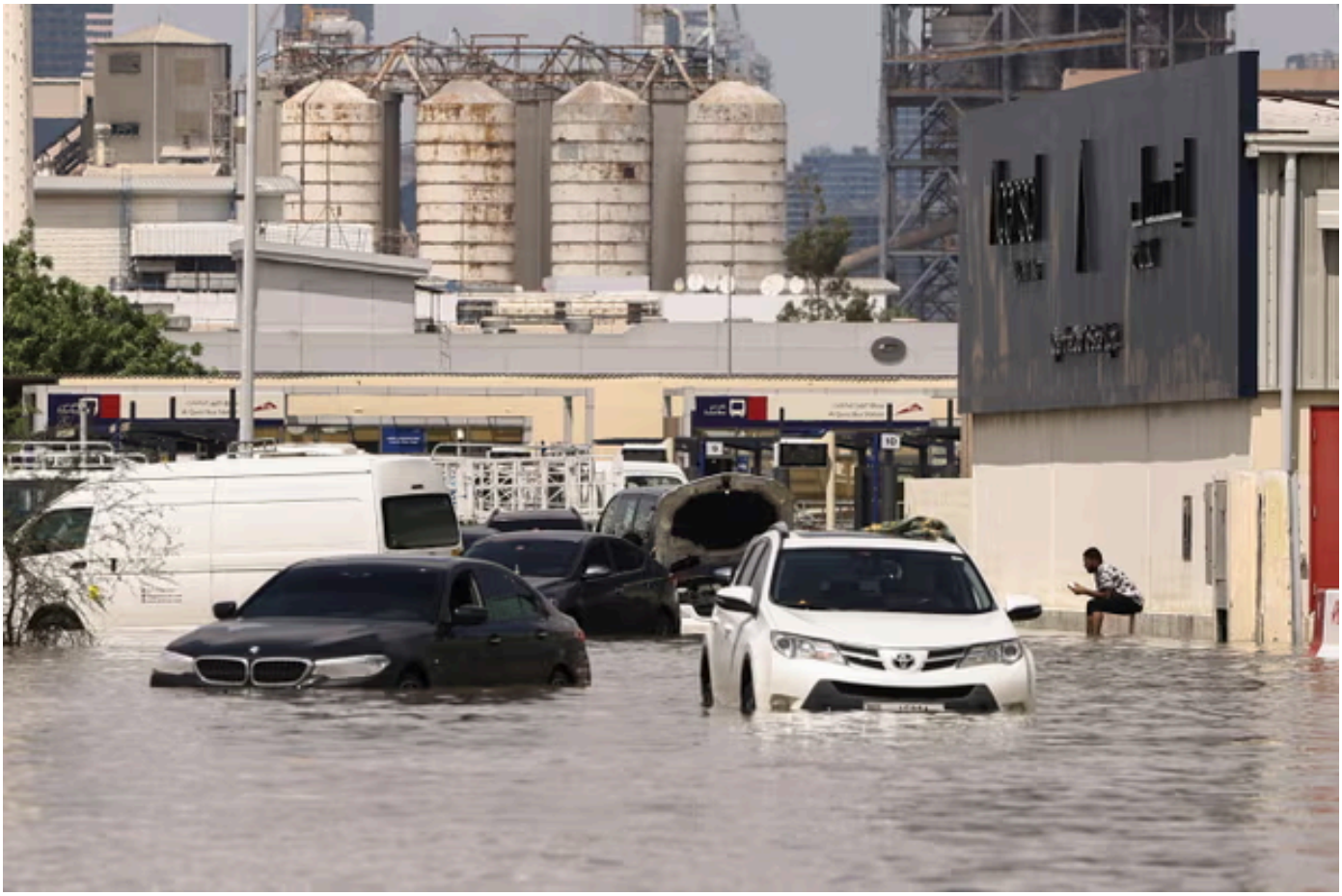
You might visit Amsterdam for its canals, and who could blame you, really. But the truly interesting waterways aren't under your feet - they're above your head.

Beautiful green roofs have popped up all over the world: specially selected plants growing on structures designed to manage the extra weight of biomass. Amsterdam has taken that one step further with *blue*-green roofs, specially designed to capture rainwater. One project, the resilience network of smart, innovative, climate-adaptive rooftops (Resilio), has covered more than 9,000 sq metres (100,000 sq ft) of Amsterdam's roofs, including 8,000 sq metres on social housing complexes. Citywide, the blue-green roof coverage is even bigger, estimated at more than 45,000 sq metres.

The "sponge city" concept is becoming increasingly popular. Planners deploy more green spaces that soak up downpours that are getting heavier as the world warms. That simultaneously reduces flooding and recharges the underlying layer of absorbent rock, which can then be tapped into in times of need. Whereas cities used to be designed to divert rainwater away as quickly as possible, increasingly, they are exploiting that resource.



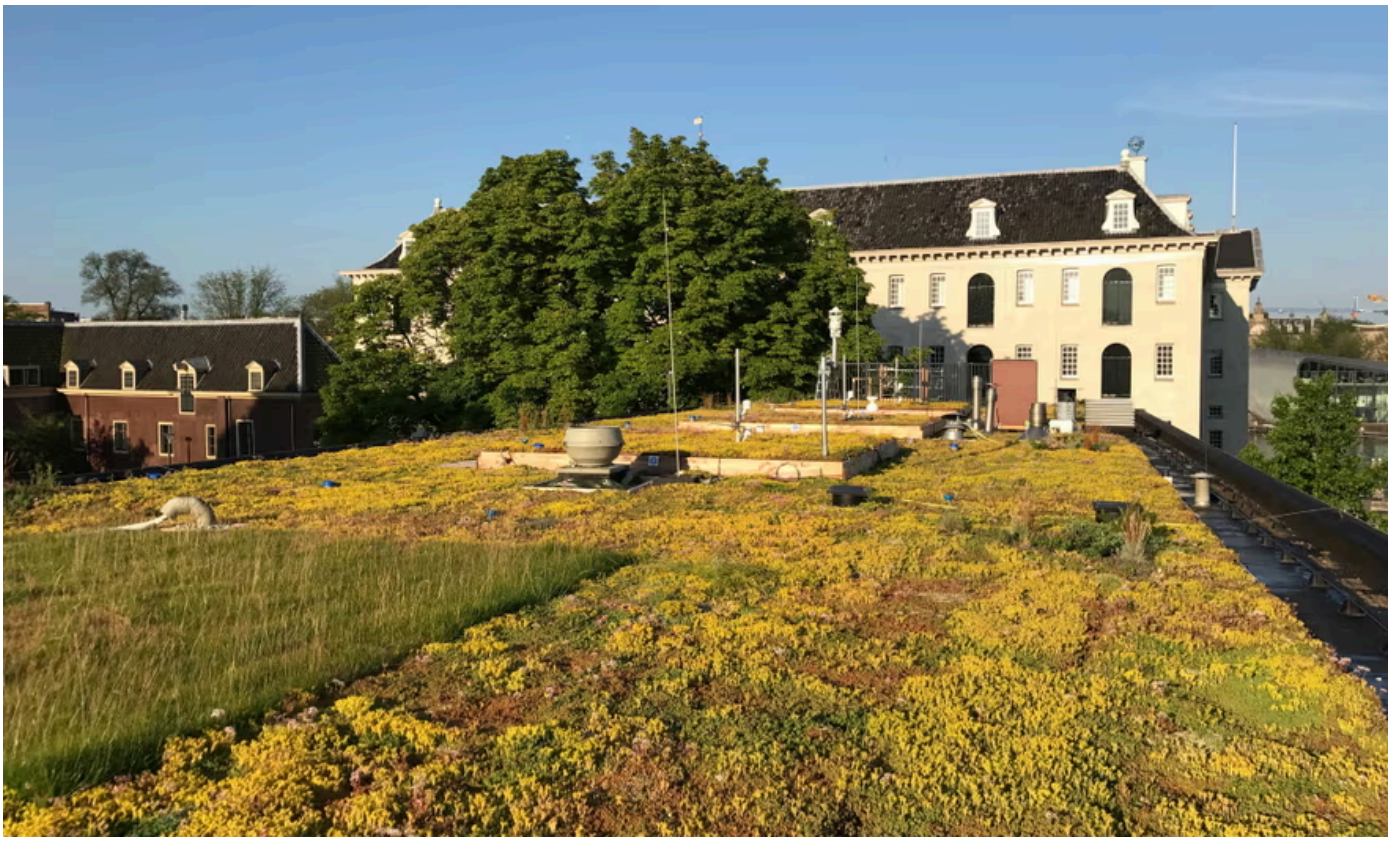
Dubai was hit by intense flooding in April. Photograph: Amr Alfiky/Reuters

A big challenge with sponge cities is that so much of an urban area is rooftops. Green roofs will soak up some rainwater to hydrate the plants there, but blue-green roofs go a step further, with infrastructure that gathers the liquid, stores it and dispenses it to the building's residents for watering plants and flushing toilets.

The system works in layers. At the surface, you have plants: some combination of mosses, shrubs, grasses, ferns, herbs and sedum, a hardy genus that's a staple of green roofs. (While plants need sunlight to survive, on a roof, they can be bombarded with too much light. It can also get hot and windy up there.) The plants are rooted in soil, providing nutrients and support.

Below that is a filter layer, which keeps the soil from getting into the next layer: a lightweight crate system that stores the water. Finally, below that are additional layers to keep water and plant roots from infiltrating the actual roof. "You have, in fact, a flat rain barrel on top of your roof," says Kasper Spaan, policy developer for climate adaptation at Waternet, Amsterdam's public water management organisation, which is participating in Resilio.

The water levels in the blue-green roof are managed by a smart valve. If the forecast says a storm is coming, the system will release stored water from the roof ahead of time. That way, when a downpour comes, the roof refills, meaning less rainwater enters the gutters and sewers in the surrounding area. In other words, the roof becomes a sponge that can be wrung out as needed. "In the 'squeezable' sponge city, you make the whole city malleable," says Spaan.

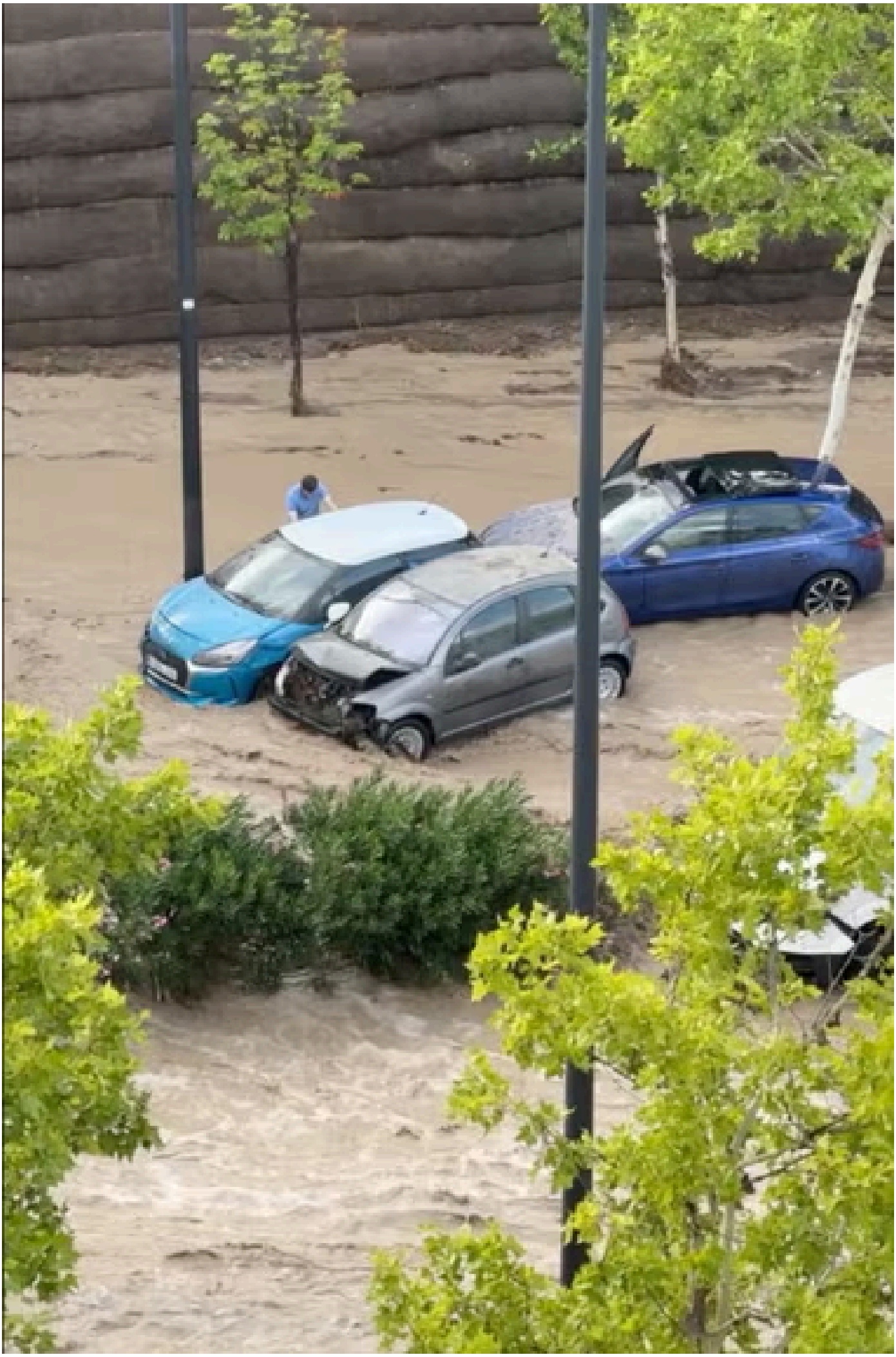


The blue-green roof functions like 'a flat rain barrel'. Photograph: Resilio

This makes the traditional system of stormwater management more flexible, but also more complicated. So the Resilio project used software from Autodesk to model the impact of blue-green roofs and the risk of flooding in Amsterdam, also adjusting for climate breakdown.

"You can take a look at historical flood patterns and then you can do simulations that will help you understand. If I could take this much capacity out of the drainage network, when the storm comes, I'm going reduce flooding by 10, 15, 20%," says Amy Bunszel, Autodesk's executive vice-president of architecture, engineering and construction design solutions. "So our software allows them to do simulations and play with different trade-offs."

Beyond the sponge-city benefits, blue-green roofs can cool the top floor of a building, essentially "sweating" off the stored water. With the right kinds of indigenous plant, they can help wildlife by catering to native pollinating insects. Going a step further, scientists are experimenting with growing crops on rooftops under solar panels, known as rooftop agrivoltaics. Theoretically, pairing that with blue-green systems could improve the efficiency of the solar panels by cooling them with the evaporating water.



Floods caused by heavy rains in Zaragoza in July 2023. Photograph: Instagram @Grismediofotografia/Reuters

Not every building can go blue-green. The additional infrastructure is not very heavy, but the water it holds is. So while it is relatively cheap and easy to build the system into new construction, accounting for the extra weight, older buildings may need retrofits to accommodate it. In the long term, it can save a building money by reducing the volume of water bought from a municipal system. Like any technology, its cost will fall as it is more widely deployed.

The idea is for places experiencing worsening droughts and flooding to deploy not only sponge city concepts on the ground - like patches of dirt with drought-tolerant plants to absorb stormwater into aquifers - but on top of their buildings as well. “We think the concept is applicable to many urban areas around the world,” says Spaan. “In the south of Europe - Italy and Spain - where there are really drought-stressed areas, there’s new attention for rainwater catchment.”

Cities could even incentivise blue-green roofs by providing tax breaks, rewarding building owners for reducing their contribution of stormwater to overburdened sewer and water systems. US cities such as Los Angeles and Pittsburgh have been rolling out something similar: taxes on the amount of impermeable area on a property, encouraging landowners to develop gardens and other green spaces.

The city of tomorrow, then, isn’t the concrete-smothered metropolis of science fiction, but an increasingly green and spongey landscape that can be squeezed in times of need. “Our philosophy in the end is not that on every roof, *everything* is possible,” says Spaan, “but that on every roof, *something* is possible.”

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