

MAGIC SPONGES



Sustainable drainage systems don't just reduce flood risk. Their permeable surfaces also remove pollution, support biodiversity and make urban spaces more pleasant. If only they weren't so misunderstood, writes Katie Puckett

In July 2021, water inundated the streets of London. Residents in Kensington & Chelsea had to be evacuated from their homes, tube lines were suspended and two hospitals closed due to power failures. This wasn't the River Thames overtopping its banks, it was the result of more than a month's worth of rain falling in just a few hours.

Such surface water or flash flooding is predicted to become more frequent, as climate change alters weather patterns and makes extreme rainfall events more common. But the London floods weren't just caused by unusually heavy rain. They were exacerbated by the fact that it landed on impermeable urban surfaces, surging straight into drainage systems and overwhelming them.

"On a natural catchment, very little water runs over the surface," explains Steve Wilson, a geotechnical engineer specialising in sustainable water management at environmental consultant EPG. "If it rains heavily enough and for long enough, it will eventually get saturated, but most of the time it soaks into the ground. Once you

cover that with a hard material, the water runs straight into the river or into a drain. That means it runs in faster, and the volume is greater.”

As the impacts of climate change become more and more apparent, making the built environment more resilient is a pressing concern for industry and government alike.

This is where sustainable drainage systems, or SuDS, come in. Originally imported from the US in the 1990s, SuDS are one type of what’s called “nature-based solutions”, which mimic natural processes to solve urban problems. They typically combine green infrastructure such as swales, ponds or rain gardens, with more pervious surfaces such as concrete block permeable paving or pervious in-situ concrete and, in some cases, harder engineering in the form of concrete pipes and tanks. There are also a range of innovative products in development, as the need to rethink urban landscapes becomes ever clearer.

SuDS have been mandatory in Scotland since 2005, and in Wales since 2019. But the relevant part of the Flood and Water Management Act 2010 has never been implemented in England, and they have yet to become a legal requirement. Now, as the government calls for a major building programme to ease the nation’s housing crisis, this could be set to change. The revised National Planning Policy Framework released in December

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requires developments that could impact drainage on or around the site to include SuDS, and Defra is considering making them mandatory on all developments, with a decision expected in the coming months. Proponents of SuDS believe that one reason they haven’t been as widely implemented as they should is because they’re misunderstood, unfairly maligned and plagued with misconceptions. Let’s unpack a few.

Misconception #1 **SuDS are just about flood mitigation**

There are four “pillars” to a sustainable drainage system, and reducing the quantity of runoff and slowing it down is just one. SuDS should also improve water quality by removing pollution, provide amenity as part of placemaking, and support biodiversity.

“It’s designing landscapes to

manage rain, to create better, more sustainable and more climate-resilient places for people and wildlife. And to protect the wider environment from pollution, erosion and flooding,” explains Kevin Barton, managing director of landscape architect Robert Bray Associates, a recognised leader in SuDS design.

These should be in balance, according to context, he says. “If you have a site next to a busy motorway junction, you’re not going to put in balance beams or stepping stones. The amenity for that scheme might be that it just looks nice as you drive past it. But if you’re talking about SuDS in an urban context, we need to integrate all of those pillars, alongside the other objectives a development needs to deliver.”

Managing rain is just one function that urban landscapes need to fulfil, he points out. “Trees and planting have incredible benefits ▶



Opposite and right: Bridget Joyce Square in west London, where Robert Bray Associates has installed a community rainpark with concrete block permeable paving laid over the existing concrete road slab

Photos: Robert Bray Associates

for health and wellbeing, and for keeping spaces cool. That's only going to become more important with climate change and increasing population density."

Misconception #2 **SuDS take land away** **from development**

The problem with focusing only on flood mitigation is that it pushes designers towards "pipe to pond" solutions. These typically involve collecting water and piping it straight to a storage tank, basin or pond.

"A lot of designers default to that, and then you don't get the other benefits of SuDS," says Wilson. "It's not integrated into the landscape and it doesn't look very nice." Neither does it remove pollution that rainwater collects from urban surfaces such as heavy metals, hydrocarbons and microplastics: "About 80% is attached to silt particles, so if you filter the silt, you're stopping most of the pollution going through the system."

This kind of infrastructure has also

given SuDS a bad name among developers, especially as planners are pushing back on the allocation of some SuDS features – for example, deep ponds that can be unsafe – as public open space.

But they really don't need to take up any additional land, says Wilson. "On most sites, the best solutions end up being a combination of landscaping, permeable surfaces and underground storage tanks. But you start by putting in as much 'green stuff' as you can, and only when you've reached the limits of those features do you consider using underground tanks. They can usually go underneath roads or parking areas."

By using the whole development to manage water, you can drastically cut storage requirements, agrees Chris Hodson, a consultant to MPA Precast and author of its guidance document, *Understanding Permeable Paving*. "Pipe to pond is a waste of space, whereas green areas and hard surfaces will be part of the urban landscape anyway. You've got to

have footpaths, roads, driveways, but all of those can be permeable. They can store water, clean it and then pass it down what we call the 'SuDS management train' to the green infrastructure."

On one project in Hackney, Robert Bray Associates included blue-green roofs on every house. "The QS estimated that we saved £800,000, compared with the cost of managing that rain in tanks underground," says Barton. "That also delivers biodiversity, improves air and water quality, and helps to reduce the urban heat island effect. So it's not a choice between housing targets and SuDS. If they're designed well, they can save developers money and make planners ecstatic."

Misconception #3 **It rains all the time**

Contrary to a certain downbeat sense of Britishness, most of the time it is not raining.

Under current guidance, SuDS have to be designed to handle the one-in-100-year events in England

and Wales, and one-in-200 in Scotland. But they also need to look good and be functional the rest of the time. By definition, most rainfall events fall into the more moderate 99-in-100-year bracket.

"There's no point digging a big hole in the ground if it's only going to have a film of water in it," says Barton. "You can usually manage the volume with a subtle level change in public open space. Then it can be 300mm or 150mm deep, not 3m. It can be a sports field, which might flood to 150mm or even 50mm only in extreme rainfall events. That's a huge volume, but you've preserved its functionality, and most of the time people don't even know it's a SuDS feature."

Misconception #4 **SuDS are soggy**

Climate change is making the UK's climate not only wetter, but more extreme – so we will also have longer periods with no rain at all. What will happen to green infrastructure in future droughts?

That was on Kevin Barton's mind

Right: Lamb Drove in Cambourne, Cambridgeshire, includes concrete block permeable paving in combination with a wide range of other SuDS elements, such as green roofs, swales and a retention pond. Installed in 2006, the paving continues to collect, clean and store the most polluted runoff with minimal maintenance. Flow controls on each of the two permeable paved access roads optimise water storage, reducing the need for additional storage features further down the site.



Photo: Chris Hodson

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in summer 2022, as London was gripped by its worst-ever drought and green spaces across the capital were parched and yellow. He was walking towards Bridget Joyce Square in west London, where the practice had installed a 2,700m² community rainpark, with planted basins, rain gardens and trees, and concrete block permeable paving laid over the existing concrete road slab. "If anything kills a properly designed SuDS, it will be drought. I was fearful about what I was going to see. But there were 6ft-high ornamental grasses, with kids playing among them, and the plants were just romping away."

In fact, SuDS are better equipped to cope with drought than most environments. Plants are chosen for drought tolerance, rather than to suit a watery environment. Even more importantly, the subsoils are constantly replenished in the rainy season, so act as a moisture battery. "Even during rainfall events that might not make it past the canopy of trees or even touch the soil, you've collected all of the water

that's fallen on the hard surfaces and channelled that into the basins too. Of all the rain that lands on the site, 50% of it never leaves."

One important lesson they have learned is not to blanket underdrain – add a continuous layer of gravel beneath – bioretention features. "Effectively, you've disconnected your topsoil from your seasonally hydrated subsoils, and it's destined to fail without irrigation. We don't want to be pumping or using potable water to keep the plants alive. Ideally we want to keep things alive passively, even during drought summers."

Misconception #5 SuDS are just engineering

"The key point for any professional is that SuDS design is multidisciplinary," says Wilson. "Engineers make sure the volumes are correct and that it's working properly, but they need landscape architecture input at a very early stage to integrate landforms into the overall development. I've also

worked with masterplanners to embed SuDS into a development from the ground up."

For Hodson, this big-picture approach is key. He thinks SuDS techniques should be applied on a much wider scale, similar to the concept of "sponge cities", invented by Professor Kongjian Yu of Peking University and resonating with a growing global community. "Rather than looking at the drainage of a site and how to connect it together, sponge cities are about architects, urban designers, planners and policymakers deciding how to absorb the water falling on a whole city. It's taking rainwater run-off as a fundamental design consideration, alongside dozens of others."

This is exactly the sort of scale that we should be thinking on for SuDS too, agrees Barton. "If you green an entire city, the benefits are so much more than just a stormwater solution. We're in a climate emergency, and a biodiversity emergency, and that's the level of ambition we need." ●



Left: Environmental consultant EPG has retrofitted a "smart" blue-green roof on the Bloc office building in central Manchester for developer Bruntwood. Unlike conventional green roofs, which use a drainage layer to remove rainwater, the 525m² blue-green structure stores rain in attenuation tanks beneath the planted surface. Advanced passive irrigation components within the attenuation layer draw water up through the structure to the underside of the substrate to support a rooftop wildflower meadow.